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Preparation Process of Fault Zones: Seismological Models and Dynamic Zoning of Seismic Hazards

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Abstract: The preparation process of fault zones involves the application of seismological models and dynamic zoning of seismic hazards. This study focuses on understanding the role of seismological models and the dynamic zoning approach in the preparation process of fault zones. Seismological models are developed based on geological structures, local earthquake catalogs, and geophysical data. These models help identify regions with high seismic activity and assess the potential seismic hazards. The dynamic zoning approach aims to determine the changing nature of seismic hazards over time and establish effective measures for the affected areas. The process includes risk assessment, early warning systems, and public awareness programs. Implementing seismological models and dynamic zoning in the preparation process of fault zones is crucial for effective earthquake preparedness and mitigation strategies. This study provides insights into the significance of seismological models and dynamic zoning for the preparation process of fault zones.

Keywords: Fault zones, Seismological models, Dynamic zoning, Geological structures, Geophysical data.

1.Introduction

Quarry shingles are areas where earthquake activity is intense in various parts of the world. The people and structures living in these regions should be in a constant preparation process against the seismic hazards. The preparation process of quarry shingles includes important tools such as seysmology models and dynamic rayonization of seysmic hazard.[2,4]

Seysmology models are the basic tools used to determine quarry shingles by analyzing earthquake activity, structural features of the earth's crust and geophysical data. These models are created by combining historical earthquake records, geological data and other relevant parameters. Seysmology models are used to identify quarry shingles and to assess the potential for a seysmic hazard.

Dynamic rayonization of Seysmic endangerment requires continuous monitoring and analysis of quarry shingles. This process includes determining how the seysmic activity changes over time and determining the impact area of the quarry. Earthquake activity is tracked using Seysmic networks, sensors and rapid data analysis techniques, and early warnings are sent to the public in case of a potential earthquake. Dynamic rayonization provides continuous monitoring of the seysmic hazard and taking precautions.

The preparation process of quarry shingles should not be limited to only seysmology models and dynamic rayonization. Risk assessment should also include other important elements such as structural analysis, contingency planning and community education. While risk analyzes assess the vulnerability of structures and populations in quarry shingles, structural analyzes assess the resilience of structures to seismic hazards. Emergency planning includes strategies for rapid response and community safety in case of earthquakes. The education and awareness of

the society aims to raise awareness about earthquake hazards and to adopt the right behaviors.

Today, many countries attach great importance to the preparation process of quarry shingles in order to be prepared for natural disasters such as earthquakes. The preparation process of quarry shingles involves the use of techniques such as seysmology models and dynamic rayonization of seysmic shingles. This study provides an introduction to the Seysmology models used in the preparation process of the quarry shingles and the dynamic rayonization of the seysmic threat through the example of Azerbaijan.

Azerbaijan is located in a geologically active region and is a country exposed to seysmic activity. Therefore, the preparation process of the quarry shingles is of great importance in order to cope with the earthquake hazard. This process includes the use of geological data, earthquake catalogues, geophysical analyzes and mathematical models.

Seysmology models are an important tool used to understand the geological structure and past earthquake activity of quarry shingles. These models use mathematical algorithms created by the analysis of geological data to identify regions with intense earthquake hazard. Seysmology models are also used in Azerbaijan to determine the quarry shingles and to assess the potential for earthquake hazard.

In this study, the preparation process of quarry shingles, seysmology models and methods and optimization of dynamic rayonization of seysmic shingles will be examined in Azerbaijan.

2. Experimental details

Methods:Seysmology Models: Seysmology models used for the preparation process of quarry shingles are based on the geological structure of the region, local earthquake catalogs and geophysical data. These models are used to determine the regions where earthquake activity is intense and to evaluate the potential of the seysmic hazard. In Azerbaijan, seymology models are created by analyzing the geological structure, fault lines and past earthquake records in the region.[3]

Dynamic Rayonization of Seysmic Hazard: Dynamic rayonization of Seysmic Hazard in the preparation process of quarry shingles includes determining how earthquake hazard changes over time and determining the impact area of the quarry. This process is carried out using continuously updated seismic data and geophysical analyses. In Azerbaijan, earthquake activity is monitored with seysmic networks, sensors and rapid data analysis techniques, and early warnings are provided to the public in case of a potential earthquake.[6]

Optimization in the preparation process of quarry shingles aims to increase the effectiveness of the measures taken against natural disasters. (Table 1) In this context, emergency plans and response strategies are optimized by taking into account seymology models, dynamic rayonization of seysmic hazard and risk assessments.

Table 1. Optimization of Seismic Preparation Process, Seismology Models, and Dynamic Zoning for Earthquake-Prone Areas in Azerbaijan

Optimization Steps	Seismology Models	Dynamic Zoning
Data collection	Gathering geological data, seismic records	Updating seismic data regularly
	Fault line analysis	Geophysical analysis
	Local seismic catalogs	Incorporating local seismic data
Model development	Mathematical algorithms	Incorporating geologic, seismic, and geophysical data
	Statistical analysis	Developing mathematical algorithms for dynamic zoning
		Defining seismic hazard levels and risk assessment
Dynamic zoning criteria	Seismic hazard assessment	Identifying high-risk areas

	Risk analysis	Determining vulnerability factors and population density
		Adjusting zoning based on real-time seismic data
Optimization and refinement	Reviewing and updating models	Continuous monitoring and analysis
	Incorporating new data	Adjusting dynamic zoning based on new findings
	Advanced analysis techniques	Optimization of emergency plans and response strategies

The optimization of the seismic preparation process, seismology models, and dynamic zoning for earthquake-prone areas in Azerbaijan involves several key steps. Data collection includes gathering geological information, seismic records, fault line analysis, and local seismic catalogs. These data serve as the foundation for developing seismology models that incorporate mathematical algorithms, statistical analysis, and risk assessment.[1]

Dynamic zoning is an essential aspect of the process, which entails assessing seismic hazard and risk levels. It involves evaluating vulnerability factors, population density, and incorporating real-time seismic data for adjusting the zoning. The optimization process includes continuous monitoring, updating models, and refining the dynamic zoning based on new findings and advanced analysis techniques.

The ultimate goal of this optimization process is to enhance the effectiveness of earthquake preparedness measures in Azerbaijan, taking into account the unique characteristics of the region. It involves a comprehensive approach that integrates various data sources, modeling techniques, and risk assessment methods to develop tailored emergency plans and response strategies.

3. Conclusion

In regions with intense seismic activity, such as Azerbaijan, the preparation process of hotbed zones is of great importance. Seismological models and dynamic zoning of seismic hazard provide effective evaluation of hotbed zones and determination of seismic hazard. Seismological models and dynamic zoning for Azerbaijan are based on geological structure of the region, local earthquake catalogs and geophysical data. These models aid risk analyzes by identifying regions of high seismic hazard and provide key information in emergency planning. Dynamic zoning of seismic hazard aims to determine the change of focal zones in the territory of Azerbaijan and the impact area of the focal point. Using seismological models and up-to-date data, dynamic characteristics of the furnace are analyzed and appropriate measures are taken in emergency planning. The risk assessment should take into account the seismic hazard as well as the sensitivity of the structures and population in the territory of Azerbaijan. This assessment aims to determine the potential impacts and risks of the furnace by combining seismological models, structural analysis and socio-economic factors. [5,6]

Seismological models and dynamic zoning across Azerbaijan play an important role in ensuring effective preparedness against earthquake hazards. This process should include a security plan that includes measures such as risk reduction, early warning and public awareness. The preparation process against earthquake hazards in the territory of Azerbaijan should be effectively implemented on the basis of seismological models and dynamic zoning.

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Internet of Things (IoT) in new innovative metrological infrastructure

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Abstract: The Internet of Things (IoT) has transformed many industries by enabling the collection and analysis of real-time data from connected devices. One of the areas where IoT is becoming increasingly important is in metrology, the science of measurement. This paper explores the use of IoT in metrology and the benefits it offers. The IoT-based metrology infrastructure comprises of sensors and devices that collect data from various sources, such as manufacturing equipment or laboratory instruments. This data is then transmitted to a central system for analysis and interpretation, enabling better decision-making in various areas such as quality control and process optimization. One of the key benefits of IoT in metrology is its ability to enhance the accuracy and precision of measurements. IoT devices can continuously monitor and adjust measurements in real-time, reducing errors and variability. This can help to improve product quality, increase efficiency and reduce waste. Another advantage of IoT in metrology is its ability to improve data collection and management. IoT devices can automate data collection and transfer, eliminating the need for manual recording and reducing the risk of human error. This data can then be stored in a centralized database and analyzed using advanced algorithms to gain insights and identify trends. IoT in metrology also offers benefits in terms of compliance and traceability. By automating data collection and recording, organizations can ensure that their processes are fully documented and compliant with regulatory requirements. The use of IoT devices can also provide a digital trail of data, enabling better traceability and auditability.

Keywords: The Internet of Things (IoT), measurement, concept of combined client architecture, metrology

1.Introduction

The Internet of Things (IoT) is a term used to describe a network of connected devices and sensors that are capable of communicating with each other over the internet. IoT has become increasingly popular in recent years due to the growing number of connected devices, from smartphones and smartwatches to home appliances and industrial equipment. The idea behind IoT is to create a more connected world, where devices can communicate with each other to provide better insights and improve efficiency. IoT technology has the potential to transform many aspects of daily life, from the way we live and work to the way we travel and interact with each other.

One of the key benefits of IoT is its ability to collect and analyze data from various sources. IoT devices can collect data from sensors and other sources, and then transmit it to a central system for analysis. This data can then be used to identify patterns, trends, and insights that can help businesses make better decisions and improve their operations.

Another advantage of IoT is its ability to automate processes and reduce human error. For example, in a manufacturing setting, IoT devices can monitor equipment and identify potential issues before they become major problems. This can help to reduce downtime, increase productivity, and improve the overall efficiency of the manufacturing process.

IoT technology is also being used in healthcare to monitor patients remotely and improve patient outcomes. Wearable devices and sensors can collect data on vital signs, such as heart rate and blood pressure, and transmit this information to healthcare providers in real-time. This can help to identify potential health issues early on and provide timely interventions.

In addition to healthcare, IoT is also being used in agriculture to monitor crops and improve yields. Sensors can be used to collect data on soil moisture, temperature, and other environmental factors that affect crop growth. This information can then be used to optimize irrigation and other farming practices to improve crop yields and reduce waste.

However, there are also concerns regarding IoT, particularly in terms of data privacy and security. IoT devices collect a significant amount of data, and there is a risk that this information could be hacked or accessed by unauthorized individuals. Additionally, as more devices become connected to the internet, there is a risk of overload or failure in the network, which could have significant consequences. Despite these concerns, the benefits of IoT technology are significant, and the potential applications are endless. As more devices become connected to the internet and more businesses adopt IoT technology, it is likely that we will see even more innovation and advancements in this field in the coming years.

The concept of combined client architecture IoT refers to the use of both cloud-based and edge-based computing in IoT systems. In this architecture, the data processing and storage is distributed between the cloud and edge devices, providing a more efficient and scalable approach to IoT. In traditional IoT systems, data is typically sent from sensors and other devices to a centralized cloud system for processing and storage. However, this approach can be inefficient and costly, as it requires a large amount of bandwidth and storage capacity. In addition, the latency associated with sending data to the cloud and back can limit the real-time responsiveness of the system.

The combined client architecture IoT approach aims to address these limitations by distributing data processing and storage across both cloud and edge devices. Edge devices, such as gateways and sensors, are equipped with local processing power and storage capacity, allowing them to perform basic data processing and storage tasks locally. This reduces the amount of data that needs to be sent to the cloud, minimizing bandwidth and storage requirements.

The cloud-based portion of the architecture is responsible for more advanced data processing and storage tasks, such as data analytics and machine learning. This allows organizations to leverage the power of cloud computing to process and analyze large volumes of data, while still benefiting from the speed and efficiency of edge computing.

2. Experimental details

Even though the Internet of Things is still relatively new, it has already encountered and adopted many diverse technologies. One may argue that WSN (Wireless Sensor Networks), LPWAN (Low-Power Wide-Area Networks), and the future 5G network in the area of IoT have surpassed RFID technology, which was formerly thought to be state-of-the-art. Because of this, the IoT definition is not yet definitive and is likely to alter as new technologies are incorporated. Since it offers a solution to certain issues, like as low energy consumption and extended range, while avoiding others, such as low transmission speed, it has particularly demonstrated potential [2].

Since 2014, a lot of work has been done to standardize vocabulary, conventions, and laws that are directly related to IoT technology, however there haven't been any significant advancements. On the other hand, several new IoT applications have been discovered, and the vocabulary of various technical groups has grown. As mentioned by John A. Stankovic in [3], one of the more important developments in the IoT world would be to improve communication amongst the growing groups to prevent creating the wheel from scratch. The IoT's application on a worldwide scale is its ultimate objective [2]. However, we can point to a concept of combined client architecture as an example of its global application in this sphere.

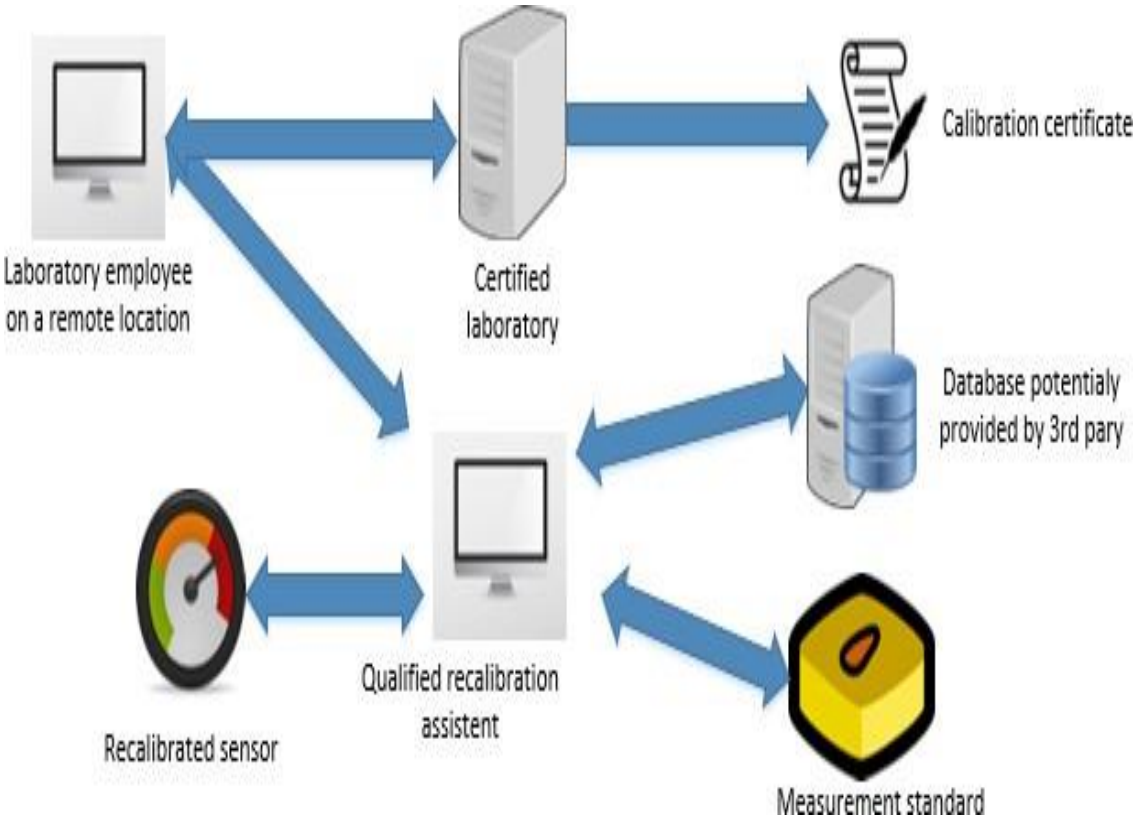

Figure 1. The concept of a unified client architecture

The combined client architecture IoT approach has several benefits, including:

Improved efficiency: By distributing data processing and storage between cloud and edge devices, the architecture minimizes bandwidth and storage requirements, improving overall system efficiency.

Real-time responsiveness: By processing data locally on edge devices, the system can respond more quickly to changes in the environment, improving real-time responsiveness.

Scalability: The architecture is highly scalable, as edge devices can be added or removed as needed, without affecting the overall system performance.

Reduced costs: By leveraging edge computing for basic data processing tasks, the architecture reduces the need for expensive cloud computing resources, reducing overall costs.

Enhanced security: By distributing data processing and storage across multiple devices, the architecture enhances security by reducing the risk of a single point of failure or security breach.

The concept of combined client architecture IoT has been the subject of numerous experiments and studies in recent years. These experiments have aimed to demonstrate the benefits of this architecture, as well as identify potential limitations and areas for improvement.

One such experiment was conducted by researchers at the University of California, Berkeley. The study focused on the use of edge computing in an IoT system for smart buildings. The researchers developed a system that utilized both cloud and edge computing, with edge devices responsible for data pre-processing and cloud-based systems for more complex analytics. The results showed that the system was able to reduce the amount of data sent to the cloud by up to 98%, improving overall efficiency and reducing costs.

Another experiment was conducted by researchers at the University of Edinburgh, who developed an IoT system for monitoring environmental conditions in a greenhouse. The system utilized a combined client architecture, with edge devices responsible for data collection and pre-processing, and cloud-based systems for more advanced analytics. The system was able to improve real-time responsiveness and reduce data storage requirements, while still providing accurate environmental monitoring data.

A study by researchers at Carnegie Mellon University also explored the use of a combined client architecture in an IoT system for monitoring air quality in urban environments. The system utilized edge devices for data collection and processing, with cloud-based systems for more advanced analytics. The study found that the use of edge computing reduced the amount of data sent to the cloud by up to 50%, improving overall system efficiency and reducing costs. Overall, these experiments demonstrate the benefits of the combined client architecture IoT approach, including improved efficiency, real-time responsiveness, and reduced costs. However, there are also limitations to this approach, such as the need for effective edge device management and potential security vulnerabilities.

3. Conclusion

In conclusion, the combined client architecture IoT approach is an innovative solution to some of the limitations of traditional cloud-based IoT systems. This architecture leverages both cloud and edge computing to provide a more efficient, scalable, and secure IoT system.

The benefits of this approach include improved efficiency, real-time responsiveness, scalability, reduced costs, and enhanced security. By using edge devices to perform data collection and pre-processing, this architecture reduces the amount of data that needs to be sent to the cloud, improving overall system efficiency and reducing costs. Additionally, edge computing enables real-time processing and analysis of data, allowing for quicker decision-making and response times.

While there are many benefits to the combined client architecture IoT approach, there are also some limitations and challenges to consider. For example, effective management of edge devices is critical to ensuring the success of this architecture. Additionally, there are potential security vulnerabilities associated with the use of edge devices, which must be carefully managed and mitigated.

Despite these challenges, the potential applications for the combined client architecture IoT approach are vast. For example, this architecture can be used to improve environmental monitoring, optimize energy usage in buildings, and enhance industrial automation. In each of these areas, the use of edge computing can provide real-time data analysis, reducing costs and improving efficiency.

Overall, the combined client architecture IoT approach represents an exciting area of innovation and advancement in the field of IoT. By leveraging

both cloud and edge computing, this architecture provides a more efficient, scalable, and secure IoT system, with numerous potential applications across a variety of industries. As such, it is likely that we will continue to see the development and implementation of this architecture in the years to come, as organizations seek to optimize their IoT systems and improve their overall efficiency and performance.

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Development of a mathematical model of a separator for the process of oil purification from organic acids

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Abstract: It should be noted that to determine the most cost-effective operating modes, different methods of optimization and optimal control are used depending on the class of devices used in the circuits that implement the technological processes of these industries and their connection diagrams. Both optimization problems and optimal control issues that need to be solved when designing optimal control systems for non-stationary technological processes are implemented on the basis of mathematical models. The paper deals with the construction of a deterministic linear mathematical model of the technological process of oil purification from organic acids, which adequately describes the current technological conditions.

Keywords: mathematical models, process of oil purification from organic acids, experimental-statistical methods, rectification column, regression- analysis method,seperator.

1.Introduction

The installation for the purification of petroleum products from organic acids, built according to the project of the American company Merikem at the Baku Oil Refinery named after Heydar Aliyev, has an annual capacity of 6 million cubic meters. tons of ELOU AVT - 6 and an annual capacity of 2 million tons. tons of ELOU AVT-2 units, only 8 million tons were produced. It is designed to clean tons of oil products from organic acids and obtain environmentally friendly oil fractions that meet international standards [1].

According to its structure, this technological process belongs to the class of technological processes, the devices of which are connected in series.

According to the regulations, the alkaline solution circulating in the technological scheme must lose its activity by at least 40%. If the alkali activity drops to less than 40%, this indicates that the control system is supplying excess alkali. An alkaline solution that has lost more than 40% of activity should be gradually replaced with a new one.

The treated alkali in the process system is removed from the ER-1 sepsrator cube and enters the sulfur-alkali stream of the plant.

According to the requirements of this process plant, the alkaline solution should be changed every three days.

2. Experimental details

15% alkaline solution is pumped from its container into the contact device ER-1 by pumps.

To completely remove sulfur compounds that may be present in the system and to prevent excess alkali solution, it is necessary to remove the resulting alkali sulfide solution and introduce fresh alkali solution into the system.

Regulation indicators in the ER-1-separator should be within the following limits:

product temperature – 30-70 ºC

pressure – less than 4,8 kg/cm^2 shouldn't be

Duration of two phases – 132 minutes

total flow speed – 0,27 mm/sec

Finally, the purified gasoline fraction is pumped from the precipitator through the inter-shop pipeline to the park of finished products of production No. 7.

To ensure complete purification of oil fractions from naphthenic acids, it is necessary to determine the optimal consumption of pure alkali supplied to each section of the unit. For this, it is essential to obtain accurate and operational information about the amount of naphthenic acids contained in gasoline, kerosene and diesel fuel separately from the primary oil refining unit.

The development of a mathematical model of complex technological processes of oil refining

consists in the mathematical finding of dependencies between the input and output variables of the process. As a rule, the construction of mathematical models that reflect these dependencies is theoretical, analytical, physical, chemical, etc. object. on the basis of compliance with the law, a logical analysis is carried out, a generalization of previous experience. When developing a mathematical model of technological processes, one of the important conditions is the prompt and accurate measurement of all input and output variables [2-4].

Experimental and statistical methods, linear and non-linear regression equations, make it possible to identify the existing relationship between any two variables, as well as to identify quantitative relationships for complex technological processes of any degree of complexity [5,-7]. The regression equation is written in linear form as follows:

$$y = K_0 + \sum_{i=1}^{n} K_i x_i$$

in a non-linear form:

$$y = B_0 + \sum_{i=1}^{n} B_i x_i + \sum_{i=1}^{n} \sum_{j=i+1}^{n} B_{ij} x_i x_j + \sum_{i=1}^{n} B_{ii} x_i^2$$

Here, y^*– output coordinate; ; K_0 and B_0 –free coefficients, ; K_i , B_i , B_{ij} $(i , j= \overline{1,n}, i \neq j)$ – linear and interaction impact coefficients, respectively; B_{ii} $(i = \overline{1,n})$ - quadratic impact coefficients; x_i $(i = \overline{1,n})$ –input parameters; n –number of input parameters.

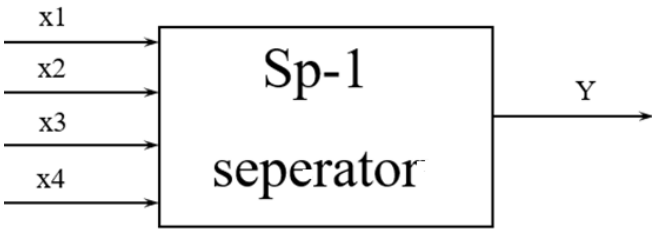

Figure 1. Structural diagram of Sp -1 separator as a modeling object

x1 - pressure at the inlet of the separator, kg/cm2

x2 – gasoline temperature, ºC

x3 – consumption of gasoline supplied to the separator, m3/s

x4 – concentration of alkaline , %

Y- the quality indicator of the received product (density at 20ºC), kg

Limitation for input and control parameters :

5,0 ≤ X1 ≤ 9,0 kq/sm2

30 ≤ X2 ≤ 70 ºC

10 ≤ X3 ≤ 19 m3/s

6 ≤ X4 ≤ 15 %

Y ≥ 780 kq/sm

Table 1 Experimental statistics of the technological process of the purification of petroleum products from organic acids

x1	x2	x3	x4	y
5.5	50	17	6	781
5.3	49	19	8	785
5.1	53	18	9	782
5.7	51	14	7	789
5.6	47	14	6	787
5.9	45	12	6	783
6.3	43	11	7	787
6.1	45	13	7	781
6.4	47	12	10	785
5.8	44	11	7	782
6.7	45	13	6	788
6.9	48	12	9	789
6.3	59	10	8	786
7.3	57	13	7	783
7.2	56	11	7	786
7.5	57	12	6	782
6.5	56	14	10	789
7.8	50	18	12	788
7.1	52	14	11	781
6.9	44	12	13	785
7.9	43	11	12	789
7.8	48	13	12	782
8	47	12	11	786
8.2	46	14	12	785
8.1	48	12	13	789
8.4	49	11	12	787
7.3	49	15	14	781
8.9	47	14	12	787
7.6	50	11	14	785
8.6	50	10	13	787

The regression equation is in linear form :

$$y = b0 + b1\,x1 + b2\,x2 + b3\,x3 + b4\,x4$$

Free coefficients:

b0 = 785.6544781

b1= 0.634170045

b2 = -0.054766307

b3 = -0.148427171

b4 = -0.020608598

3. Conclusion

İncluding the above results into the regression equation, we get the following equation:

Y= 785.6544781 + 0.634170045 x1 - 0.054766307 x2 - 0.148427171 x3 - 0.020608598 x4

Quality indicators of model :

Fisher criterion --- 1.107

Number of observations ---30

Square deviation --- 1.78

Regression coefficients ---0.238705495

-0.085654964

-0.124783726

-0.020705055

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Startup of a bench-scale continuous flow aerobic granular sludge system for the treatment of wastewater

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Abstract: This research conducted in the frames of the Project of Innovative Training Centre to support a postgraduate 3rd cycle Advanced Course to face Environmental Emergency in Azerbaijan / ITACA. Research held in the Water Institue of University of Granada, Spain, under the supervision of Professor (Associate) Alejandro González-Martínez. Moreover, it must be noted that this aerobic granular sludge technology is patented and the patent reference number is 202230987. As known, aerobic granular sludge is an accumulation of microbial cells in a matrix that is capable of removing carbon, nitrogen, and phosphorous, as well as other contaminants, in a same bioreactor under the same conditions. The high quality properties of such biomass contribute to the high settling capacity and therefore the technology is able to recover organic matter and nutrients in a compact bioreactor design. Thus, it is of great environmental importance to develop continuous flow granular sludge systems that can retain granular biomass and treat wastewater efficiently, especially with low building, service and operation costs. The primary objective of this pilot project was to produce aerobic granular sludge in a continuous-flow system using synthetic wastewater as influent to imitate natural wastewater in the first stage, and to conduct subsequent studies to address the treatment of actual municipal wastewater, biological nutrients, or other complex effluents. As a result, this startup continuous flow aerobic granular sludge bioreactor's granules not only accomplished stability, but also displayed an unusual for the continuous flow aerobic granular reactors, mean size of up to 7-8 mm. Along with the high treatment percentage of the wastewater, the experiment's advantages include its easy layout, and design, as well as simpler operational specifications, the necessity of less energy and territory. Consequently, the bioreactor successfully treated wastewater from a real wastewater treatment plant in a continuous-flow mode with the average 73-74% of removal.

Keywords: Aerobic granular technology, continuous flow reactor system, bench-scale column type reactor, granular size, settling velocity, organic matter removal.

1.Introduction

Due to higher treatment requirements, many wastewater treatment plants require capacity expansion. Additionally, surface area is frequently limited. Given the lengthy solids retention time required to accommodate slow-growing bacteria, the nitrification step of conventional nitrogen removal, in particular, necessitates high reactor capacities when based on the conventional activated sludge method. Additionally, issues with solids-liquid separation caused by filamentous bacteria or inadequate floc development are frequent in traditional activated sludge processes and call for plant expansions. In order to address these issues, new, more handy, and effective nutrient removal technologies, such as integrated fixed film activated sludge (IFAS), membrane bioreactors (MBRs), moving bed biofilm reactors (MBBR), and aerobic granular sludge (AGS), have been developed in recent years. The definition of "aerobic granular sludge" refers to the earliest systems, which were exclusively operated under aerobic conditions. Today, however, different redox states (anaerobic, anoxic, and aerobic) are used to effectively remove organic waste and nutrients utilizing granular sludge.

The majority of biological wastewater treatment procedures use aerobic methods, which are particularly energy-intensive due to the energy needed for aeration, which makes up between 47 and 70 percent of the process' overall energy consumption. It is crucial to choose the process configuration and operating parameters for biological wastewater treatment systems that maximize the removal of organic matter and, if necessary, nitrogen while minimizing energy use. The sequencing batch reactor and the continuous-flow activated sludge technique are typical process setups for biological wastewater treatment based on suspended-growth heterogeneous mixed cultures. The most prevalent method is continuous-flow activated sludge, which, in its most basic form, comprises of a biological reactor, a settling tank that produces concentrated microorganisms for recycling to the reactor and for withdrawal, as well as a clarified effluent stream.

Aerobic granular sludge is a compact and energy efficient biological wastewater treatment process. It has a number of advantages over conventional activated sludge, including superior settling, high biomass retention and therefore higher volumetric load, lower oxygen demand, and reduced sludge yield. In addition, due to its dense and compact granular structure, aerobic granular sludge provides greater resistance to sudden changes in operating conditions such as temperature, organic affluence and toxic substances.

Due to the huge diffusion gradients of electron donors and acceptors present in aerobic granular sludge, which provide various redox conditions, simultaneous nitrification, denitrification, and phosphorus removal are all achievable in one reactor. This permits the proliferation of several guilds of bacteria in different sections of the granule. Microbial relationships in granular sludge contribute to several metabolic pathways for the degradation of contaminants, and such technology has been used to treat highly toxic and persistent compounds in wastewater on a large scale, including particulate matter, nitrogen, phosphorus, phenols, pharmaceutical compounds, heavy metals and even nuclear waste. Nevertheless, it is of great importance to note that recent appliance have mainly focused on the denitrification of groundwater polluted with pesticides and nitrates, which is fully implemented, thereby ensuring biosafety and drinking water quality. Thus, technologies in the field of biological water treatment continue efficiently develop.

Aerobic granular sludge is a densely aggregated mass of microorganisms, extracellular polymeric substances, and inorganic compounds in a matrix that is capable of removing carbon, nitrogen, and phosphorous, as well as other contaminants, in a same bioreactor under the same conditions. These thick microbial consortia usually have spherical or ellipsoidal shape and ideally have a smooth external surface and a solid structure.

With the use of synthetic, household, and industrial wastewaters and various reactor setups, distinct inoculums of aerobic granular sludge have been cultivated. In general, laboratory-scale reactors using synthetic wastewater produce stable granules in a matter of weeks or even a shorter period than the pilot- and full-scale reactors, which frequently experience granule instability during the start-up process. Granules grown in municipal wastewater typically have a diameter of 0.2 to 1.5 mm. The larger size and greater density of the granules lead to fast settling time and small sludge volume index. The granules described as a multilayer structure containing channels and pores for the flow of oxygen and materials.

Granules mostly consist of an outer aerobic layer over anoxic/anaerobic layers. Thus, microorganisms that use oxygen such as heterotrophs, ammonium and nitrite oxidizing bacteria, and glycogen or phosphate accumulating microorganisms grow in the outer aerobic layer, while the deeper layers typically contain denitrifying heterotrophs, as well as again the organisms storing glycogen or phosphate. Other specific microbes such as anammox, archaea, denitrifying and methane-oxidizing autotrophic bacteria also can be found in the aerobic granular sludge. Dead cells and sediments can also exist under anaerobic conditions at the center of the aerobic granules. Thus, microbial diversity and community structure directly affect sludge characteristics as well as the performance (Fig.1).

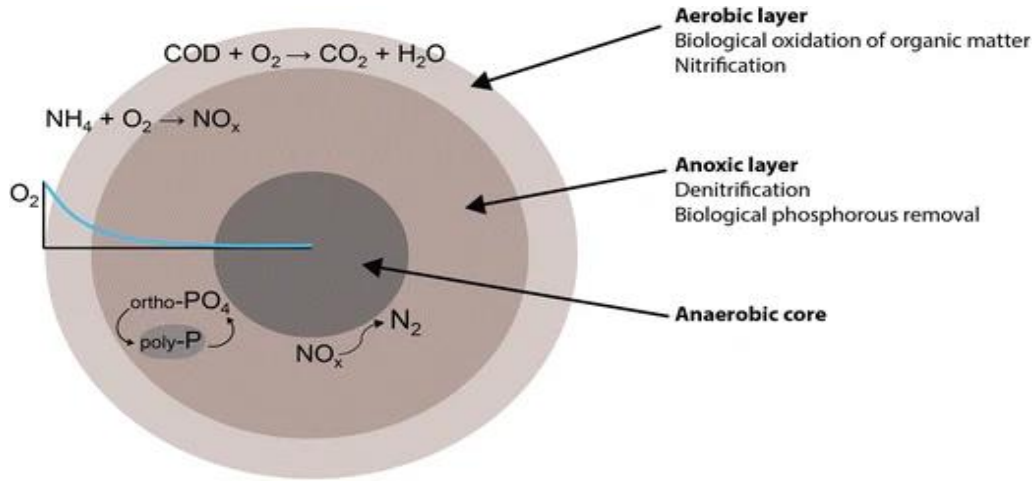

Figure 1. Schematic drawing of an aerobic granule showing all the different organic material, nitrogen, and phosphorus conversion processes occurring in the various redox zones.

Granulation has been explained to take place in several stages, including:

1. cell-to-cell contact,
2. forces of attraction between cells that cause them to aggregate,
3. maturing of the microbial aggregates by creating a matrix of extracellular polymeric substances on which cells are able to adhere and grow in number, and
4. the creation of a structure that is three-dimensional that is formed by hydrodynamic forces and the microbial organisms associated.

Cell-to-cell contact and the creation of aggregates are strongly dependent on the capacity of microorganisms to form aggregates, which is governed by mechanisms within cells and their physical and chemical properties. Hydrophobicity of the cell surface plays a crucial role in the initial phase of granule formation. The biomass has a tendency to become more hydrophobic during granulation. As the protein/polysaccharide ratio rises, the negative surface charge of granules decreases, reducing electrostatic attraction between bacterial cells and promoting granulation.

According to some reports, filamentous fungi and stalk protozoa serve as critical for the formation of the granular structure, thereby increasing the surface area available for bacterial attachment. Granulation has alternatively been defined as the outcome of dynamic floc/particle aggregation and breakup or microcolony expansion. The process of creating granules, however, involves several complicated phases that are controlled by numerous physical, chemical, and biological factors. Because microbial populations are so diverse, choosing the right species to do the job successfully depends heavily on the reactor's design, operation, and environment. Although continuous flow-operated granules have been reported to have decreased diversity, there is currently little knowledge in this area. The impact of the microbial community on the mechanisms involved in the granulation process was rarely discussed in most papers on this subject. High resolution identification of the microbial community is now achievable because to the advent of novel molecular techniques. A favorable impact on the early granulation process and the structural skeleton of granules, affecting their compactness, stability, and porosity, has been documented for filamentous and slow-growing microorganisms. Some of these microorganisms are nitrifying and denitrifying bacteria, which multiply slowly even in ideal substrate and climatic circumstances. The COD/N ratio is a crucial element in encouraging the selection of nitrifying and denitrifying microorganisms. Granules' porosity is reduced by the COD/N ratio, which also influences their compactness. Density and compactness have an impact on granules' anaerobic center, which is typically home to denitrifying bacteria.

The perfect conditions in the aerobic granular sludge reactor favor the aggregation of microorganisms that shape the young granules by supporting regular, spherical, dense, and compact aggregates. As the microbial aggregates mature, the substrate gradients in the granule cause them to expand, which creates various biological niches that enable a diverse community to cohabit and perform a variety of tasks that are used in wastewater treatment.

For the second stage of wastewater treatment, the use of aerobic granular sludge has emerged as a workable substitute method to conventional floc-based activated sludge. Granular sludge has been shown to have notable benefits over traditional activated sludge systems in laboratory, pilot, and full-scale studies. Granular biomass exhibits all of the previously discussed characteristics, making this technology a promising system for biological wastewater treatment in contrast to activated sludge, which is characterized by slow-settling flocculent biomass and necessitates a sizable secondary clarifier, a lower concentration of mixed liquor suspended solids, and a significant amount of system energy. Additionally, because of the shorter hydraulic retention time, aerobic granular sludge systems have less of an impact on the environment. Considering these benefits, aerobic granular sludge may be used instead of the traditional activated sludge infrastructure. In fact, aerobic granular sludge requires a 25–50% smaller installation area, 23–40% less money for energy, and 20–25% less money for running costs.

The ability of aerobic granular sludge to withstand harmful substances is very important characteristic. When it comes to organic matter, nutrients, or chemical compounds, these types of influents have a significant impact on the biomass concentration of typical activated sludge. Aerobic granular sludge, however, can handle high load shocks. In fact, the removal of emergent pollutants is not a treatment objective for conventional activated sludge technology. The release of emergent and priority contaminants, such as pharmaceutical chemicals that end up in natural water bodies are subsequently concentrated at the effluent discharge point from these wastewater treatment facilities.

Another crucial selection factor for sludge granulation has been reported by some recent research to be washing off the biomass that hasn't

been granulated. The majority of genera were washed out proportionally to their relative abundance on the floc-particles during the initial stages of granulation in a system for nitrogen and COD removal, though, according to the results of various studies, high wash-out rates would act as an accelerant of granulation by the physical selection of bigger particles. As a result, the biomass was gradually removed by washing until granules were revealed. When granules formed, erosion of the granules caused microorganisms on the granular surface to be preferentially washed out of the reactors while those developing inside the granules were kept there.

The four processes of feeding, aeration, settling, and draining are used in sequential batch reactors to run aerobic granular sludge technology. To produce dense and compact biomass as well as excellent physicochemical performance in subsequent batch cycles, granular cultivation and operation in a steady condition are thoroughly carried out. Aerobic granular sludge systems are typically constructed on cylindrical columns that have different height/diameter ratios and run in batch operations. The first step of the cycles in batch mode is an aeration stage, which is utilized to accelerate the breakdown of organic waste, nutrients, and contaminants. The granular biomass is then given time to settle at the reactor's bottom after the aeration has been stopped. Because biomass selection pressure is dependent on settle time, this parameter is important. Following that, the wash-out of biomass and the discharged effluent are related. The reactor is then refilled with fresh water. However, this method of operation has some drawbacks, namely the comparatively small amount of treated water that is generated in comparison to alternative systems that run continuously. Consequently, from a technical standpoint, the development of aerobic granular sludge that operate in continuous flow may offer a benefit over sequential systems.

The ability to settle is a significant advantage of aerobic granular sludge compared to conventional activated sludge. One of the main reasons is the fact that wastewater treatment plants with conventional activated sludge systems needs larger area for further separation of liquid phase from the solid fraction. On the other hand, the unique decanting of the granules ensures easy and quick separation of solid and liquid, because the granules are in different phases and as a result, this effective settling rate allows operations to be carried out in shorter period of time. Repetition of this action allows separation of the densest granules and the flocculent and filose microorganism masses are washed away. As the separation of solid and liquid phases takes place in one bioreactor, secondary purification is not required after such biological treatment.

In general, the amount of organic contamination in water can be calculated via an important measure called oxygen demand. The test is most frequently used to assess the effectiveness of treatment methods and to quantify the waste loadings of treatment facilities. The concentration of a particular chemical is not determined by oxygen demand testing; instead, it assesses the combined impact of a variety of factors. Since oxygen demand is not a pollutant, wildlife are not directly threatened. However, by lowering the amount of dissolved oxygen, it may indirectly threaten living things.

There are three methodologies that are frequently used for evaluating oxygen demand. Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) are two methods that quantify oxygen demand directly. Total Organic Carbon (TOC), a third technique, estimates indirect oxygen demand.

Among the three test techniques used to estimate oxy gen demand, the test for BOD best reflects aerobic waste treatment and the functioning of aquatic environments. In this experiment, microbes take in organic compounds as food while additionally taking in oxygen. The standard BOD analysis calculates the sample's oxygen consumption over a five-day period. The established approach, which only permits a delayed study of the effluent quality, does not seem to be the best tool for real-time environmental monitoring right now. Because the test takes so long to perform, the results only provide historical information and do not allow for an efficient process control system or a quick assessment of the water quality. The measurement variability in certified laboratories reaches 20%, and this figure rises between laboratories due to the variability of the microbial populations collected, despite the fact that this test is one of the most widely used in the field of water monitoring. Also, the test has limitations in certain applications, like industrial wastewaters, which commonly include cyanides, heavy metal ions, and other chemicals potentially dangerous substances to microorganisms. When toxic compounds poison microorganisms, they are incapable to metabolize waste, leaving the BOD test useless as an indicator of organic pollution. Regardless of the BOD measurement type, all of those techniques are based on the same bacterial population and have the same necessary analysis time (often 5 days). Due to this, each method have the same limitations for the high throughput monitoring of BOD in the environment.

Traditional BOD measurements are carried out using a standardized procedure currently known as the closed bottle test and detailed in International Standard (ISO 5815-1:2003 Water quality - Determination of Biochemical Oxygen Demand after n days (BODn)). These tests are based on microbial samples often collected from the environment in order to mimic the microbial diversity found there. According to these guidelines, the technique entails placing samples that could be contaminated with organic waste into particular bottles, aerating them, and adding a microbial population. Following hermetically sealing, the bottles are kept at 20-22°C in a dark environment for incubation. The dissolved residual oxygen is measured in all examined samples following a 5-day incubation period in order to calculate the BOD.

There are three main uses for the BOD5. First of all, it serves as a gauge of how closely the waste treatment process and wastewater discharge adhere to the rules as they currently stand. Second, the ratio of biological to chemical oxygen demand in wastewater treatment facilities reveals the amount of effluent that can be degraded. Third, the size of the wastewater treatment facility required for a particular location is determined by the ratio of COD/BOD5. It is also possible to determine the BOD results for a particular sample considering the COD test results. Between BOD, COD, and Total Organic Carbon (TOC), an empirical relationship exists. For each sample, the precise relationship must be determined. The test is beneficial for monitoring and control after correlation has been established.

In the Chemical oxygen demand test, organic carbon is converted to CO_2 and H_2O by the heat and a powerful chemical oxidant in an acid solution. The amount of oxidant used is measured by titrimetric or photometric techniques to assess the oxygen demand. Toxic contaminants do not adversely effect the test, and results are available in 1-1/2 to 3 hours, allowing for quicker process management and water quality evaluation. Colorimetric and titrmetric techniques are used to measure the results of COD assessments. It is simpler, quicker, and generally more precise to use colorimetric methods. However, a titrimetric technique can be performed if a spectrophotometer is unavailable, the samples are colorful or turbid, or if a spectrophotometer is not available. Colorimetric measurements make it possible to periodically check on the digestion's completion. It implies that rapid and precise analysis of samples that are simple to comprehend is possible.

Numerous oxidants have been tried by analysts as part of the COD test technique. Permanganate (in either acidic or basic solutions), cerate, persulfate, periodate, iodate, bromate, perbromate, hypochlorite, perchlorate, ferrate, bismuthate, hydrogen peroxide, oxygen, ozone, hydroxyl radical, vanadate, ultraviolet light, bomb colorimetry, combinations of various oxidants, and electrochemical techniques have all been used in experiments in the scientific laboratories. And, due to the various challenges, including: reagent production, low oxidation potential, reagent stability, photosensitivity, poor oxidation efficiency, cost, and other procedures that proved to be overly complicated, these approaches have not been effective. However, it has been demonstrated that a number of oxidants can generally get around these issues. Potassium dichromate and, more recently, manganese III sulfate are the two most commonly employed oxidants.

2.Experimental details

According to the Standard Methods for the Examination of Water and Wastewater, the biological oxygen demand (BOD5) and the chemical oxygen demand (COD) were examined during this experiment. In terms of removal ratios, BOD5 and COD were expressed based on their concentrations in influent and effluent, respectively. Caldwell and Langelier's approach, published in 1948, is based on the measurement of pressure loss brought on by microbes oxidizing organic materials. In fact, a predetermined amount of sample is poured into the sample bottles. Using the gaseous oxygen trapped in the sealed bottle, the microbes break down organic materials. This procedure produces carbon dioxide, which is typically absorbed using pellets of sodium hydroxide. In order to calculate the BOD value, a manometer converts the pressure changes to oxygen consumption (Fig.2).

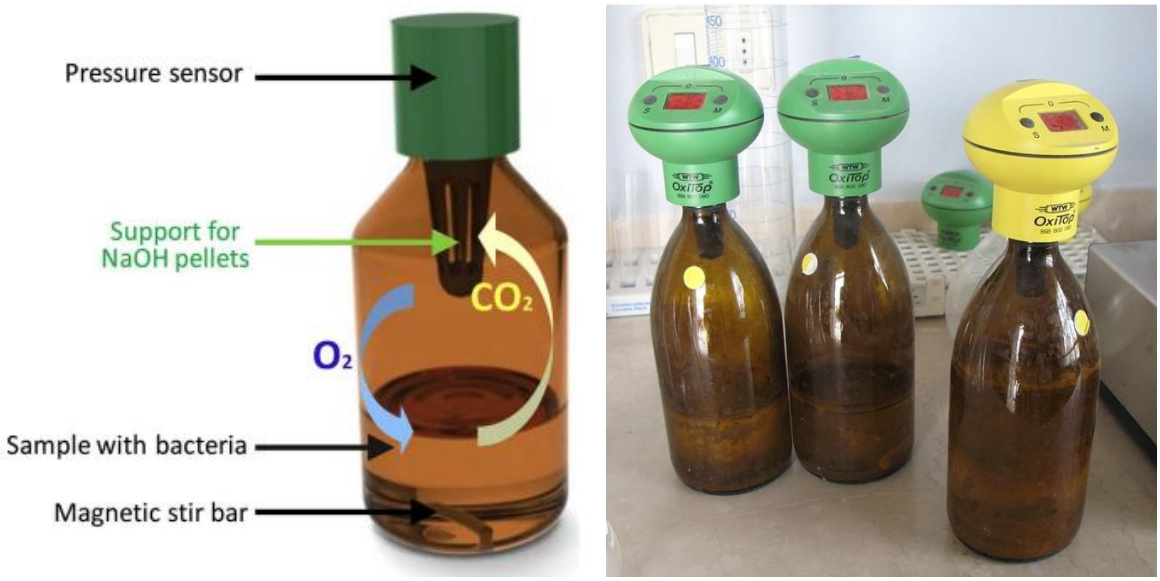

Figure 2. Incubation bottle for BOD measurement by the manometric method

In the manometric method, a manometer is used to quantify the pressure drop brought on by oxygen consumption in a bottle containing a sample. A potassium hydroxide solution is used to absorb the carbon dioxide that is created. BOD can be computed using the equation below:

$$BOD_n = \frac{M(O_2)}{R.T_m} \cdot \left(\frac{V_{tot}-V_l}{V_l} + \alpha \frac{T_m}{T_o}\right) \cdot \Delta p(O_2)$$

where $M(O_2)$ is molecular weight of oxygen (32000mg/mol), $R.T_m$ is gas constant (83,144L.hPa/(mol.K)), V_{tot} is bottle volume (ml), V_l is Sample volume (ml), α is Bunsen absorption coefficient (0.03103), $\Delta p(O_2)$ difference of the partial oxygen pressure (hPa), T_m is measuring temperature for BOD and T_0 is temperature (273.15 K).

As previously mentioned, based on the standard protocol, Allythiourea solution was added to the previously measured amount of water sample, including both influent and effluent, and placed into the incubation bottles. Then, sodium hydroxide pellets were used in order to absorb carbon dioxide produced from digestion process of microorganisms in the sample (Figure 3). As the last step of BOD test preparation magnetic stir bars added to the each bottle, pressure sensor caps put on and the bottles placed into the dark environment with approximate 20-22 degrees Celsius temperature condition, on a magnetic stirrer for the incubation during the next 5days.

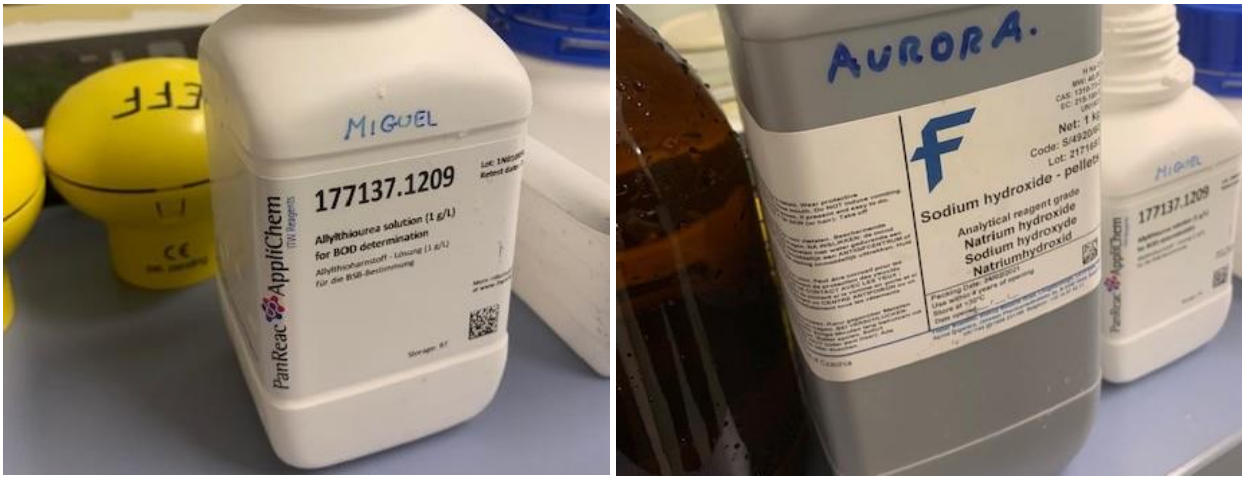

Figure 3. Allythiourea solution and NaOH pellets used for BOD5 determination.

The micro digestion method and the macro digestion method are the two COD digesting techniques. Large amounts of reagent, heavy glassware, and significantly more space are needed for the macro digesting method. As usual strong oxidants (hexavalent chromium and manganese III sulfate) are

present in the COD reagents' strong sulfuric acid solution. These reagents oxidize organic carbon molecules to CO2 and H2O during the digesting process.

Compared to the macro digestion method, micro digestion provides the following benefits:

- Reagent disposal costs are cheaper due to smaller reagent amounts.
- The closed container ensures consistent and greater recovery of volatile chemicals.
- Preparation tubes are simple to use and need minimal handling time.
- Digestion requires less analyst attention and therefore fewer space and equipment.

Experiments on COD calculations done according to the protocol and consisted of steps as, turning on the COD reactor and preheat to 140 degrees Celsius while preparing sampling tubes with a mixture of sample, oxidizer and acid (Fig.4). Amount of each measured as dedicated by the method in the following order: 3ml of sample wastewater (either influent or effluent), added 2ml of the oxidizer ($KCrO_{4)}$, added 4ml of the acid (H_2SO_4 + Ag + Hg).

Figure 4. COD calculation materials for the method of micro digestion.

Tubes with the previously mentioned mixture of sample, oxidizer and acid placed into the pre-heated COD Reactor. Then the tubes heated for or 2 hours (because we used Dichromate COD Reagent). After the necessary time passed, the tubes removed from the reactor and cooled to room temperature. Further, COD results determined colorimetrically on UV Spectrophotometer (Fig.5). The use of colorimetric methods is simpler, faster, and generally more accurate.

Following the protocol, the settling velocity was calculated by recording the time it took for each granule to sink freely into the water after being dropped from a specific height using a measuring cylinder (Fig. 5).

Figure 5. Measuring of settling velocity of the granules.

For the implementation of the pilot project for the treatment of wastewater in a bench-scale continuous flow aerobic granular sludge system, optimal conditions and characteristics for the research and building of the bioreactor took into account. The most efficient of the available options choosen to be the municipal wastewater treatment plant in Órgiva, Granada (Fig.6).

Figure 6. Wastewater treatment plant in Órgiva, Granada.

Transparent acrylic plastic was used to build a bench-scale column-type aerobic granular sludge bioreactor. The height of cylindrical column was 150cm and the diameter was 18 cm (Fig.7).

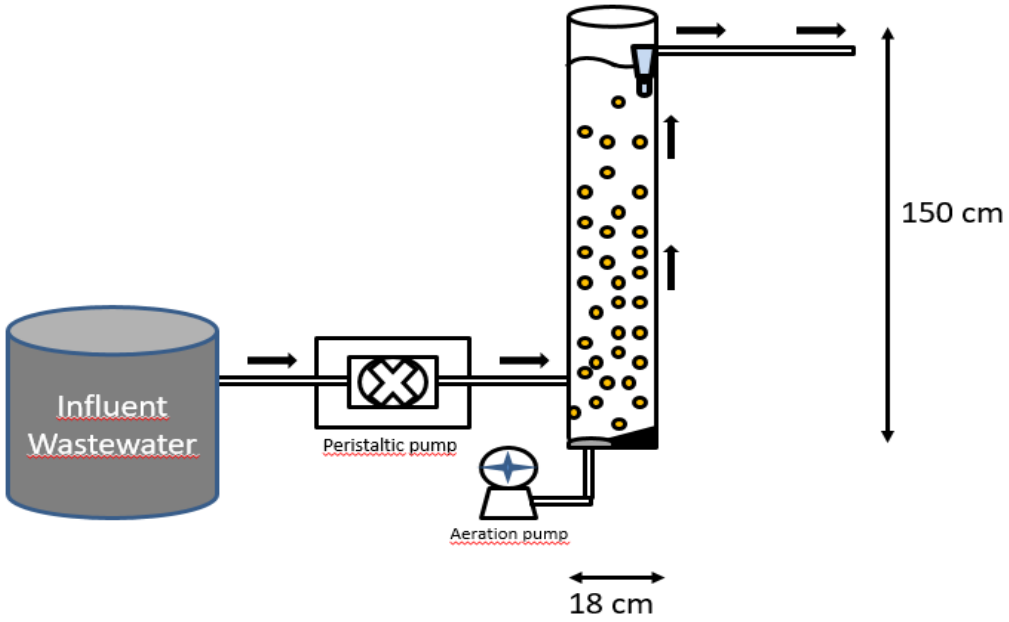

Figure 7. Scheme of the bioreactor.

The actual operational volume was 35L and the hydraulic retention time (HRT) was 8 hours. The aeration of the bioreactor has been moving between 15 and 10 L/min at the beginning of the pilot project implementation and reached steady 12 L/min before start of serious experimentation.

First, 1 L of granular biomass from an aerobic granular sludge system operating in a sequential batch reactor for treating lab-scale synthetic wastewater was added to the bioreactors. The following ingredients used to feed the bioreactors with synthetic wastewater, which mimic urban sewage: CH3COONa, NH4Cl, MgSO47H2O, K2HPO4, KCl, and KH2PO4 (Table 1).

Compound	g/L	Quantity per g for 120 L
CH3COONa.3H2O	1,50	180,00
NH4Cl	0,25	30,00
MgSO4·7H2O	0,1	12,00
K2HPO4	0,085	10,20
KCl	0,04	4,80
KH2PO4	0,03	3,60
NH_4^+	0,084	84,2
$N\text{-}NH_4^+$	0,065	65,5
PO_4^{2-}	0,067	67,4
$P\text{-}PO_4^{2-}$	0,022	22,0
CL^{--}	0,185	184,9
$CH3COO^-$	0,648	648
CH3COO- del 3xH2O	0,649	649

Table 1. Composition of the synthetic wastewater.

Periodically throughout the experiment, physicochemical characterization was examined. The biomass characteristics have been evaluated based on granular size and settling velocity. Standard methods were used to measure the chemical oxygen demand and biological oxygen demand at day 5, in order to determine the effectiveness of organic matter removal (Fig. 8).

Figure 10. Continuous flow aerobic granular sludge bioreactor examinations.

Start-up and evaluation of performance, as well as, inoculation of granules started on 24th of March. Bioreactor chemical oxygen demand and biological oxygen demand for the effluent was calculated to be 463,3 mg/L and 230 mg/L respectively.

A week later (31st of March), the bioreactor was inoculated with more granular biomass from a lab-scale aerobic granular sludge sequencing batch reactor located in the Water Research Institute (Granada, Spain). On that date, the test results of the effluent wastewater determined to be 350 mg/L for COD and 340 mg/L for BOD.

On the next 3 weeks of April, the startup bioreactor faced various operational problems, such as broken

influent tubing, leading to destruction of granular biomass and generation of suspended biomass.

On 19th of April, the system was recovered and suspended biomass eliminated. Following that, the bioreactor inoculated with the new batch of granules from the laboratory. For the preparation for start of serious experimentation and efficient application of the treatment, some changes have been made to the settling devices.

On April 25, the main experimentation started and chemical, biological oxygen demand for both bioreactor influent and effluent, as well as settling velocity of the granules calculated twice a week until May 26 (Table 2).

Date	Bioreactor COD for Influent (mg/L)	Bioreactor COD for Effluent (mg/L)	Bioreactor BOD for Influent (mg/L)	Bioreactor BOD for Effluent (mg/L)
25.April	786,7	203,4	250	50
28.April	1226,7	286,7	260	50
02.May	1121,7	436,7	480	60
05.May	1128,4	170	420	80
09.May	1360	459	340	90
12.May	1333,4	407,3	430	70
16.May	1426,7	1002,4	460	240
19.May	1308,3	867,4	420	170
22.May	1209,7	765	390	150
26.May	1395	612,7	450	120

Table 2. Results of COD and BOD tests.

As a result, in order to choose a superior continuous bioreactor design and setup, the effectiveness of organic matter removal was assessed. COD and BOD5 were used to determine this parameter. According to the results for the first months of the serious experimentation, removal capacity was approximaately 74 %.

In case of BOD_5 results, the bioreactor was also able to remove around 73,5 %, which is not only an anticipated result, but also proves us the empirical relationship between COD and BOD indicated earlier.

As previously mentioned, the settling velocity was determined in accordance with the protocol by recording the time it took for each granule to freely fall into the water after being dropped from thespecific height of a measuring cylinder. On each calculation around 10 granules of various size and shape was picked manually and average settling time calculated (Table 3).

Date of calculation	Settling speed (m/h)
25 april	172,9
2 may	173,7
9 may	178,9
16 may	169,5
22 may	162

Table 3. Settling velocity of the aerobic granular sludge.

Granule size development is mostly out of control because of the complex relationships between a number of environmental variables. A more or less constant granule size appears to be reached via the balance between granule growth, attrition, and breakage [24]. As can be seen (Fig. 11), the granules in our continuous flow aerobic granular sludge bioreactor achieved not only stability, but also a mean size of approximate 7-8mm which is something new. As most previous studies indicate that

continuous flow systems usually have granules (average size around 2mm) much smaller than that of sequential batch reactors (up to 14mm) [1].

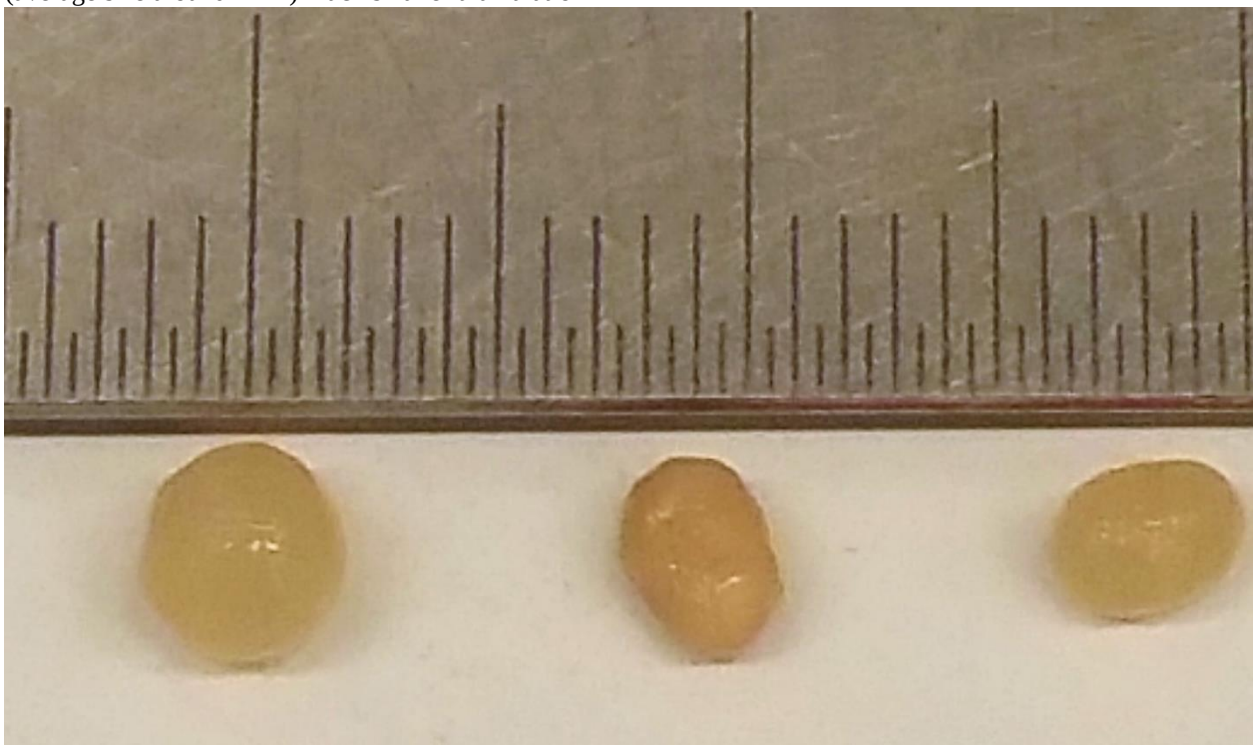

Figure 11. Granules obtained in AGS CFR.

The mean size and settling time are two variables that offer crucial insight into the stability and compactness of granules [20]. When serious experimentation first began, there were not any significant differences in the settling velocity of the granules, but in the last few days, we have noticed a little increase, which is a desirable outcome as it means that the operational conditions are satisfactory for the granules to get dense and heavy.

3.Conclusion

Since it is a system with significant advantages over traditional activated sludge, aerobic granular sludge technology has been the subject of extensive study in recent years. The majority of continuous flow reactor system research has focused on treating industrial or municipal wastewater. But it is unquestionably a fact that technology must be used on a larger scale. It is obvious that continuous flow reactor systems offer extra benefits over traditional activated sludge systems, and that granular systems have considerable operational advantages over both. In this context, aerobic granular technology can be seen as expanding obviously, and its acceptance as an innovative technology is a recognized reality in the whole cycle of water management.

The benefits of the conducted experiment include not only high percentage of removal, but also the fact that it has simpler structure and easier operational parameters. Such model of aerobic granular sludge continuous flow reactor needs less space to build, mainly because there is no secondary settler and all the treatment take place in same (primary settler) bioreactor. The latter also makes the energy consumption and overall operational costs much less than the traditional wastewater treatment systems. Without any exact calculations, just considering the previously mentioned differences and obtained removal rates of the startup bioreactor, we can already predict that such prototype has potential of decreasing costs of wastewater treatment up to 50%.

In conclusion, the configuration at the pilot scale could serve as a model for future studies to implement aerobic granular sludge continuous flow bioreactor at full scale due to its simple structure and favorable outcomes obtained, such as high removal performance, ability to establish approximately stable well-structured granular biomass for steady-state, and short start-up times. In order to treat wastewater at full scale, additional research needs be conducted to test the design and identify the best operational parameters. Moreover, in the near future, it is undeniable that aerobic granular sludge in continuous flow reactor systems must be taken into account as a viable system for nutrient and organic

matter degradation, particularly for nitrogen and phosphorus, which are common elements in actual urban wastewater.

The most significant findings were the production of granules in an aerobic continuous flow granular bioreactor. It was something that had not been done before, as all the previous aerobic granular technologies worked with sequential configurations. Thus, it must be repeatedly noted that this aerobic granular sludge technology is patented and the patent reference number is 202230987.

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Innovation city of the future

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Abstract: The growth of the world's population, as well as the population of our country, increases the number of building constructions, and over time, the plots of land allocated to parks and recreation areas in big cities either decrease or are canceled. On the other hand, people, especially parents (in some families it is one parent, but in many families both parents) face time problems because most of the day is spent at work. Due to the lack of time, they cannot spare time for their own rest, as well as for the rest of their children. For this reason, recreation corners being more accessible, closer, built in more convenient places, will lead to the solution of the above-mentioned problems. It is better if this convenient place is inside the building. Our observations show that the roof of most buildings remains neglected due to lack of use for any reason. If these large areas are used effectively, the building will become an accessible space for residents. Our team suggests that if parks are built on top of the buildings, these parks will be useful both for building residents to go up to the top of the building (through the elevator placed inside the building) and rest in the park, and for increasing the percentage of oxygen in the building. In addition, the residents of the building who have little time will relax in the park without going to the yard of the building, without having to travel a distance, without wasting time, and they will walk their children in the fresh air.
Keywords: arduino kit, moisture meter, water motor, drip irrigation, population growth, waste to fertilizer, residential building

1.Introduction

One of the new approaches in education is to provide a problem-based learning (PBL) environment tailored to local demands and needs. At this time, students make it a habit from their school days to build educational projects aimed at the needs of their communities, to be responsible for the common good by making suggestions, and to take steps aimed at solving problems. It is always interesting for students to solve their needs and concerns with the help of technologies, and they Z generation (Z generation) give and offer useful suggestions in this direction more easily.

Bringing the development level of the educational system and infrastructure of our country to the level of the world's leading educational systems until 2030 is indicated as one of the main priority directions in the socio-economic development documents.

Increasing students' modern scientific and technical knowledge, interest in the field of high technologies, enabling the preparation of initial prototypes in robotics, development tendencies in the field of innovation should be laid from high school.

Our students from Jalilabad, who are working towards the solution of the problem posed in the project, tried to find a solution to the problem using their applied skills and knowledge in the field of modern technologies in accordance with the needs of the region and gave their suggestions.

2.Experimental details

The demography of the world's population has not remained stable in any historical period, it has always undergone changes. According to the statistics released in November 2022, the number of the world's population has exceeded 8 billion. The population in our country has already exceeded 10 million people. In fact, this is gratifying. On the other hand, the increase in the population in big cities, especially in Baku, as well as the influx of people from the provinces to the capital increases the number of building constructions, and over time, the land areas allocated to parks and recreation areas in big cities either decrease or are canceled. On the other hand, people, especially parents (in some families it is one parent, but in many families both parents) face time problems because most of the day is spent at work. Due to the lack of time, they cannot spare time for their own rest, as well as for the rest of their children. For this reason, recreation corners being more accessible, closer, built in more convenient places, will lead to the solution of the above-mentioned problems. It is better if this convenient place is inside the building.

Healthy and safe living, recreational conditions, environmental safety and other clauses are included in the following articles of Chapter 3 of Section 1 of the Urban Planning and Construction Code of the Republic of Azerbaijan:

Article 7. Basic principles of urban planning and construction activities

7.0. Urban planning and construction activities in the Republic of Azerbaijan are carried out on the basis of the following principles:

7.0.1. provision of social minimums related to healthy and safe living, working and recreational conditions;
7.0.2. ensuring security;
7.0.3. ensuring ecological safety and environmental protection;
7.0.4. ensuring compliance with urban planning documents;
7.0.5. preservation of historical landscape and cultural heritage objects;
Article 8. Provision of social minimums
The social minimums determined by this Code and other regulatory legal acts regarding healthy and safe living, working and recreational conditions must be ensured in urban planning and construction facilities, especially in construction facilities designed for human habitation or use.
Article 10. Ensuring ecological safety and environmental protection
10.1. Environmental safety and environmental protection must be ensured within the framework of urban planning and construction activities.
10.2. Construction activity must be evaluated in terms of its impact on the environment in accordance with the law. The results of the assessment should be taken into account when determining measures to ensure environmental safety and environmental protection during construction activities.
There is also the legality of applying the proposed project to buildings.
Our observations show that the roof of most buildings remains neglected due to lack of use for any reason. If these large areas are used effectively, the building will become an accessible space for residents. Our team suggests that if parks are built on top of the buildings, these parks will be useful both for building residents to go up to the top of the building (through the elevator placed inside the building) and rest in the park, and for increasing the percentage of oxygen in the building. In addition, the residents of the building, who have little time, will have a rest without going to the yard of the building, without having to travel a distance, without wasting time, and will have their children walk in the fresh air.
The students who participated in the "Digital Agronomists" student camp project, which won the VI grant competition for development and innovation in education of the Ministry of Science and Education, thought in the direction of solving this problem and prepared a model to show the solution to the problem.
The goal of the project is to involve Jalilabad schoolchildren in activities in scientific and technical innovative directions, to design drones for agrotechnical purposes, to apply them according to the needs of agriculture in the field of experience, thereby achieving the development of professionally oriented engineering-design, digital and cooperation skills.
Trainings were organized for the students who participated in the project in three areas - mechanical engineering, drone design, and programming, and our students acquired many skills in these trainings. During the trainings held within the project, students learned to design 3D in TinkerCad program and printed their designs.
But our students did not only use the skills acquired in the project to achieve the goal, but also explored ways to solve several problems and tested their skills in these directions as well.
The students who prepared the "Innovation City of the Future" project managed to build a modern irrigation system using microbit and arduino kits. If watering and fertilizing the trees and greenery in the park that will be created on top of the building is carried out with the modern technology that we have envisioned, manpower will not be needed to protect the greenery of the park, although it will be a small number.
The supplies needed for the irrigation system are:

- ✓ Arduino kit
- ✓ Microbit kit
- ✓ Moisture meter
- ✓ Solar panel
- ✓ Battery compartment
- ✓ Water engine
- ✓ Pipes

A program is written on a microbit or arduino and connected to a small water motor. A moisture meter is connected to the other side of the Arduino. A drip irrigation system is created from the pipes connected to the water engine. A soil moisture meter determines the soil moisture percentage and activates the irrigation system. When the soil moisture drops below 50%, the moisture meter sends a signal to the mocrobit or arduino. After receiving this information, the Arduino starts the water motor. When the humidity reaches 50% again, the adruino stops the water motor via the humidity meter. The water motor gets its electricity from a solar panel installed on top of the building. The battery compartment can also provide electricity when needed.
In order not to waste drinking water when watering trees, dirty water can be cleaned through a filter installed on top of the building and fill a tank placed in the park. In addition, rainwater can be collected in a tank through a large retractable umbrella installed on top of the building. This umbrella will also create conditions for the residents of the building to walk comfortably in the park in rainy weather. The umbrella can also be used to protect trees from damage in windy weather.
The elevator installed on the outer wall of the building is designed to raise the waste accumulated in the building and which can be turned into fertilizer to the park above the building. Residents of the building can call the elevator through the remote control and add waste to the elevator through a special window to empty their waste that can be turned into fertilizer

into the elevator. The elevator will lift this waste to the top of the building. Waste is emptied into a container under the attraction installed in the park. While the children are playing in the attraction, the waste inside the container is mixed by means of an installed wheel, and after a while it turns into fertilizer. After that, these fertilizers are emptied at the base of the trees. In this way, both the residents of the building are freed from some of the waste, and the greenery grown on top of the building is fertilized.

The attraction can also be used to start a water motor. A water motor connected to the attraction can be turned on while children are playing and the motor will release water into the tubes as the attraction moves.

The water tank, chairs, elevator, elevator handles used in the building model were designed in TinkerCad software and printed on a 3D printer. The building model was designed in CorelDraw and printed on a laser cutting machine.

3.Conclusion

In our country, especially in the city of Baku, the increase in the population increases the number of building constructions, and over time, the plots of land allocated to parks and recreation areas in big cities either decrease or are canceled. For this reason, recreation corners are more accessible, closer, built and built in more convenient places, which leads to the solution of this problem. It is better if this convenient place is inside the building. Our observations show that the roof of most buildings remains neglected due to lack of use for any reason. If these large areas are used, the building will become an accessible space for residents. According to our team's proposal, parks on top of buildings will be useful for residents of the building to go up to the top of the building through the elevator placed inside the building and relax in the park, and also to increase the percentage of oxygen in the building. In addition, the residents of the building, who have little time, will have a rest without going to the yard of the building, without having to travel a distance, without wasting time, and will have their children walk in the fresh air.

In addition, our students working in the project can receive the following useful results:

- ✓ With this, the learning results of students in precise and technical subjects will increase.
- ✓ They will get acquainted with the directions necessary to prepare modern innovative engineering-design products
- ✓ They will be prepared for a number of technical-creative competitions for the future.
- ✓ Discovery of areas of interest will help in conscious choice of profession and specialty
- ✓ Azerbaijan's future programmers, mechanical engineers, and drone operators will be ready.
- ✓ Interest in robotics and programming will increase among students.
- ✓ It will increase interest in useful associations and activities among schoolchildren who join such projects. This meant support for increasing the quality of education.

All of this will lead to the beautification of our cities, to a situation comparable to European cities, and the practical skills and knowledge that our students from Jalilabad will acquire in the field of modern technology in accordance with the needs of the region will play an important role in their preparation as qualified specialists in the future. will be

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Application of artificial intelligence in electrical devices

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Abstract: This article focuses on the significance of applying Artificial Intelligence (AI) to electrical appliances, examining its potential benefits and exploring new methods for autonomous appliance management. Intelligent control of electrical appliances plays a pivotal role in enhancing energy efficiency, reducing waste, and improving user experience. Implementing AI in this domain ensures optimized performance and longevity of the devices.

Keywords: Artificial Intelligence, Electrical Appliances, Energy Efficiency, Smart Management.

1.Introduction

In recent years, with the rise in prominence of Artificial Intelligence (AI), its impact has been felt across various sectors, notably in the management and optimization of electrical appliances. A significant proportion of these appliances are operational in homes, industries, and public spaces. Their efficient and reliable functioning plays a crucial part in simplifying our lives. The application of AI to electrical devices is a burgeoning concept, related to the role of technological advancements in every field. [4,5] This application not only makes the devices more reliable, safe, and user-friendly but also enhances their operational efficiency. Some even believe that this application will completely revolutionize the industry. An extensive explanation of the benefits obtained by applying AI to electrical appliances is detailed below:

1.1 Energy Efficiency:

Optimization: AI can monitor the operational mode and energy consumption of the device in real-time, proposing necessary adjustments to enhance its operational efficiency.

Increasing Energy Satisfaction: Excessive energy consumption may be related to the sub-optimal operation of the device. AI can identify such inefficiencies and assist in taking necessary measures.

Economy: Reduced energy costs not only increase financial efficiency but are also environmentally friendly.

1.2. Safety:

Detection of Abnormal Operation: AI can analyze changes related to the device's operating parameters and pinpoint potential anomalies that might pose a threat.

Safety Alerts: In abnormal and hazardous situations, AI can halt the device's operation and send warnings to the user.

1.3. Self-directed Repair:

Proactive Monitoring: AI can preemptively identify potential vulnerabilities and problems.

Service and Repair Planning: By determining the essential service and repair needs of the device, AI can optimize service timings and urgent repairs.

1.4. Enhancement of User Experience:

Personalized Settings: Based on user preferences, AI can adjust the device's parameters.

User Interface: Smart devices can offer users a more intuitive and comfortable interface, enhancing the user experience.

In the future, the application of AI in electrical appliances will grow and lead to the emergence of new innovations. The table below provides examples of how artificial intelligence is applied in various electrical appliances.(Table 1)

Table 1. Below provides examples

Device	*Technology/Method*	*Description*
Smart Thermostat	Learning algorithms	Controls home temperature optimally, learns the user's routine, and increases energy efficiency.
Smart Household Appliances	IoT and Analytics	Ovens, refrigerators, and other appliances can adapt to the user's habits and can be integrated with schedules.
Smart Lighting	Sensors and algorithms	Adjusts the light level and color automatically or based on the user's habits.
Security Cameras	Image recognition	Detects motion, human faces, and other objects to send alerts.
Smart Kettle	Remote Control and Learning algorithms	Learns the user's routine and heats up the water automatically when tea is being prepared.
Robot Vacuum Cleaner	Navigation and Sensors	Maps the house, plans the optimal route for the vacuum, and tries to avoid obstacles.

2.Experimental details

The integration algorithm of Artificial Intelligence (AI) in electrical devices is contingent upon various factors, as each device has its unique features, requirements, and operational mechanisms. [1] However, it's possible to present a general abstract algorithm that illustrates how AI is integrated into electrical devices. (Fig 1)

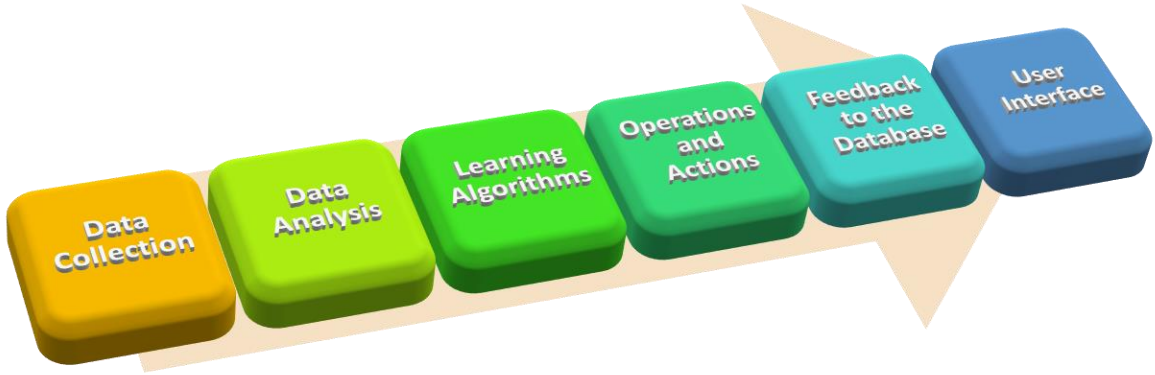

Figure 1. AI is integrated into electrical devices

Data Collection Collecting data from sensors to measure the status and operational parameters of the electrical device, such as temperature, electrical power, pressure, etc.

Data Analysis The gathered data is fed into AI models, which then analyze the data to make decisions.

Learning Algorithms Learning algorithms (e.g., deep learning, reinforced learning, etc.) assist in understanding the data to select the best course of action.

Operations and Actions Based on the analyzed data, AI executes operations or measures to optimize the functioning of the device.

Feedback to the Database The reactions and results from the device are reintegrated into the database, perpetuating the learning process to enhance system accuracy and efficiency.

User Interface A suitable interface is designed for users to monitor the status of the device and intervene if necessary.

This algorithm provides a comprehensive overview of AI's application in electrical devices. However, the precise details of the algorithm might vary depending on the specific device or application context.

3.Conclusion

Over the past decade, the application of Artificial Intelligence (AI) in electrical devices has paved the way for revolutionary advancements in various sectors. [2,3,5] Through these applications, devices have achieved enhanced energy efficiency, refined user interfaces, and the ability to autonomously adapt and learn. The implementation of AI has facilitated the emergence of autonomous decision-making, proactive, and self-regulating electrical devices. This translates to greater efficiency in the energy industry, lesser environmental impact, and more convenient and beneficial experiences for users. The future expansion and development of AI in electrical devices will guide us into a world that's more innovative and adaptable.

This conclusion sheds light on the revolutionary impact of artificial intelligence on electrical devices and offers insight into the potential future developments in this field.

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Impact of Robots on Quality in Construction

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Abstract: Due to the development of science and technology and the increase in technical progress, as in other fields, robotics began to develop rapidly in the field of construction. The rapid development of robotics has led to an increase in the quality level in the construction field, a reduction in injuries and a number of positive aspects. Today, with the application of robots in the field of construction, large buildings and constructions are built in a short time. 4 main future research directions of the development of robotics have been identified. Deep integration of robotics into the construction field; Robot production near construction objects; Flexible adaptation to the environment; Constant development of robots. This kind of development of robotics enables the wide development of the construction field and its transformation into a larger industrial field.

Keywords: Quality in construction, Construction robots, Automated control methods

1.İntroduction

Today, the construction sector is one of the largest industries in the world. Although it is a very large, developed field, progress towards automation is very slow. It is for this reason that the integration of robotics in the construction field is very slow compared to other industries. The main reason for the late integration of robotics into the construction industry is the lack of proper calculation and planning in the construction industry[1].Today, robotics is developing rapidly in many industries. For example, robotics is rapidly developing in fields such as architecture, demolition, and masonry. Autonomous robots applied in these areas offer a number of advantages. One of the main advantages in the field of construction is the timely detection of inconsistencies during the work process and the correct transfer of data to the system can be performed through robotics. Increasing accuracy, significantly increasing responsibility and productivity, reducing errors, reducing costs, reducing accidents, and fully following all the instructions are some of the advantages that robotics brings to the construction field. The rapid development of this form of robotics offers advantages in terms of utility and quality, despite the reduction of human labor. Therefore, these advantages brought by robotics make robotics indispensable for large industries. The main functions of the robots used in construction are to be able to perform the tasks assigned to them in a timely and accurate manner[1].

2.Experimental details

The main functions of robots used to increase efficiency in the construction field are as follows.

- Correctly predicting tasks required of robots

- Evaluation of design progress

-Timely and accurate detection of discrepancies

- Identifying and automating work that will create a danger for people

- Determining control and inspection duties

One of the famous companies as a manufacturer of robots used in construction is Robotnik. In 2002, the products manufactured by this company achieved success in more than 60 Avopa-level researches and projects. Currently, more than 30 large-scale projects are being implemented. Some of these projects are logistics-oriented, some are health sector-oriented, some are construction-oriented, etc. The robots used in these fields are intelligent robots. Taking into account the general characteristics listed, robots applied in the construction field make better use of resources, create more useful construction processes, and ensure that overall higher quality is achieved[1].

What are the advantages of robotics in construction? - At present, the rapid development of robotics in various industries is in the center of attention. It is known that the field of application of robotics is very large. Consider the integration of robotics into the construction field. This includes:

- Prefabrication outside the construction site -i.e. pre-production inspection

- Automated and robotic systems

- Drones and construction vehicles

- Exoskeletons

Achieving high quality with the application of robotics in construction is achieved with LIDAR and point cloud technology, i.e. "sensing technology".

We can point out the following as the main advantages of robotics in construction.

1. Solving the problem of unskilled workers in construction - We know that construction is a labor-intensive field. The application of robotics enables the reduction of labor costs in construction, the increase of productivity and quality. One of the main problems in the construction industry is the lack of skilled, qualified workers. The application of robotics to the construction site has eliminated this problem. The use of robots has not only increased labor productivity, but also replaced unskilled workers. The demand for robots in construction will start increasing day by day. The main reason for this is the forecast for the rapid development of the construction area until 2030. According to the forecast, the number of jobs will increase by 200 million. The introduction of robots will enable the automation of the complex construction site and the faster construction of buildings without reducing the number of workers. Robots will solve the skills shortage problem, but they will not replace humans. On the contrary, it will require more qualified workers[1].

2.Increasing speed with off-site manufacturing activities – individual components or modules in today's manufacturing facilities, factories, plants are well suited for creating automation. The process of transitioning to modular construction outside of the production area can be of great benefit to the construction industry. Nowadays, big companies like Katerra are already using these modules. Since the development of the modules is relatively weak, it is still done manually. As the project grows, all processes will be automated. Assembling large critical building components into completed building modules requires consideration of very large prefabrication (LSP) works[1].

In order to ensure accuracy in construction, it is necessary to assess the entire site and its surroundings before, during and after the construction project. Point cloud technology eliminates this problem by scanning, reducing additional costs.

3.Ensuring safe working conditions - Providing a safe working environment is one of the most important tasks of managers in the construction field. The issue here is not just the injury of workers. At the same time, the costs related to the hazardous area are also very high. The development and integration of robotics into the construction field also eliminated this problem. Thus, the use of robots in dangerous jobs became an irreplaceable way in terms of increasing safety [1].

Exoskeletons, which were first applied in the military field, developed and moved to other industrial fields. Among these fields, it is necessary to mention health care and construction. Considering the military field, exoskeletons have not been developed at a perfect level in the field of construction and industry. These exoskeletons provide effective solutions to the challenges posed by an aging workforce in the construction industry. At the same time, it creates conditions for older workers to work on the spot and perform physical tasks. From the past to the present, the biggest projects where robots have been applied have been advanced mining vehicles and excavators. Nevertheless, there are problems in the automation and robotization of traditional trucks used in the construction field today. This, in turn, affects the quality of construction.

The application of robots to the construction site is very important in terms of safety as well as increasing the quality of construction. Today, projects performed by large companies such as Built Robotics are considered hybrid projects. The main reason for this is that drones perform both quality and safety work. Controls and inspections carried out by drones bring the construction to a state of confusion.

4. Increases the usefulness of given tasks - There are no cases of fatigue, burnout, or lack of motivation towards the work process in the robots used in the construction field. Due to these characteristics, the application of robots in construction is convenient. A person encounters situations such as monotony of work, exhaustion, etc. Robots that surpass humans with such features are still not considered perfect. Robots that serve to achieve high quality in the field of construction need to be continuously maintained [1].

5. Reduces labor costs and waste – They produce large jobs in a short time span, less labor costs and less waste. Robots can work longer and more usefully than a human. However, people are still needed to manage them. For this reason, there is a need for highly qualified workers who can operate these mechanisms[1].

6.Construction safety ensures that the number of accidents and injuries is minimized - For many years, the construction site has been considered one of the most dangerous areas due to the complexity of the work environment. The main reason why the construction site is considered dangerous is the lifting of heavy loads, the use of various elements, the complexity of the work process, etc. The application of robots in construction ensures the minimization of injuries and injuries [1].

7. Programming to meet special demands – From the time of the ancient Romans to the present day, the field of construction has been continuously evolving. Today, this field has developed so much that software-controlled robots are already used. Robots can be programmed for different types of tasks. In this way, they can solve any kind of problem [1].

What are the disadvantages of construction robots? - it is known that although robots are used in fields such as construction, healthcare, and military today, these mechanisms also have disadvantages. Despite the fact that robots accurately perform the tasks given in the construction field, they also have disadvantages. These are the following.

- Potential job losses

- Initial Investment Costs

- Recruitment of Skilled Personnel

- The complexity of the construction process

- User resistance

- Technology limitations

1. Complexity of the construction process – The construction industry is a very diverse business. Today, there are more than 80 different types of this field. The construction field is one of the areas with the most changes.

Making robots work in an area with a changing structure like a construction site is a difficult task. These machines do not have the ability to think like humans. They need to be strengthened, they require different programming. Ensuring that robots work alongside humans in a safe manner requires standardization[1].

Although the development of individual robot projects makes some difference, working together in a systematic way will benefit. Building information modeling believes that better planning, programming and digitization will ensure a more accurate understanding of data than robotics. The development of a large-scale framework such as Building Information Modeling will encourage the further increase in the efficiency of large-scale structural projects carried out by robots.

2.User resistance - all the tests and researches on the application of robots in the construction field are for the creation of new systems. All workers in the construction sector are rightfully relieved that robots will take over their jobs, eliminating the need for human labor in construction. The reason for this is that the field of application of robots is growing more and more, robots should be more useful compared to humans. The demand for robots from companies that manufacture robots for various purpose fields is not perfect, which means that the sales of robots are not that high. The main reason for this is that robotic mechanisms require a lot of support, maintenance, and training [1].

3. Limitations in robotics – robotics is getting more and more advanced every day. However, a number of difficulties arise in this field in construction. In order for robots to be used in a beneficial way in construction, a number of problems must be overcome. These problems are as follows[1].

-Coping with external and harsh environments

- Operations that affect battery life

- Difficult operations that require additional training and increased costs

- Potential additional risks to health and safety

Associated Builders and Contractors estimates that more than 430,000 skilled workers are needed in the construction industry in the United States. According to the research of this organization, it was determined that young workers do not go to the construction field because it carries a high risk. This, in turn, leads to a serious shortage of construction workers. The result of 42% of the general surveys conducted is that construction workers consider their health and safety as a priority[2].

According to the studies and investigations conducted by the International Labor Organization, it has been determined that the number of accidents resulting in death worldwide is 4 times higher in the construction sector than in other sectors. On average, the number of deaths in the construction site is 108,000 people. This leads to a decrease in quality in the construction area[2].

The USA believes that the introduction of robots can make construction safer.

- Transportation of large and heavy loads

- Working in dangerous places

- Implementation of new, safer methods in construction

Applying robots to monotonous, repetitive and dangerous tasks is important both from the point of view of quality and safety.

Taking into account the changing climatic conditions, the importance of applying robots in the construction field is obvious. So, it is very important to use robots in areas where the weather is extremely variable. Companies that support the development of robotics are also working to eliminate the problem of labor shortage[2].

What are the implications of robots for the future?- The use of robots in the construction assiduity is growing fleetly, and this brings a number of consequences that need to be considered. Construction robots have the eventuality to revise the assiduity with possible counteraccusations for labor, design costs and safety[2].

The use of construction robots can have a major impact on labor vacuity in the assiduity, as robots can be used to reduce the need for homemade labor. This could lead to a reduction in being construction jobs or the need to retrain being construction workers for further technical places to alleviate the impact of robotics[3].

In addition, the use of construction robots can lead to significant cost reductions for systems. Robots offer the eventuality for more effective construction systems, which can reduce labor costs, and perfection can also lead to reduced material destruction. This can affect in huge savings for the construction assiduity and its guests[3].

Eventually, the use of robots can also have a major impact on security. Robots can work in surroundings that may be too dangerous or delicate for humans, similar as working at heights or in dangerous areas. This can reduce accidents and injuries on construction spots, making construction safer and more seductive.

The impact of construction robots is huge and the possibilities for the future of the assiduity are instigative. Construction robots can have a major impact on the assiduity, and these impacts must be considered to insure the assiduity is well set for the future[3].

3.Conclusion

Today, robotics are available in almost all fields, such as healthcare, military, construction, etc. Although the development and integration of robotics into other fields gives the impression that there will be no need for workers, this is not the case. For example, today, the development of robotics and its integration into the construction field have a direct impact on the quality of construction. In ancient times, it took a lot of time to build large structures like the Egyptian pyramids, but now, with the development of robotics, this time can be saved. At the same time, the security measures created during construction disappear. Such advances in robotics are accelerating the development of the construction industry. At present, there are robots in the construction field, such as bricklaying robots, carpenter robots, roofing robots, etc., which replace human labor and at the same time require human intervention, which, in turn, ensure the development of the construction field.

Since robots are widely used in welding and drilling, they have eased human labor in the construction sector. Integrating robots into these areas eliminates the need for manual labor in welding and drilling operations. This helps reduce the potential for human error and increases the accuracy of welds and fasteners.

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Evaluation of the ecological situation in the liberated territories of Azerbaijan

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Abstract: As a result of the 44-day victory march, the Azerbaijani Army saved our historical and cultural heritage from Armenian vandals by liberating our territories occupied for nearly 30 years. Restoring the territories freed from occupation after the Patriotic War, improving the ecological situation and environmental conditions is one of the priority issues facing Azerbaijan at the moment. Regarding the elimination of environmental damage and pollution as a result of the conflict, the government of Azerbaijan has announced plans to implement a comprehensive restoration process in the affected areas. This includes ecosystem restoration, cleanup of hazardous waste and pollutants, and implementation of sustainable development projects. The government also established a task force to oversee the process and sought international support and expertise for the initiative. One of the issues that should be addressed in this direction is the elimination of environmental damage in these areas, and solving the problem of pollution as a result of metal and processing industry waste.
Keywords: liberated territories, pollution, environment, ecology, Azerbaijan.

1. İntroduction

In recent times, the Azerbaijani government has implemented a socio-economic development strategy aimed at creating favorable conditions for solving environmental problems and implementing effective measures for environmental protection. This approach has been inspired by the unique political leadership style of the late Great Leader and National Leader Heydar Aliyev, who prioritized the protection of nature and stood against those who disregarded the environment.

The legacy of Heydar Aliyev has been carried forward by President Ilham Aliyev, who has made environmental protection a priority in Azerbaijan. Along with the First Lady of Azerbaijan, Mehriban Aliyeva, who also serves as the Vice President of the Republic, Goodwill Ambassador of UNESCO and ISESCO, the President has initiated and supported several projects aimed at addressing environmental problems in the country.

Through these efforts, there is hope that Azerbaijan will soon be able to eliminate environmental issues and create a sustainable future for its citizens. The commitment of the government to prioritize the environment demonstrates its dedication to the well-being of the people and the planet.

The government of Azerbaijan has launched several initiatives aimed at promoting environmental sustainability and optimizing the use of natural resources. One of these is the State Program of Socio-Economic Development of the Regions of the Republic of Azerbaijan, which outlines the country's strategic priorities for 2019-2023. This program includes various measures to improve the quality of life in rural areas, promote entrepreneurship and innovation, and strengthen regional infrastructure, while minimizing negative environmental impacts and preserving natural heritage.

Another key initiative is the Action Plan for Ensuring Efficient Use of Water Resources, which covers the period from 2020 to 2022. This plan aims to increase the efficiency of water use in different sectors, including agriculture, industry, and households, through the adoption of best practices and innovative technologies. The plan also seeks to enhance water governance, monitoring, and regulation, and to promote public awareness and participation in water management.

In addition, Azerbaijan has implemented a State Program for 2020-2024 on the study and efficient use of the mineral-raw material base, which focuses on the exploration, extraction, processing, and utilization of various mineral resources, including oil, gas, metals and non-metallic minerals. This program aims to enhance the competitiveness of Azerbaijan's mining industry, promote sustainable development, and ensure social and environmental responsibility in mining operations. The program also includes measures to strengthen geological subsurface research, mapping, and monitoring, and to improve the legal and institutional framework for mining activities.

The government of Azerbaijan is actively working towards improving the environmental situation in the country. To this end, several initiatives have been taken, including the "State Program for the protection and sustainable development of forests in the Republic of Azerbaijan for 2022-2030" and the "National Strategy for the efficient use of water resources."

Efforts are also being made to enhance the legal framework governing environmental protection in Azerbaijan. The ultimate objective is to create a natural ecological environment that allows citizens to exercise their right to a healthy life and to promote the efficient use of natural resources.

The government aims to address the existing environmental challenges in the country and protect environmental components as part of its 2025 strategic vision. The ultimate goal is to create a sustainable and healthy environment for all citizens of Azerbaijan.

Improving the natural environment and utilizing resources effectively to enhance people's well-being is a crucial aspect of social reforms in our country. The government's consistent attention to environmental concerns has encouraged efforts to enhance the environment, and successful large-scale projects have been executed and are ongoing. The Year of Ecology, declared by President Ilham Aliyev in 2010, has presented significant responsibilities to citizens, state organizations, non-governmental organizations, law enforcement agencies, and media regarding addressing environmental issues.

Over the past century, human activity has had an increasingly detrimental impact on the environment, leading to the overexploitation of natural resources and environmental degradation. In response, our country developed a new environmental policy after gaining independence and transitioning to a market economy. This policy focuses on three main areas: implementing sustainable development practices to minimize pollution and protect the environment, effectively managing natural resources to meet the needs of current and future generations, and addressing global environmental issues through national and international cooperation.

To achieve these goals, several initiatives have been established to improve the ecological situation in our country. These include preventing water pollution, protecting biodiversity, increasing green spaces, protecting air quality, preventing soil degradation, including the remediation of soil contaminated with oil and other pollutants, improving the management of industrial and domestic waste, and properly disposing of hazardous waste.

It is essential to note that the country recognizes the importance of balancing economic development with environmental protection. Therefore, the government is implementing policies to promote sustainable development practices that ensure economic growth while minimizing environmental damage. This involves using non-exhaustible energy sources through alternative and non-traditional methods to achieve energy efficiency.

Furthermore, the government is committed to assessing national needs and collaborating with international organizations to address global environmental issues. By leveraging national resources and opportunities, the country can contribute to global efforts to mitigate climate change, reduce pollution, and protect the environment.

The Republic of Azerbaijan has made significant strides in addressing environmental issues and has integrated environmental protection into its long-term development strategy. The government's environmental policy aims to protect ecosystems, promote sustainable development, and minimize harmful impacts on the environment.

2. Experimental details

The rivers flowing through Azerbaijan have their origins in neighboring Armenia and Karabakh, and unfortunately, they have become contaminated by waste from various sources. The pollution has been so severe and long-term that the Araz River, in particular, has seen a decline in its valuable fish species.

However, Azerbaijan has faced challenges in meeting its international obligations regarding the previously occupied territories that it has only recently regained control over after almost three decades. This lack of control has made it difficult for Azerbaijan to address issues related to transboundary water management in line with international norms.

Unfortunately, Armenia's decision not to join the UN Convention "On the Protection and Use of Transboundary Water Streams and International Lakes" has only exacerbated the situation.

The previously occupied territories of Azerbaijan are home to an extensive ecological network, including 6426 km of irrigation channels, 185 km of collector and drainage channels, 1429 artesian wells, 539 hydrotechnical construction facilities, 220 hydroelectric power stations, 88 pumping stations, and 8 water reservoirs with a total volume of 640 million m3. This network has been developed over many years to support agriculture, energy production, and other essential activities in the region. However, the use and maintenance of this ecological network were disrupted when the territories were occupied. The consequences of this disruption have been significant, impacting both the environment and the people who rely on these resources. In recent years, efforts have been made to restore and rehabilitate the ecological network in these areas, with the aim of mitigating these impacts and promoting sustainable development.[1, s.1]

There are several water reservoirs located in areas that were previously occupied by Armenians, including the Sarsang reservoir situated on the Tartar River. The Sarsang reservoir, with a capacity of 500 million cubic meters, was intended to irrigate 100,000 hectares of agricultural land in the Lower Karabakh region. However, due to long-term neglect and lack of maintenance, the reservoir is currently in a state of disrepair, which poses a serious threat to the approximately 400,000 residents living in the foothills and central Aran areas of the region. The Azerbaijani government has expressed concern that the Sarsang reservoir could cause a humanitarian, ecological, and man-made disaster.

In August 2020, Araik Arutyunyan, the leader of the self-declared regime in the occupied territories of Azerbaijan, announced a program to expand the irrigated areas and increase agricultural production in the unrecognized "NK" territory. Arutyunyan described the self-governance system in the occupied territories as "the project of the century." However, the international community does not recognize the self-declared regime or its activities in the area.

It is essential to address the concerns about the deteriorating condition of the Sarsang reservoir as it poses a significant risk to the population living downstream. Proper maintenance and repair work are required to prevent a potential humanitarian and environmental catastrophe.

On August 28, 2020, the flow of the Incesu river was obstructed by the Armenian side. The river originates in Armenia and flows through Azerbaijan's Gazakh region, but its closure has resulted in a significant decrease in water resources for the bordering village of Kamarli and has caused difficulties in irrigating local farmland. It is believed that the Armenian side intentionally closed the river, and this action has had negative consequences for the affected Azerbaijani community.

On September 27, a counterattack by the Azerbaijani Army resulted in the liberation of the village of Sugovushan and the reopening of the Sugovushan reservoir, which had been under occupation. This development is a significant step towards the provision of water to low-lying areas of Azerbaijan and restoring ecological balance.

A meeting of the Working Group on Environmental Issues was held at the Coordination Headquarters in Azerbaijan. The meeting was attended by representatives of various state institutions, members of the President's special delegations for Karabakh and East Zangezur economic regions. The purpose of the meeting was to discuss the environmental situation in the liberated regions and evaluate the monitoring conducted in these areas.

At the meeting, the participants were informed about biomonitoring, ecosystem restoration and water quality improvement measures carried out in order to prevent transboundary pollution in Okchuchay. The group also discussed proposals for solving environmental problems in the region.

It should be noted that the monitoring conducted in the regions freed from occupation is vital for assessing the damage caused to the environment as a result of the occupation and for taking appropriate measures to restore the natural balance. The efforts of the working group in this regard will not only benefit the people of Azerbaijan, but will also contribute to global efforts to protect the environment.

Azerbaijan's Minister of Ecology and Natural Resources, Mukhtar Babayev, has revealed that the government is working on a plan to restore the ecological health of the Okchuchay water basin. Babayev stated that the area has been subject to ongoing environmental damage, which has led to significant pollution. International laboratory monitoring has identified that the levels of heavy metals and other pollutants in Okchuchay exceed acceptable limits by a significant margin. Babayev has confirmed that the government has approached several international organizations and relevant institutions to address the issue. A Working Group has been established, including representatives from the Azerbaijan National Academy of Sciences and other relevant institutions, to analyze the monitoring results and develop proposals for the restoration of the Okchuchay water basin.[2]

Okchuchay is a river located near the border of Armenia and Azerbaijan. Recent monitoring conducted on the river has revealed serious changes in the water's color and a strong odor. Further analysis of water samples from a monitoring point confirmed an increase in the concentration of iron, manganese, molybdenum, ammonium, and sulfates in the water, indicating increased pollution levels.

The automatic hydrological stations installed in Okchuchay, including the transboundary rivers, also confirmed the increase in pollution. As a result of continuous pollution from the Western Zangezur territory, appeals have been made to international organizations to inform them about the ecological crisis and critical condition of the river and its ecosystem.

Despite calls and appeals made to the German "Cronimet" Holding company, a shareholder of the "Qajaran copper molybdenum" plant in Armenia, one of the main sources of pollution, no practical measures have been taken to address the issue, and the pollution continues today. It is essential that immediate action is taken to prevent further pollution and to restore the river's ecosystem to its natural state.

Ecological restoration has the potential to bring about a resurgence of nature in territories that have been freed from occupation, and we believe that its implementation is vital within the framework of the Great Return initiative.

Through ecological restoration, damaged ecosystems can be revitalized and restored to their natural state, allowing for the re-establishment of wildlife and biodiversity. This process involves careful planning, monitoring, and implementation of various techniques, such as soil regeneration, reforestation, and water management. It is a long-term process, but one that can have a significant impact on the health and resilience of ecosystems.

Azerbaijan's commitment to sustainable development has been highlighted by the Advisor to the Minister of Ecology and Natural Resources, Rasim Sattarzadeh. He emphasized that the country's economic growth in the coming years will be based on policies that prioritize environmental factors. The government has placed ecological considerations at the forefront of recent strategic documents, with the

aim of improving the country's environmental situation and ensuring ecological security amidst rapid economic development. Azerbaijan's natural resources are diverse and valuable, and the state has made their protection and effective management a priority. In the "Azerbaijan 2030: National Priorities for Socio-Economic Development" document approved by the President, responding to global climate change and providing a high-quality environment for a healthy population are key goals for the country's next stage of development. The "Socio-economic Development Strategy of the Republic of Azerbaijan in 2022-2026", which was approved in July of this year, reflects the government's commitment to a clean environment and green growth. The strategy includes activities aimed at improving environmental quality and maximizing the efficient use of natural resources.[7]

In recent years, Armenia's furniture industry and export indicators in this field have seen an increase. This trend has raised concerns that it may be related to the utilization of forest resources in Karabakh, where valuable tree species grow.

The flora in the liberated areas is facing a critical situation with many species of trees and shrubs on the brink of extinction. Some of the endangered species include the pistachio, medicinal styrax, Araz oak, walnut, Oriental sycamore, common pomegranate, forest grape, pyrkal, boxwood, Eldar pine, common date, willow pear, and many others. In total, the region is home to over 460 wild and shrubby plants, 70 of which are unique to the area and cannot be found anywhere else in the world.

It is essential to address the plight of these endangered species as they play a vital role in the ecosystem, providing food and shelter for various animals and insects. Additionally, some of these plants have medicinal properties that have been used for centuries to treat various ailments.

The liberated territories of Azerbaijan comprise of several nature reserves, including the Basitchay and Karagöl reserves, Lachin, Gubadli, Arazboyu, and Dashalti reserves, covering an area of approximately 43,000 hectares. These reserves were established to safeguard the diverse flora and fauna found in the region, many of which were listed in the "Red Book of the Republic of Azerbaijan." Unfortunately, during the occupation, much of the wildlife in these reserves was destroyed, causing irreversible damage to the region's ecology.[4]

Arzu Samadova, head of the Biological Diversity Protection Service of the Ministry of Ecology and Natural Resources, said that work is being continued to restore the biodiversity of the recently liberated territories of Azerbaijan. Samadova said that there are about 43,000 hectares of specially protected natural areas in these regions, including two state reserves.[6]

During the nearly 30-year occupation, Armenian armed forces often deliberately set fires in Azerbaijan's territories known as "security zones", as a result of which land and forests were destroyed. This activity caused concern among international organizations as early as 2000.

In the resolution adopted by the UN General Assembly on September 7, 2006, it addressed the situation in the occupied territories of Azerbaijan and authorized the OSCE mission to assess the impact of the fires on the environment. After a 10-day assessment, the mission reported significant environmental and economic damage caused by the fires, as well as threats to human health and safety. The assessment found that the scale of the burned areas is extensive and the impacts on the economy, environment and local people are significant.

In the report, it is estimated that more than 110 thousand hectares of territory were destroyed as a result of deliberate fires in previously occupied territories. These fires not only destroyed vegetation, but also destroyed all living organisms and topsoil, including grasses and shrubs.

During the Patriotic War, the environment in Azerbaijan was heavily impacted. According to a report by the Ministry of Emergency Situations on October 30, the regions of Goygol and Goranboy were subjected to heavy artillery fire, which led to a forest fire in the area. This ecological disaster was a cause for concern as it posed a threat to the surrounding flora and fauna.

There have been reports from Azerbaijani officials and state structures alleging that the Armenian armed forces utilized shells containing white phosphorus. This type of weapon is known to cause severe burns and can also result in toxic poisoning. Furthermore, the use of white phosphorus can spark uncontrollable fires that are challenging to put out, making it a highly hazardous form of ammunition when employed in combat situations.

For a long time, Karabakh remained under the occupation of Armenia and became the center of illegal activities. This has resulted in the emergence of a thriving "grey market" controlled by Armenia's state-owned companies and influential multinational corporations. The main sectors involved in these activities were mining.

Azerbaijan's occupied territory is rich in natural resources, including precious metals, with over 160 deposits found in the region. Among them are 5 gold deposits, 7 mercury deposits, 2 copper deposits, and 1 lead and zinc deposit. There is also a hard coal deposit, 6 alabaster deposits, 4 vermiculite deposits, and 1 raw material suitable for soda production.[5, s.36]

The natural resources located in the occupied territories of Azerbaijan were crucial for the country's economic potential. Unfortunately, these resources were systematically plundered and exported abroad by Armenian forces during the long years of occupation. As a result, Azerbaijan was unable to conduct any geological research in these lands or

benefit from the rich mineral and raw material base that they offered. The situation has created significant economic challenges for Azerbaijan, which must now work to rebuild and develop the infrastructure and industries in these areas.

Until 2002, Armenia's gold production did not exceed 2 tons per year. in 2003, an additional 2 tons of gold were produced from the "Söyudlu" deposit, and in 2004, another 2.5 tons of gold were produced. Unfortunately, the mining industry often creates hazardous waste pools that require special treatment. According to the report, as of 2016, there are millions of tons of waste filled with dangerous heavy metals and other substances in the waste pools located in the territory of Karabakh. In particular, near the village of Heyveli (known as "Drmbon" among Armenians), three waste dumps were located in an ore deposit that posed a serious threat to the environment and public health.[3]

There are concerns regarding the proximity of certain tailings ponds to important water reservoirs. For instance, the Sarsang reservoir is located near the tailings ponds of the Kyzylbulaq mine. The gold mine's waste pool, situated in the previously occupied Zangilan district, near the village of Vejnali, is adjacent to the Beshitchay State Reserve. Over the course of 11 years of operation of the Kyzylbulag mine and the mountain-concentration combine in Heyvali village, approximately 4 million tons of waste were accumulated in two waste pools. The mining exploration process resulted in the destruction of 20-30 hectares of forest area.

In 2013, Base Metals began operating the Kashen copper-molybdenum mine near Aghdara after other copper deposits in the Karabakh region were depleted. Prior to this, the company had worked on a gold and copper mine in Heyvali village, also known as Drmbon, which had been almost completely depleted over a 10-year period.

Base Metals faced controversy when it was discovered that the company was in violation of environmental protection laws, leading to protests and the suspension of financing from a foreign lender. In 2017, the State Credit Agency of Denmark accused the company of failing to adhere to environmental standards and withdrew its guarantee for export loans provided to the mine operators in the Texut field.

The State Credit Agency of Denmark cited several issues as reasons for cancelling the loan for the Texut mine. These included concerns about water pollution in the production area, the seismic stability of the mine's tailings pool, and poor working conditions.

3. Conclusion

Unfortunately, the long-term occupation of Karabakh and its surrounding regions has had a devastating impact on the environment. The occupation has resulted in damage to the biological diversity of the area, including the flora and fauna, and has caused significant harm to the specially protected natural areas. The occupation has also led to the burning of vast areas, the pollution of water resources, and the deliberate deprivation of water to the local population. Additionally, valuable tree species and forests have been looted, and the ecological balance has been severely disrupted due to the exploitation of natural resources.

In response to these challenges, the government of Azerbaijan has implemented large-scale initiatives to address environmental issues and restore the affected areas. These initiatives include the rehabilitation of damaged ecosystems, the protection of biodiversity, and the promotion of sustainable resource management practices. The government is also working to raise awareness among the local population about the importance of environmental protection and to promote environmental education at all levels.

Despite these efforts, much work remains to be done to fully address the environmental challenges facing Azerbaijan. The government must continue to prioritize environmental protection and work closely with local communities and international organizations to implement effective solutions.

In order to restore the territories that have been liberated from occupation, our country is committed to conducting a thorough investigation of the current state of the environment and natural resources in these areas. Our priority is to implement programs for the restoration of ecosystems that have been destroyed due to deforestation, burning, and other forms of ecological degradation. We also aim to reintegrate these restored natural resources into the economy in a sustainable way.

We are committed to working closely with experts and stakeholders to ensure that our efforts to restore the environment are effective and sustainable. We will also prioritize the protection of biodiversity and the promotion of eco-friendly practices in the region.

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Benefits of Quality Control in Construction. Quality control methods

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Abstract: Quality control in construction generally involves assuring compliance with minimal morals of material and workmanship in order to ensure the performance of the installation according to the design. Quality assurance and control has been established by experimenters to give guidance for establishing an applicable quality operation procedure, in order to lower cost, increase productivity and client's satisfaction, as well as request share in construction. This can help construction assiduity to achieve successfully, their objects, and insure that all phases of construction systems constantly meet customer's conditions. principally, the ideal of the study is to assess the position of quality assurance and control in construction through compliance evaluation and assessing the benefits and factors of enforcing quality assurance and control on construction systems in Abuja and Environs. The exploration methodology espoused was an in- depth literature review and questionnaire administration while the data collected were subordinated to descriptive statistical analysis through the operation of chance, frequence, mean and score. The findings have shown that construction establishment's adherence and compliance to International Standard Organisation series is low. The benefits of espousing Quality assurance and control are to ameliorate point operation, enhance character for good design and proper effective planning. It also stressed factors affecting quality assurance and control perpetration to be inharmonious extending procedure, design complexity, poor performance of quality and low tendency for platoon work. Eventually, the measures for perfecting quality standard are enforcement of quality standard by agency of government and nonsupervisory bodies and provision of training service on quality assurance. The study also recommends that all stakeholders need to understand the significance of quality assurance and control norms and also inculcate them throughout the design productive phase of their systems.
Keywords: Quality control, Quality Assurance, Statistical Process Control (SPC), Quality in construction

1.İntroduction

Quality control is important in the construction assiduity. The tools, outfit and mechanisms used in the field shouldn't only meet strict criteria in terms of quality and norms and should be suitable for their purpose. But it's inversely important to insure that they're duly maintained throughout the design.

Fortunately, there are several ways you can insure figure quality control. In this short composition, you will learn about the significance of quality control in the construction sedulity and its swish practices. What's Quality Control in Construction? – It's important to understand the significance of quality control in construction and what it entails. Because quality construction isn't limited only to construction companies. This applies to their trading mates and other stakeholders in the construction force chain. This includes checking the quality of work done by construction contractors, suppliers and subcontractors- indeed down to importing ministry, accoutrements and outfit used on point.

Construction quality control can be divided into two broad orders quality assurance and quality compliance. therefore, quality assurance focuses on the quality of the product or service, and quality compliance construction meets current legal or nonsupervisory conditions.

But what's total quality control? How is it done?- There's simply no periphery for error when it comes to setting effects up. Every piece of outfit used must be checked for quality and functionality so that it can perform its part effectively. And this is where quality control procedures can help.

Quality control procedures are the way a construction company takes to insure quality in its work. These procedures are important because they help ameliorate structure quality and reduce pitfalls [1].

Companies can achieve quality control operation in construction by using

-International Organization for Standardization ISO 9001 – A set of norms created by ISO to guide how companies should manage their quality operation process and meet the requirements of guests and other stakeholders.

- Kaizen- Kaizen is a gospel and process used in the business world to concentrate on small, nonstop advancements that lead to dramatic change over time. It's a noway ending process.

- Six Sigma- a set of styles for assaying and perfecting processes. It focuses on barring blights in any process by relating, measuring and barring the variables that beget variability in the process.

- Construction Quality Control Plan – A document that outlines the way to be followed during construction. It includes the objects, procedures, timelines and liabilities of all parties involved.

What are the problems that may arise during general quality control in construction? – Quality control issues in construction can be divided into three broad orders.

1.Structure or structural quality issues – The first order is related to the design of the structure or structure. These problems are frequently due to structural engineering and design crimes, similar as inaptly designed placement, poor material selection during construction, and shy design.

2.Quality problems with construction accoutrements - The alternate order is related to construction accoutrements and processes. This includes poor material selection, poor manufacturing controls, and indecorous assembly of factors.

3.Poor workmanship in the construction assiduity- The construction assiduity has had a problem with poor workmanship since its commencement, and these problems should noway be taken smoothly. Lack of quality control sweats in construction can lead to expensive blights, including erosion, earth, plumbing problems, and indeed injuries, death, and structural damage to the structure or point[1].

Some of the problems associated with structure accoutrements include.

-İnordinate consumption of these accoutrements and generation of waste in the product process.

-Lack of quality control in their manufacturing process results in low quality accoutrements.

-Lack of force chain translucency, including subcontractor mismanagement and supplier/ seller failures.

- Non-standard accoutrements don't meet original or transnational construction product regulations or norms.

What's the reason that makes quality important and important in construction? – Construction quality operation is important because it's a largely regulated assiduity. It also helps insure that the structure is completed safely, functionally and on time within budget.

The main advantages of quality control in construction are as follows.

- Help reduce pitfalls, especially in relation to the threat of damage or accidents.

- İnsure the design stays on schedule and within budget.

- İnsure that the structure is fit for purpose and meets the norms set by the customer and nonsupervisory authorities.

The process of quality control in construction consists of a series of examinations carried out throughout the construction process. But it all thresholds at the veritably morning of the construction design. Before starting a construction design, all accoutrements and outfit must be fit for purpose and meet all applicable norms and conditions. One way to reduce the threat of imperfect material or outfit is to check the goods before they're packed to you. This can be done using 4 types of quality control styles which include

- Pre-production examination- Identify quality pitfalls before the product process begins.

- During product examination- Review of product line problems while product is in progres.

- Pre-Shipment examination- Checking the volume and quality of goods before they're packed to you.

- Container Loading, Unloading Control – Ensure products are loaded and disburdened rightly to avoid expensive mishandling of goods.

2.Experimental details

Construction Industry norms are supported by NQA. The construction assiduity is different and includes contractors, subcontractors, engineers, masterminds, contrivers, suppliers, and other professionals in the private, public, and military sectors. Depending on the nature of your association, any of several norms may be applicable, including.

- ISO 9001 the transnational standard for quality operation- is one of the most extensively used ISO systems in the world.

- ISO 14001- transnational standard for environmental operation systems.

- ISO 50001 the transnational standard for energy operation systems and ESOS, a obligatory energy assessment scheme for large associations grounded in Great Britain.

- ISO 45001 is an transnational standard for health and safety operation that replaces the old OHSAS 18001 system.

- SSIP- Safety in Procurement Schemes is a collective recognition scheme for occupational health and safety norms, particularly within construction.

- ISO 44001- transnational standard for cooperative work.

It's important to note that although quality is reflected in the final product, to be effective, it must also be applied at each different stage of product, which uses the following norms.

ISO 9001:2015-These are transnational norms developed by the International Organization for Standardization(ISO) and they apply to Quality Management Systems, which are a set of guidelines that a company freely implements during the product process. These are general norms that can be directed and customized for each company and demonstrate the company's will to achieve optimal quality and nonstop enhancement through conduct and processes grounded on well- defined strategies aimed at achieving defined and specific pretensions[1].

Specialized Compliance Document(DIT) This is a document that companies may bear to demonstrate a favorable specialized assessment of the felicity of workshop for either structure or construction work in terms of accoutrements , styles or construction systems. This document is issued at the company's request by the Eduardo Torroja Institute of Construction lores(IETcc), the only body authorized to issue it in Spain.

European Technical Assessment(ETA)- European Technical Assessment(ETA), officially European Specialized blessing, is a harmonized European standard, making it valid for all EU countries. Its objects are as follows:
- furnishing performance evaluation information on the main characteristics of the construction product.
- furnishing the necessary specialized details for the perpetration of the Performance durability Assessment and Verification (AVCP) system.
Benefits of instrument for the Construction Industry- ISO has designed each of the below norms to be astronomically applicable to any association anyhow of assiduity. Each has a unremarkable set of processes and marks to cover performance and initiate a cycle of nonstop enhancement. While every association is different, there are several enterprises universal to the construction assiduity that standardization can help with. These include:

Injury Prevention – According to International Labor Organization(ILO) estimates,2.78 million workers die each time as a result of artificial accidents or occupational conditions. In addition, 374 millionnon-fatal work- related injuries and ails add to the profitable and mortal costs of shy health and safety operation. ISO 45001 is one of the most important norms for the construction assiduity as it provides a visionary frame for precluding and responding to health and safety incidents.

Effectiveness and delicacy- ISO norms can help construction companies run a profitable business and deliver on their pledges to guests. ISO 9001 increases pungency; translucency and internal communication help you win business without compromising the quality of work you complete. Most importantly, it provides a high- position frame to insure other enterprises — health and safety, energy use, and asset operation — are aligned with your broader business pretensions.

Regulatory Compliance As regulations on energy use and green structure come more strict, both government agencies and private companies will seek mates with demonstrated credentials in these areas. ISO norms similar as ISO 14001 and ISO 50001 are honored and accepted around the world – they offer an effective way for contractors to meet compliance conditions and grow their business in new areas and homes.[1]

What are the main factors causing quality problems in construction? What is the root cause of these problems?

1. Low- quality outfit

The type of outfit used must be of high quality to produce a safe and durable structure. analogous outfit lasts longer and leaves no room for any damage. On the other hand, poor construction installations produce problems similar as leaks, concrete cracks, unanticipated falling ceilings and unacceptable structures. Aahing drain pipes produce poisonous soil in structures. There are common manufacturing issues that affect low- end tackle. Some of these problems are inferior drywall and deteriorating flash[2].

2. Lack of proper control of the workshop by the contractor

As the contractor, it's your job to insure that everything is done according to the design's overall quality plan. The contractor ensures that the design is completed on time and that coffers aren't wasted. Through constant monitoring, the contractor ensures the quality of the design and safety against any construction blights[2].

Still, builders can intentionally face a sign of disaster staying to be, If proper controls are lacking or absent. The contractor should be there to descry any blights in the future. They need to know how each material fits into the design.

3. There's no quality system

The worst source of blights is occasionally the absence of a managed quality system in a design or indeed a commercial association. The lack of a system can lead to possible losses of the design's fiscal inflow. An illustration of this is the" handover of concrete to the point", if the concrete brought to the point doesn't conform to the design, if it'll be checked by anon-authorized hand of the quality department, the concrete can be poured into the foundation. blend for the base. thus, there must be a system for delivering concrete to the point and examining it in the same way as other structure accoutrements. And this should be done by a competent quality director or case director[2].

4. Weak or absent quality procedures

For any construction design to serve duly, certain procedures are needed to be proved under ISO 9001 norms. These procedures give a way to insure that all details of the construction work are carried out. There's a long, noway - ending list of procedures that a construction company must validate. serve it to mention a many; inspection, purchase, blessing of accoutrements , control of reports and documents,etc. in any construction work. must have procedures. Having quality procedures in place creates better quality operation systems that help construction blights.

5. Design complexity

masterminds and formulators can develop complex designs. It takes time to understand a complex design, and with analogous designs, installation is more delicate. In trying to understand the complex nature of the design, you can miss important little details like structure supports. A structure without strong columns for support can develop cracks, which can beget the structure to collapse.

A complex design can take some time to complete, only half of which is returned to the design for better understanding. Complex designs add complexity to construction work that only a inventor can interpret. No matter how complex the design is, it should be easy to understand.

All these sources of unhappiness in construction result in a loss of coffers, haves and after them try to fix the pests[2].

3.Conclusion

We all know the significance of quality in construction. Quality control procedures in construction not only minimize the pitfalls of detention. But it also ensures that the design meets their conditions and prospects. One common quality control system in construction is the examination of accoutrements and outfit used in a construction design.

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The Benefits of Zero Waste

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Abstract: "Zero waste" is an approach that minimizes the generation of waste and avoids the reuse, recycling and disposal of waste as much as possible. This approach helps conserve natural resources, reduce waste, reduce greenhouse gas emissions, and provide economic benefits.Zero waste requires that waste be managed close to the source. This means separating materials for recycling, reuse or energy production. It also requires changing consumer behavior and consumption habits. A zero-waste approach is one of the cornerstones of a sustainable future and will be very beneficial for people and our planet.

Keywords: zero waste, greenhouse gases, disposal, waste reductio.

1.Introduction

It is a waste prevention system that aims at prevention of wastage, correct and efficient use of resources, reduction of generated waste, establishment of proper collection and sorting system and recycling of waste.

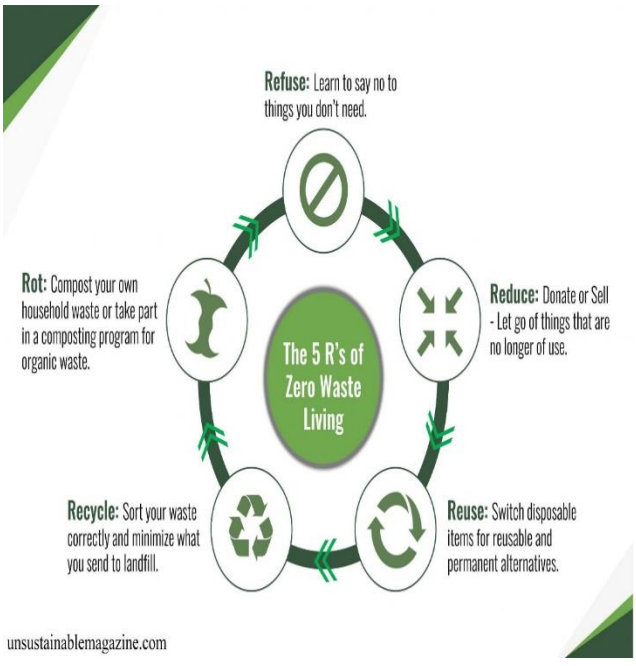
Here, in addition to the state, each enterprise signs a contract with waste processing enterprises. Special types of waste containers are placed on each floor in 2 or 3 number intervals depending on the size of the floor. It was first used in Japan in the 70s. As a result, general waste containers were canceled in offices and special sorting containers were placed. This applies not only to offices but also to residential areas and even homes.

The implementation of zero waste simplifies the sorting process and at the same time helps the waste to speak more easily. Special waste collection places are created and education is carried out. Interest is created for citizens. This interest is often material. For example, for each plastic water container delivered, an amount of around 1 cent is given.

In Turkey, this issue is carried out under the leadership of the Ministry of Environment. Almost 80% of companies in the public and private sector are implementing it. In July and December, it is declared to the legislation.org system. At this time, monitoring is also carried out in parallel. Fines are also available for non-compliance. These fines are based on the administrative and criminal code.

In Germany, there is even a special sorting line for radioactive waste. Thus, as part of the zero waste project, batteries or other radioactive materials, electronic devices are thrown into specially designated containers and sorted from there.

The Zero Waste system is one of the reforms implemented after the Green Day revolution in Japan, Germany and the Netherlands in the 70s. It has not yet been implemented in our country. However, certain works have been carried out in that direction.



2.Experimental details

The Zero Waste system is implemented in 7 stages:

1. The initial stage where goals are set and teams and systems are established. At this stage, the Preliminary review is carried out. Inspection and inspection is carried out at the enterprises where the system will be applied and the teams that will implement the process.

2. Perception of the current situation. Here, the general situation and conditions are analyzed in a realistic manner and the first step is clarified.

3. Planning. At this stage, the positive and negative aspects of the initial step and the overall process, harm and benefits (these may be economic) are calculated and a general road map is established. It is absolutely necessary to stick to this plan.

4. Need and reason. Here, "why should we do this?" the question is answered. Detailed and detailed answers to this question are prepared (there must be statistical data). These answers are fully communicated to the team that will be doing the work so that they can clearly and thoroughly answer the questions that person X is 99% likely to ask during the same education process.

5. Awareness. At this stage, a team of pre-prepared specialists communicates with people and educates them about the Zero Waste system. Here, education should be done in detail and correctly, all laws, rules and obscure points should be clearly explained.

6. Implementation of the process. Here the process is implemented and the system starts to do its work. Zero Waste System is currently implemented in all developed countries of the world.

7. Evaluation (Evaluation). This is the last stage. The work done at this stage is evaluated and this process continues regularly. Problems that have arisen are analyzed and new methods are tested to make the system more effective.

Sorting takes the most important place in the Zero Waste system. For example, the sorting in Turkey is as follows:

This in itself is one of the main criteria and foundations of the Zero Waste system. At the same time, according to the statistics of 2019, an economic profit of 20 billion TL was achieved.

Even if the implementation of the Zero Waste system is not fully implemented in our country, recycling of solid waste is carried out. It is part of the Zero Waste system.

The benefits of achieving zero pollution are many and wide. Some of the main advantages are:

Improved public health: Zero pollution means cleaner air, water and land, which reduces respiratory diseases, cancer and other health problems caused by exposure to pollutants.

Enhanced Biodiversity: Pollution has devastating effects on plant and animal life, which can lead to the loss of entire ecosystems. Eliminating pollution helps preserve and protect biodiversity, which is essential for maintaining a healthy planet.

Increased economic opportunities: The transition to a zero-pollution economy requires investments in clean energy, green technologies and sustainable infrastructure. This creates new job opportunities, spurs innovation and spurs economic growth.

Improved quality of life: Zero pollution means living in a cleaner, healthier and more sustainable environment, which can lead to increased happiness, productivity and overall well-being.

Reduced greenhouse gas emissions: Many forms of pollution, such as carbon dioxide emissions from fossil fuels, contribute to climate change. By eliminating pollution, we can significantly reduce our carbon footprint and reduce the effects of climate change.

3.Conclusion

Based on world practice, we can easily say that by using the Zero Waste system, we both prevent waste and at the same time help protect the ecological balance. Overall, achieving zero pollution is essential to protecting the health and well-being of people and the planet, and it improves our quality of life and offers numerous benefits that can create a more sustainable future.

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Study of specıfic characterıstıcs of dıversıty dynamıcs of forest-plant bıogeocenoses of Lankaran regıon

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Abstract: The study of the characteristic features of the multi-year dynamics of the forest-plant biogeocenoses of the Lankaran region helps to understand in detail the changes and developments in the forest ecosystems of this area. This research allows to analyze the health and stability of ecosystems and to determine how the existing natural forces affect the region. The following stages are prominent for studying the characteristic features of the multi-year dynamics of forest-plant biogeocenoses: Some of the characteristic features of the perennial dynamics of forest-plant biogeocenoses are listed below: Plant diversity, Changes in plant penetration, Water supply and soil composition, Biodiversity changes, Human impact, Global changes and conservation measures.

The above-mentioned are the general steps taken to study the characteristic features of perennial dynamics of forest-plant biogeocenoses of Lankaran region. This study is an important step in providing detailed information on ecosystem conservation, natural forces and human impact on the region. However, it is recommended to use experts and field workers to conduct detailed and advanced research.

Keywords: plant biogeocenoses, subtropical climate, forest biogeocenoses, Lankaran region, ecological geographical region

1.Introduction

The rich natural conditions of the Lankaran region, primarily the subtropical climatic conditions, the abundance of rains, the temperature over 10ºC, the abundance of hot days, the mild winters and the hot summer months create ample opportunities for the expansion of the areas of tea cultivation, citrus orchards and the development of vegetable growing, and provide ample opportunity to obtain a high yield from them. In recent years, the rapid development of the economy is observed with an increase in anthropogenic impact on the environment. Thus, the pollution of soils, water bodies, and atmosphere in individual regions is higher than the permissible normative indicators, at the same time, the processes of desertification and landslides have become active, the reduction of fresh drinking water, and the thinning of forests have increased. Among the global environmental problems, deforestation and the depletion of wood resources are the most pressing problems.

Observations show that population growth in 150-160 years, urbanization, creation of industrial and agricultural buildings, water supply facilities, construction of highways and railways, pipelines and other measures caused fundamental changes in the natural conditions of the country , and this effect did not bypass the forest massifs [1] .

In the Lankaran natural-ecological geographical region, complex natural factors have led to the formation of a large number of soil and plant varieties. This diversity manifests itself more clearly in the fact that the territory of the natural province is mountainous and plain. Lankaran region is one of the oldest agricultural zones of Azerbaijan, and as a result of natural and anthropogenic processes in those areas, a number of ecological changes have occurred in forests and vegetation in general in recent years .

A forest is such a natural complex that, in addition to trees, bushes, grasses, animals, insects and microorganisms enter it. As the soil considered suitable for the forest is distributed in climatic conditions, it in turn affects the soil and climate where it exists. The daily temperature change in the forest is weaker than in the open area.

The forest is considered the main mass of organic substances of the entire biosphere and plays an important role in the circulation of substances and in changing the environment. The forest has an active influence on the environment in which it exists. The negative consequences of the wrong attitude of the anthropogenic factor to nature accumulate over many years and create major environmental problems, sometimes leading to an ecological crisis. Such cases are found in all countries of the world. In the nature of any country, there are many different reasons for the emergence of an ecological crisis: weak legislation; shortage of highly qualified specialists-ecologists; priority of enterprise interests over general national interest; weak reconciliation of the economy with the environmental situation; low level of

ecological culture; weak sense of environmental responsibility; lack of funds etc.

When we turn the pages of our history, we see that in the recent past, the flora and fauna of our republic was very rich. The area of forests containing very valuable tree species has decreased significantly. Currently, some types of trees and shrubs - ironwood, azat tree, sycamore tree, silk acacia, boxwood, heart-leaved alder, hyrkan birch, chestnut-leaved oak, and danaya are included in the red book of our republic, and measures have been put forward to preserve and increase them [2].

The forests of the southern region are also of indispensable importance in the formation of relief and climate factors of this region. However, in recent times, indifference and drastic interventions in forest massifs are accompanied by the depletion of rare trees and the reduction of plant resources.

It is known that the human body requires 1 kilogram of oxygen per day. As a result of waste thrown into the environment, this demand reaches 15 kilograms, in this regard, forest protection is one of the global problems. The solution to this problem is first of all the creation of a correct economic-ecological system [3] . The implementation of restorative measures in the forest, the protection of forests from fire is of great importance in the protection of the ecological environment .

Recently, the primary natural landscapes in the studied area have been replaced by derivative landscapes or turned into agrocenosis. Unplanned deforestation has led to soil erosion, the development of gullies on the slopes, floods, landslides, aridification of the area, drying up of mountain rivers and, as a result, the transformation of agrocenosis. A number of important issues that were not clear in the obtained electronic map of the plain-foothill and mid-mountain areas of the area where we conducted our research have appeared. In order to clarify these issues, an expedition was organized and they were resolved on the spot. That is, although leguminous plants are visible in most cases in the natural fodder areas of the area, they play a secondary role in these areas. Because these are not the main mass of the grass. The main mass of the grassland is composed of forage grasses and plants belonging to the group of various herbs. Their development and productivity are often adversely affected by other plant groups, such as grasses and grasses. Legumes include *Medicago* , *Trigonella* , Astragalus , Trifolium , Onobrychis , and *Melilotus* . These species can be found in meadows, forest clearings, gardens and bushes, forests, ditches and riverbanks. At the same time, in places affected by desertification and erosion, associations formed by shrub formations around cliffs are also found (blackthorn, mixed, blackberry, cherry-hip multi-herb thicket). As a result of the observations made in the area and the comparison of topographic and aerial photographs of different periods, the centers of ecological crisis in vegetated areas and the dynamics of their area change were determined[4].

2.Experimental details

The lithological aspect of the area is composed of different rocks, different elevation changes, etc. all types and types of erosion occur in the natural zones of the region. The main reason for the occurrence of the erosion process in the area and the expansion of its area is natural processes, the shape of the slope, the slope, etc. as well as the result of the very active influence of people on nature. The forest and forest thickets around many villages of the area have been deliberately cut down and destroyed by the population living here in order to turn them into pastures and crops. The unsystematic, excessive and unseasonal grazing of cattle creates conditions for the formation of trails, the washing away of soil and the occurrence of dangerous floods. In many areas, especially on the southern slopes, forests have been unsystematically cut down, and desertification and erosion have intensified and covered large areas. From the research conducted on the southern slopes of the Talysh mountains, it was determined that forests were cut down in Astara, Lankaran, and Lerik, grass plant groups were developed in one part of the mountain slopes, and the other part was used under agricultural crops. Unlike forests , they have weak water-regulating, low soil-protecting and weak climate-forming properties. Climate, improper agrotechnical measures of vegetation, etc. such factors affected soil fertility [5].

With reference to the climatic data, distribution patterns of forest biogeocenoses, main plant formations, soil names, altitude, average annual precipitation, average annual temperature, humus, nitrogen content, etc. given

At the same time, the cultivation of the lands used for agricultural crops without observing the measures against erosion also caused a decrease in the fertility of those lands. If the reserve of humus in mountain-forest-yellow soils was 130.4 t/ha on average in the 0-20 cm layer in the past period, in the modern period

this indicator was 101.7 t/ha and decreased by 28.7 t/ha. The amount of humus decreased more in podzolic-yellow soils. So, its amount in the 0-20 cm layer was 105.8 t/ha before, but now it is 79.4 t/ha and decreased by 26.4 t/ha [6,4] . In the investigated area, the long-term planting of the river plantations without agrotechnical measures and the destruction of the grass layer caused the erosion process to go strong. In such areas, since rainwater cannot soak into the soil, it forms surface water flow and washes away the soil, and in many cases causes the formation of gullies and ravines. This has led to the disruption of the water regime in the river basins, especially the Lankaranchay basin located in the studied area, and to the occurrence of floods and, as a result, to the change of the soil-vegetation cover.

Degradation of not only plants, but also soil cover in the foothills and plains has led to the accumulation of weathering materials that create conditions for erosion and flood processes. In this regard, preparation of scientific innovation bases for effective use of soil and vegetation, protection and improvement of biodiversity is one of the actual scientific and practical problems of the modern era.

From the conducted researches that as a result of deforestation in the foothills, middle and low mountain slopes of Lankaran region, fundamental changes have occurred in the vegetation and soil cover. Such a situation has seriously affected the soil erosion and the gradual change of the microclimate, as well as the destruction of plant genetic resources during the desertification process.

As a result of the digital analysis of photographs and images taken from space at different ranges of the earth, it was determined that fundamental changes in vegetation and soil cover occurred as a result of deforestation in the foothills, middle and low mountain slopes of Lankaran region. Such a situation has seriously affected the degradation of soils and the gradual change of microclimate, as well as the destruction of plant genetic resources during the process of desertification.

Another ecological consequence of deforestation in regional climate changes is the change in albedo of the earth's surface. Albedo (Latin for whiteness) is a value that characterizes the surface's ability to reflect the rays falling on it. The integral albedo of the canopy of trees is 10-15%, that of grass is 20-25%, and that of fresh rain is 90%. The albedo of the earth's surface is one of the important factors that determine the climate both in the world as a whole and in its individual regions. It has been determined that if the albedo of the earth's surface changes by only a few percent, serious climate changes can occur on the planet. Currently, large-scale variations in the albedo (heat balance) of the entire earth's surface have been detected with the help of space images. Scientists believe that the reason for this is, first of all, the destruction of forest plants and the development of anthropogenic desertification in a large part of our planet [7] . Environmental disturbances caused by economic activity may be the result of incorrect or incomplete accounting of ecological components of any territorial activity. Such cases often occur in the studied area. They consist of the following: - greatly exceeding the limit of the given man-made load falling on the territory; placement of production areas and economic facilities that are ecologically incompatible with the natural complex; misestimation of ecological consequences of production forces and anthropogenic changes of natural landscapes.

3.Conclusion

Statistical data on the forest biogeocenoses of the region were collected, the latest (2014-2019) state of forest massifs was studied based on the comparison of actual and forecast indicators, and the trend of change was evaluated by comparing them with past indicators.

changes in forest biogeocenoses have been determined against the background of anthropogenic and climate changes in the Lankaran accumulative ecological region during 60-65 years, and the tendency of wood resources to decrease in terms of quantity and species has been observed .

At the complementary stage of landscape studies, the ecological assessment method was used while performing the socio-economic function of the landscape, and by preparing a complex of measures for landscape planning and landscape protection of the forest resources of the region, the harmless limit norms of ecotourism recreation pressure were determined.

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Influence of anthropogenic factors on climate change

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Abstract: This study undertakes a comprehensive investigation into the intricate interplay between anthropogenic pollutants and climate changes across diverse temporal and spatial scales. The analysis delves into the nuanced impacts of aerosols and greenhouse gases on temperature fluctuations in the Northern Hemisphere and its terrestrial expanse, covering the temporal interval from 1881 to 2012. A primary focus is directed towards discerning optimal periods characterized by minimal aerosol contamination. Consequently, the research period is judiciously partitioned into distinct temporal segments: 1881-1901, 1924-1945, 1962-1995, and 1996-2012. The findings unequivocally underscore that the epoch of maximal atmospheric aerosol pollution aligns with the years spanning 1962 to 1995, manifesting as an aerosol radiation effect index of -0.59 W/m² and a concomitant carbon dioxide radiation effect index of 0.79 W/m².
Keywords: climate changes, global warming, "greenhouse" effect, anthropogenic factors, Northern Hemisphere, radiation

1.Introduction: Contemporary global climate dynamics are shaped by an intricate amalgamation of multifarious factors, encompassing both natural phenomena and anthropogenic activities. **(İmmanuel, 2023)**As the world grapples with these intricate and intertwined dynamics, profound shifts in both global and local climates have become manifest. **(A, 2016)** These shifts bear considerable ramifications, ranging from jeopardizing the intricate balance of food security and sustainable development to exacerbating extant poverty. The implications encompass a broad spectrum of observable phenomena, including temperature anomalies, glacial ablation, elevated sea levels, extreme weather manifestations, ecological imbalances, and consequential dwindling of agricultural yields.

The pivotal role played by human activities in precipitating these climate perturbations, precipitating a looming ecological crisis, is a matter of undeniable import. The relentless acceleration of anthropogenic contributions to climate transmutations over the past century underscores the gravity of our influence upon the atmospheric milieu. **(Safarov, 2011)**The escalating intensity of economic activities, widespread integration of sophisticated technologies in production, and the meteoric proliferation of hydrocarbon-fueled vehicular transportation have cumulatively catalyzed the amplification of greenhouse gases and aerosols within the atmospheric strata. **(Uluxanli, 2018)**These coalesced entities serve as conduits for facilitating the transmission of short-wave solar radiation while concurrently impeding the escape of long-wave radiation, thus engendering a climatic analog to the greenhouse effect, culminating in temperature elevation. The ramifications of these compounded influences have culminated in an ascendant global temperature average surmounting by 0.5°C over recent decades. The sustained trends in emissions augur the potential for a projected 1.5°C elevation in global warming, materializing between 2030 and 2050 relative to pre-industrial baselines, thereby accentuating the manifold adversities besetting Earth's climatic equilibrium. **(A, 2016)**

2.Experimental details

This study constitutes a meticulous scrutiny of both anthropogenic and natural aerosols, with a particular focus on unraveling their distinctive influences on the radiation regime, particularly during the temperate phases of the year, predominantly summer. To facilitate this investigation, a temporal span spanning from 1881 to 2012 has been deemed optimal, predicated upon the discerned seasonal patterns associated with aerosol presence, coupled with the identification of periods typified by minimal atmospheric aerosol contamination. This temporal span is further delineated into three salient segments: 1881-1901, 1924-1945, and 1996-2012. It is noteworthy that the zenith of atmospheric aerosol contamination is pinpointed within the interval spanning 1962 to 1995.

Table 1. Index values of the radioactive effect of aerosols and carbon dioxide on the climate (S.A. Ahmadov, M.S. Ahmadov, 2019)

Low and high pollution of the atmosphere periods and indicators	Carbon dioxide and aerosols for selected periods of low and high pollution of the atmosphere difference in radiation exposure			
	1881-1901	1924-1945	1962-1995	1996-2012
Indices of radiation effect of aerosols, W/m2 (norm for the years 1881-2010 - 0.33 W/m2)	-0,26	-0,14	-0,59	-0,21
Carbon dioxide radiation effect index,W/m2	0,09	0,30	0,79	1,50
The difference in the radioactive effect of carbon dioxide and aerosols on climate	-0,17	+0,16	+0,20	+1,29

According to the table, the difference in the radiation effect of carbon dioxide and aerosols on the climate was recorded as -0.17 W/m² in 1881-1901. But in the following periods, this price increased, in the years 1924-145 +0.16 W/m², in the years 1962-1995 +0.20 W/m², and finally in the last period, 1996-2012, this indicator increased sharply + It was 1.29 W/m².

Figure 1 shows summer and winter temperature changes for each decadal period in the Northern Hemisphere since 1883, and separately for the dry part of the Northern Hemisphere, to show the variation of temperature anomalies over different periods.(Figure 1)

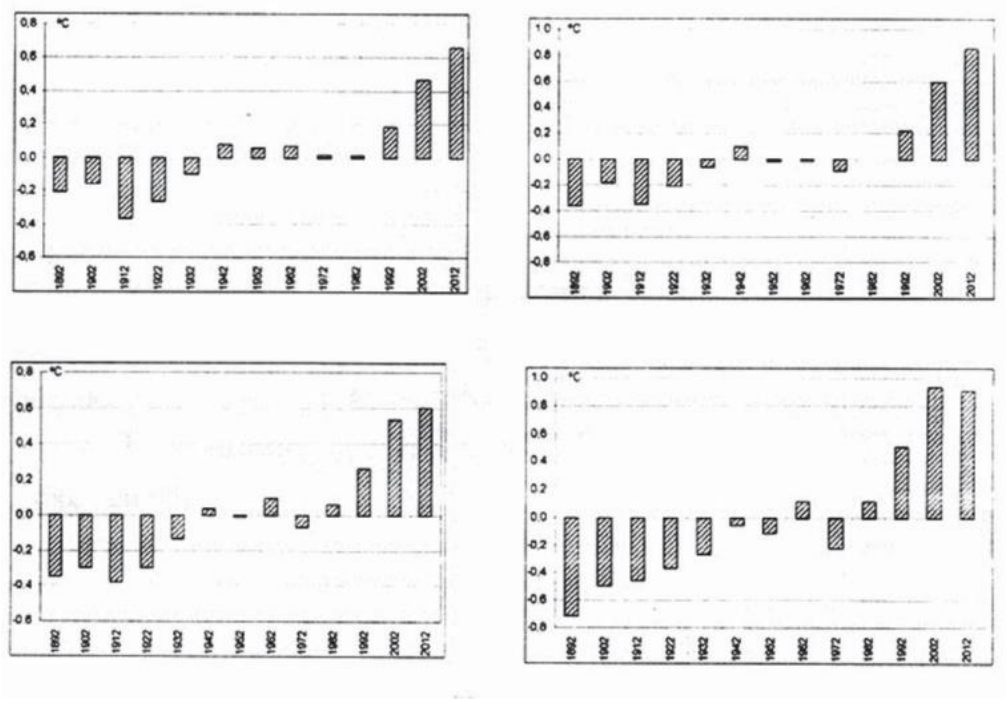

Figure 1. Temperature changes in summer (a, b) and winter (c, d) in the NorthernHemisphere (left) and a separate dry part of the territory (right) in ten-year period (S.A. Ahmadov, M.S. Ahmadov, 2019)

Looking at Figure 1, the maximum indicators of negative temperature anomalies were recorded in the winter months in the first 40 years and in the last 30 years in the general area. However, in the last ten years (2002-2013), the recorded indicators of temperature changes in winter and summer were compatible with each other. In the dry area, the recorded indicators are slightly different, as the

values of temperature changes were higher in summer than in winter. During the first 40-year period, negative temperature changes in summer were much less than in winter. In the 30s and 40s, positive temperature changes were recorded higher than in winter.

Let's take a look at the changes of aerosols, carbon dioxide and corresponding temperature in the atmosphere during the last 130 years separately, based on the periods we have allocated to them.

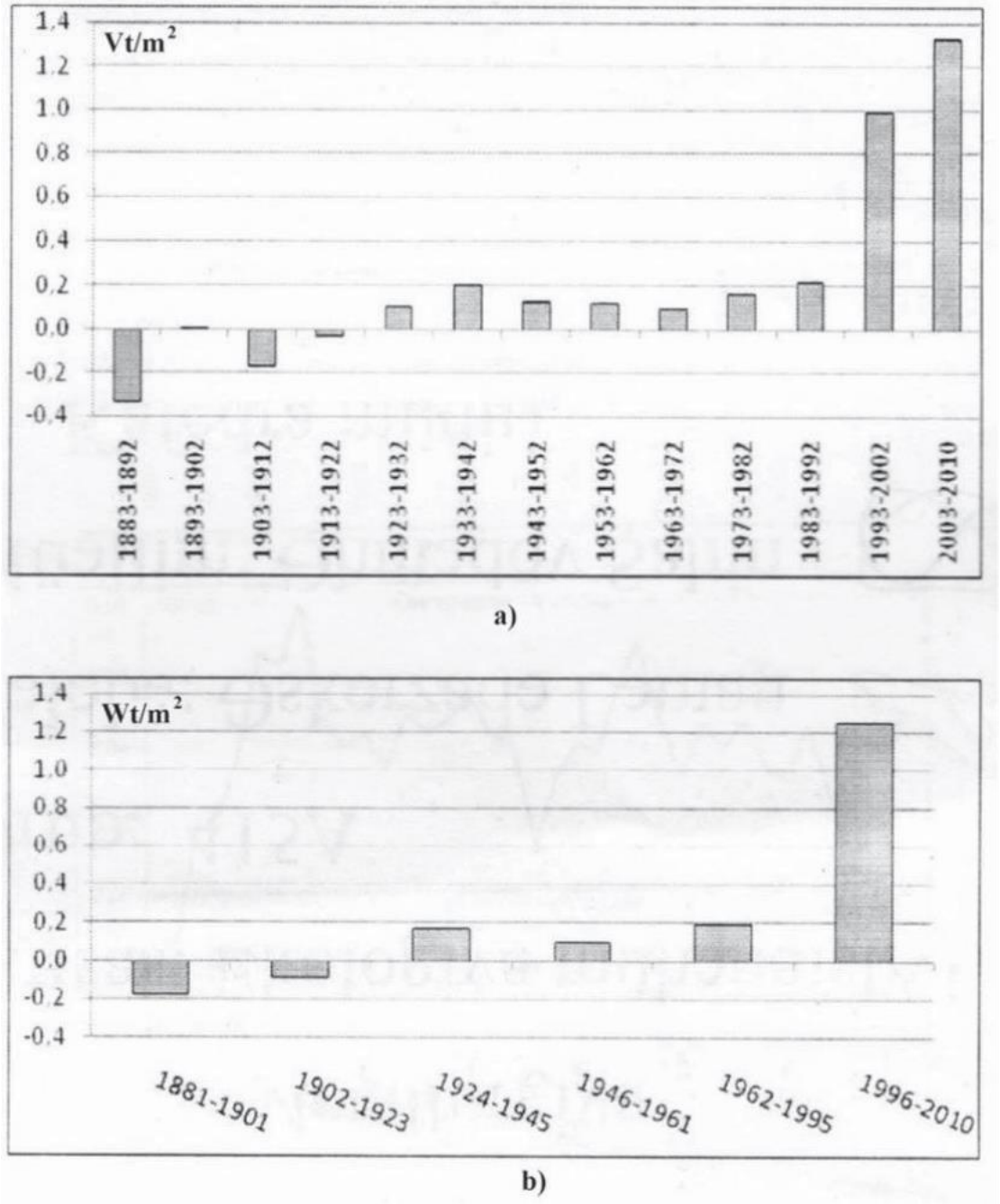

Figure 2. Radiation indicators of carbon dioxide and aerosols in the relevant period (S.A. Ahmadov, M.S. Ahmadov, 2019)

1881-1901: during the period of low temperature, the temperature anomaly indicators recorded in winter are about 1.5 times higher than the temperature anomaly indicators recorded insummer. At the end of the period, the amount of carbon dioxide in the air is lower because the atmosphere is more polluted with aerosols. Due to the low level of carbon dioxide, those periods coincide with the cold months of the year.

1924-1945: during this period, the temperature anomalies recorded in summer were less than the temperature anomalies recorded in winter. Therefore, during this period, the amount of aerosols in the air was not high, and the effect of carbon dioxide was also minimal. Atmospheric pollution was the least recorded during this period.

1962-1995: the anomalies recorded during the period of lower and higher temperatures are of the same magnitude, which means that the influence of aerosols and carbon dioxide on the atmosphere is the same and very small.

1995-2012: highest recorded temperature anomalies in summer and winter. During this period, the influence of carbon dioxide and aerosols on the atmosphere is the highest and to the same extent. In the cold months of the year, the increase in temperature changes is characteristic.

Taking into account the "greenhouse" effect, it is possible that the increase in temperature is recorded in the upper latitudes of the atmosphere. If we take into account the above for one reason or another, if the greenhouse effect occurs, temperature anomalies are more pronounced in the upper latitudes of the atmosphere, and these anomaly indicators are usually recorded in the cold months of the year.

3.Conclusion

The empirical analysis undertaken unveils salient insights into temperature anomalies manifesting within the purview of the Northern Hemisphere. Figure 1, an illustrative visualization, perceptively maps the trajectory of temperature fluctuations spanning decadal periods, effectively charting distinctions between the seasonal manifestations of summer and winter. Intriguingly, the winter months across the initial four decades bear witness to maximal negative temperature anomalies, echoing a comparable pattern within the subsequent three decades. Of note, during the chronological interval 2002-2013, temperature alterations across the ambit of both summer and winter evince a remarkable congruence. In regions characterized by aridity, discernible disparities emerge, as the amplitude of temperature fluctuations within the realm of summer surpasses the corresponding variations witnessed in winter. A retrospective analysis unfurls that during the first four decades, nominal summer temperature fluctuations starkly contrast with the accentuated winter anomalies. However, during the 1930s and 1940s, instances of positive summer temperature deviations were conspicuously more pronounced vis-à-vis winter counterparts. (S.A. Ahmadov, M.S. Ahmadov, 2019)

Subsequently, Figure 2, a visual representation steeped in empirical data, illuminates the intricate interplay between aerosols, carbon dioxide, and temperature shifts across the temporal expanse of the past 130 years, meticulously demarcated into the afore-mentioned discrete temporal segments. Pertinently, during the time frame spanning 1881-1901, characterized by relatively low temperatures, the recorded winter temperature anomalies emerge as approximately 1.5 times greater than the summer temperature anomalies. Furthermore, within this period, the atmospheric milieu witnesses a diminutive concentration of carbon dioxide, concomitant with a heightened presence of aerosols. This symbiotic interaction of reduced carbon dioxide levels aligning with augmented aerosol presence aligns with the frigid months of the year. A parallel dynamic manifests within the temporal ambit of 1924-1945, with this period similarly characterized by a dearth of aerosols and a correspondingly muted impact of carbon dioxide. Intriguingly, the interval spanning 1962-1995 stands out as a phase of parity in anomalies under divergent temperature regimes, indicative of a marginal influence of both aerosols and carbon dioxide. Finally, the epoch spanning 1995-2012 emerges as one heralding pronounced temperature anomalies during both the summer and winter seasons. This period is characterized by a correspondingly heightened influence of both carbon dioxide and aerosols upon the atmospheric milieu.

The discernible amplification of both natural and anthropogenic influences accentuates Earth's average temperature escalation by 0.5°C. Prevailing emission trajectories portend a potential 1.5°C elevation in global warming between 2030 and 2050 relative to pre-industrial benchmarks, thereby exacerbating strains within the global climatic ecosystem. (Odoh, 2023) International endeavors, epitomized by the pivotal Paris Agreement of 2015, collectively endeavor to arrest carbon dioxide saturation and thereby ameliorate climate perturbations. This landmark accord cogently underscores the global commitment to mitigating global average temperature escalation, resolutely aspiring to circumscribe the rise below the threshold of 2°C.

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Ecological situation, restoration of lake Zigh on the Absheron Peninsula.

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Group: BA 572 A

Abstract: This article talks about the ecological condition of natural and artificial lakes on the Absheron Peninsula. Absheron improvement and cleaning of the lakes in the peninsula due to pollution, ecological condition methods are discussed. They are also talking about the protection of these lakes.

Keywords: Absheron peninsula, lakes, ecology, pollution, cleaning, protection.

1.Intoduction

There are more than 200 lakes with a total area of 3325 hectares in the Absheron Peninsula. 41.5 million cubic meters of wastewater of various compositions are discharged into these lakes annually. Due to the fact that the concentration of petroleum products, heavy metals and other toxic substances in the water is many times higher than the allowable norm, an increase in radionuclides is observed in the bottom sediments of lakes. The discharge of domestic wastewater into lakes and surrounding areas further complicates the critical ecological situation on the Absheron Peninsula. In order to solve environmental problems, the Ministry of Ecology and Natural Resources, along with other projects, has developed a project "Improving the environmental condition of lakes and other reservoirs on the Absheron Peninsula." However, the analysis shows that the full implementation of this research is associated with a number of organizational and financial problems. Therefore, ecological, geological-morphological and other research works on all lakes on the peninsula have not been completed. Rising water levels in the Caspian Sea over the past 20 years have also affected the ecological conditions and hydrological regime of the lakes. Thus, the area of lakes has increased, the concentration of petroleum products, phenols, surfactants, heavy metals and other harmful substances in the water has exceeded the allowable level. There is a risk of an increase in radionuclides in the sediments and a decrease in water-soluble oxygen.

Girmizi Lake with an area of 7.2 km^2 and a volume of 8.3 million m^3 is located in Garadagh, south of Lokbatan settlement. The basis of the sewage discharged into the Girmizi Lake is the domestic sewage of Lokbatan settlement and the water flowing from Khojahasan Lake. The discharge of wastewater into the lake has disrupted the oxygen regime of its water.

As a result of long-term exposure of the lake to anthropogenic influences, excessive pollution with oil and oil products, phenols and other negative effects, its geological structure, soil rocks, bottom relief and other parameters have been degraded.

A number of landscaping and landscaping works have been carried out around Lake **Yasamal-1**, and domestic and communal sewage discharged into the lake has been prevented. Of the specific water pollutants, only phenols and copper levels slightly exceed the norm, which is due to their accumulation at the bottom of the lake for many years and their re-emergence in the upper layers of the water (re-pollution processes). The current ecological condition of Lake Yasamal-1 is satisfactory.

Domestic and communal waters of Masazir and Novkhani villages are discharged into **Masazir Lake**. Due to the mineralization of the water, Lake Masazir belongs to the group of saline lakes. The ionic composition of water is dominated by chlorides and sulfates. The waters of Lake Masazir are highly polluted.

Domestic wastewater from the surrounding settlements is discharged into **Kurdakhani Lake**. Lake Kurdakhani belongs to the group of short-water lakes. The oxygen regime of the studied lake was violated.

Lake Bulbula, like the Boyuk-Shor Lake, is highly anthropogenically affected. Due to the mineralization of the water, Lake Bulbula belongs to the group of short-water lakes. Long-term observations show that Bulbula Lake is relatively less polluted than Boyuk-Shor Lake.

Up to 80% of the wastewater discharged into **Khojahasan Lake** is municipal waste. Due to the mineralization of the water, it belongs to the group of short lakes. The content of chlorides in the lake water is several times higher than normal, and sulfates are several times higher, which is due to the fact that the lake is fed by groundwater associated with seawater.

Table.1

№	Names of lakes	Mcr / hour on the surface of the water	Mcr / hour on the surface of coastal soils
1	Boyukshor	8-12	15-24
2	Masazir	6-9	21-25
3	Mirzaaladi	12-15	13-19
4	Kurdakhani	8-14	18-26
5	Girmizi	9-16	16-24
6	Bul-bula	10-14	16-31
7	Khoja-Hasan	6-18	23-32
8	Duzlu	9-14	24-28

2.Experimental details

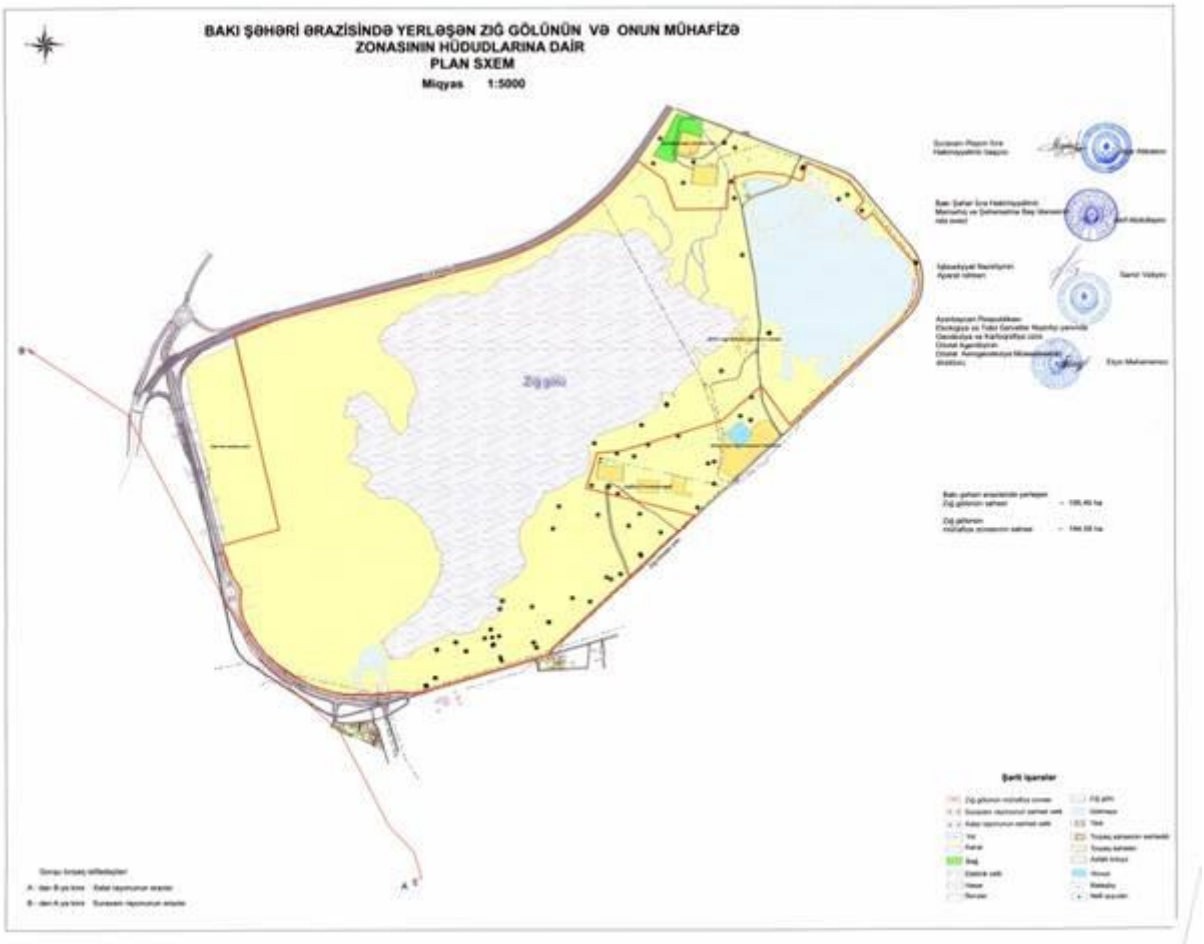
In order to prevent pollution, it is very important to give characteristics and classification of pollution sources. There are 3 types of pollution. These are: physical, chemical and biological.

Physical - Pollution with radioactive elements (with ionizing radiation), electromagnetic waves (with non-ionizing radiation), heat pollution, sound (small-wave ultrasound, vibration-vibration), intense light flood.

Chemical – Pollution caused by solid, gaseous and liquid chemical compounds.

Biological – Pollution caused by bacteria, viruses, fungi, mutated organisms (genetically altered).

Approved by the Order signed by the President of the Republic of Azerbaijan Mr. Ilham Aliyev on



January 17, 2014 "As a result of the work carried out in accordance with the Decree dated December 26, 2013, everything in this area has completely changed. Under the coordination of the Ministry of Economy, Tamiz Shahar OJSC handed over the first phase of the project in May 2015. In the next stage, which envisages the full restoration of Boyukshor Lake, the lake will be returned to its natural historical course, the water level will be regulated and the ecosystem will be restored. The first phase of the Boyukshor Lake restoration project has been approved by the President of the Republic of Azerbaijan, Mr. Ilham Aliyev. Tasks on improving the ecological condition of 9 lakes of Absheron peninsula (lake in front of Khojahasan, Boyukshor, Binagadi settlement Sports Complex, Girmizi, Puta (Lokbatan), Gu, Zabrat, Bulbula, **Zykh lakes**) in the state programs on socio-economic development of Baku and its settlements carried out within.

Lake Zigh has a surface area of 20 ha and a depth of 1.5 m. The annual volume of domestic wastewater discharged into the lake is 1826 thousand cubic meters, and industrial (oil, gas) waste is 73 thousand cubic meters. The results of the analysis of the taken water samples show that the lake water is salty and the degree of mineralization reaches 166 g/l. Chlorides 96, magnesium 42.6, and sulfates 5.4 g/l exceed the sanitary standards by 274.21 and 11 times, respectively. The oxygen regime of the lake water is disturbed. The concentration of oxygen is 1.6 times lower than the sanitary norm. A high amount of cadmium 8.4, copper 6, detergents 0.45 mg/l is observed as pollutants, which is 8.4 in accordance with the sanitary norm; 6; 4.5 times higher. Manganese (222 mg/kg), oil products (63 mg/kg), copper (66 mg/kg), nickel (40 mg/kg), cadmium (21 mg/kg), zinc (18 mg/kg) are found in bottom sediments of Lake Zigh. kg), chromium (12 mg/kg) and cobalt (8.6 mg/kg) were collected.

The ecological situation in the lake can be estimated as average.

"It is beneficial to turn the lakes around Baku into a park and restore them. The drying of the lakes creates conditions for desertification on the peninsula. As a result, the greenery decreases and causes a lack of oxygen," ecologist Telman Zeynalov told ANS PRESS.

At present, although not around Zigh Lake, improvement works are being carried out around the village of Zigh. Undamaged areas are turned into parks and added value.

We believe that in the next years, landscaping works will be carried out around Zigh Lake, a park will be built, and the set goal will be achieved. Residents and visitors from abroad will enjoy Lake Zigh and its surroundings.

Plan 1.The ecological condition of 9 lakes will be improved and they will become one of the recreation centers of the residents, while other lakes are supposed to be drained. This has both positive and negative sides.

3.Conclusion

The press secretary of the press service of "Tamiz Shaher" Open Joint Stock Company stated that currently works are underway to improve the ecological condition of the Great Shore lake. Work related to cleaning Zigh Lake from waste water and improving its ecological condition will be started in the near future. Other lakes are not planned to be drained. The fate of those lakes has not yet been decided.

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Artificial Intelligence (AI) in non-destructive testing.

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Abstract: Non-destructive testing (NDT) is an essential process for ensuring the safety and reliability of various materials and structures. With the rapid advancements in artificial intelligence (AI), there has been a growing interest in applying AI techniques to NDT. AI has the potential to enhance NDT by improving inspection speed, accuracy, and reliability. One of the most promising applications of AI in NDT is automated defect detection and classification. Using computer vision algorithms and machine learning models, AI can analyze images and other types of data obtained during the inspection process and detect defects with high accuracy. Additionally, AI can also classify defects based on their type and severity, allowing for a more efficient and targeted approach to repairs and maintenance.Another area where AI is being used in NDT is data analysis and decision-making. By processing large amounts of data obtained during inspections, AI algorithms can identify patterns and trends that may not be apparent to human inspectors. This can help improve the overall reliability of NDT and prevent potential failures.Overall, the integration of AI in NDT has the potential to improve inspection quality, reduce costs, and increase the overall safety and reliability of various materials and structures. However, there are still several challenges that need to be addressed, including the lack of standardization and the need for more robust and reliable AI algorithms.

Keywords: Probability of Detection, Artificial Intelligence, Discontinuity, Defects, True Positive, False Positive, Non-Destructive Testing, Non-Destructive Evaluation, NDT 4.0, NDE 4.0, Industry 4.0, Industrial Revolution, Automatic Defect Recognition, Image Enhancement, Denoising.

1. İntroduction

After the three great industrial revolutions, industry production was networked and digitalized, which is referred to as industry 4.0. The advancements in NDT/E equipment are the fundamental driver of Non-Destructive Testing and Evaluation 4.0 (NDT & NDE). Progress in industry 4.0 and NDT 4.0 currently have a unique interaction. Artificial intelligence (AI), which in this case focuses on image processing and assessment, is one technology that has an impact on both.

The probability of detection (POD), a popular NDT statistic, aids in demonstrating compliance with inspection quality criteria. In order to increase the Probability of Detection (POD) by utilizing the digitalization brought on by the industrial revolution, this article analyzes the role of these new technology breakthroughs in the NDT process.

2.Experimental details

The definition of artificial intelligence (AI). Artificial intelligence (AI) is the name given to computer systems that have the ability to see, comprehend, respond, and adjust their behavior in response to the environment. The term is often used as a synonym for Machine or Deep Learning and is seen as a contrast to rule-based programming.

You may think of an AI model as assessment software. It is a so-called network of evaluation functions in the context of deep learning, which has the capacity to learn any number of complicated relationships. The evaluation functions' settings, the network architecture, and the interface for querying evaluations then serve as a model that may be used elsewhere, such as in different software or manufacturing facilities.

How effective is NDT currently, without AI. In Data Science and Artificial Intelligence, metrics are important when evaluating the result of a given method. The receiver-operator characteristic is the most important statistic for a binary decision issue. It outlines four probable prediction states. For instance, a method or algorithm should be able to determine if a component is defective or not.

Due to the fact that a sample is either rejected or not, this choice is binary. True positive refers to when the algorithm correctly rejects a sample, whereas true negative refers to when it does not accurately reject the sample and the sample is defect-free. False

positives, on the other hand, occur when the algorithm accepts the sample even when the component is flawless. False negative is the reverse (the component contains defects, but the algorithm accepts the sample).

The finest NDT assessors are predicted to have a maximum performance/accuracy of 85,2 % POD with 2,1 % PFA for true-positives and true-negatives, but the overall results are inferior due to a high false alarm rate. [2]

Probability of Detection (POD). Based on the aforementioned classifications, we can conduct a test in which we provide the algorithm, examiner, or procedure with a number of samples (for example, 1000) that are either known to have faults or are defect-free. The samples are subsequently assessed to determine whether or not they contain flaws. We can assess how the examiner or method did using the four performance classifications above because we know how they should have performed with this sample set.

With this method we can analyze data in many ways. The Probability of Detection (POD), a popular NDT statistic, is defined as follows:

POD = True Positive / (True Positive + False Positive)

A separate factor can be used to evaluate an algorithm based on POD. As an illustration, the graphic below displays POD values in relation to the size of a specific fault. The chance approaches 100% in an asymptotic fashion. The POD is 90% at the highlighted point for a 22mm defect. POD is frequently interpreted in the context of NDT as POD depending on fault size.

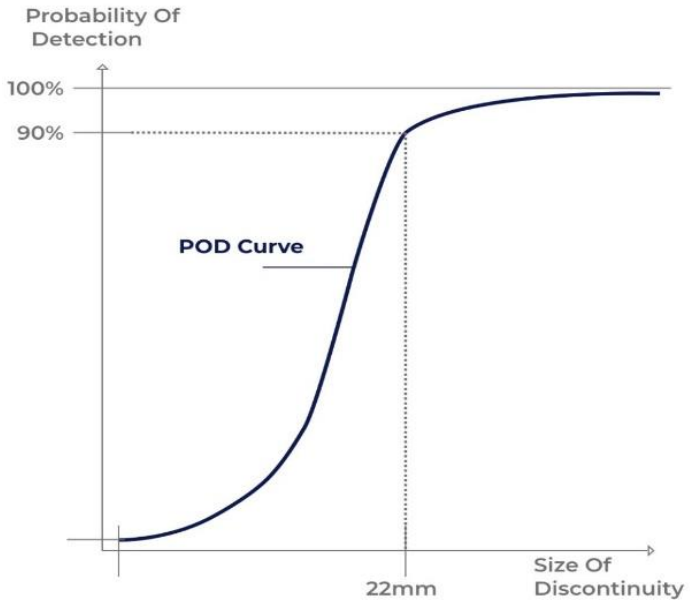

Figure 1: POD Curve

The usage of Artificial Intelligence (AI) for NDT 4.0. Several environmental factors can cause an image to become distorted in some areas or to have general noise cover the entire thing before it is displayed on a monitor or film. There are numerous sources of noise, making rule-based augmentation impossible. Salt and pepper noise is one type of noise, in which a single pixel is completely black or white. Gaussian noise is another illustration; it is consistently dispersed over the image. Signal-to-noise ratio (SNR), which is the widely used technique for estimating noise, is also included in a number of weld image inspection standards.

The traditional method for denoising involves applying static filters to the image as a convolution, such as low/high pass static filters. If you were to do this manually, you would have to separate the image into several patches (for example, 1616 pixels), optimize each view according to your expertise and the location of the patch in the image, and then put everything back together.

These AI models are widely used in photography to improve low-resolution photographs, fix lighting issues, or add filters. We concentrate on the creation of these AI algorithms for use in digital radiography and radioscopy.

For instance, when applying national standards, noise in weld photos is a significant concern. Consequently, a denoising is helpful to present the

flaws in a clear manner. This increases the time spent on one image as well as the human observer's detection rate. Figure 2 provides an illustration of this, showing a noisy weld image (top) with various artifacts and noise granularities.The image may be transformed into a less noisy image (bottom) while maintaining the majority of the image's information if an AI could rebuild it and respond to various noise kinds automatically. The benefit of such an AI algorithm is the ability to treat local features (such as flaws, weld edges, backdrop, etc.) differently depending on where they are located.

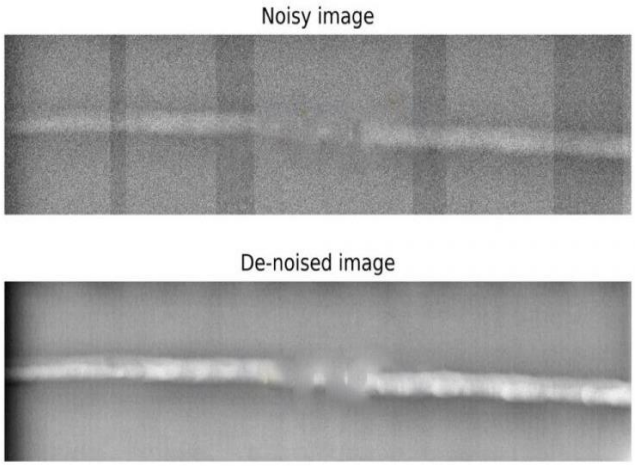

Figure 2. Noisy and denoised image comparison

To train such an AI, you would require data with minimum noise that could be used to show the algorithm examples of good photographs, such as by taking several long exposure photos. After that, the model will produce the denoised photos when you feed it noisy images. (Disclaimer: Figure 2 is an exaggerated example since non-disclosure agreements forbid showing the most recent data in the public. It doesn't reflect how technology is right now. But it will illustrate the potential of an AI algorithm.)

In addition to denoising, Figure 3 provides an illustration of picture enhancement in which a weld fracture is visible. Different depths can be seen depending on the value range that is displayed to the human observer. As a result, it frequently takes two or three views for an observer to properly perceive all flaws in all levels. A human viewer can now spot every flaw in a single photograph thanks to the assistance of an AI program. The detection rate or POD of a human observer is increased while time is also saved. For practical purposes, this also implies that you may utilize photos shot under less-than-ideal circumstances, such limited exposure time, while still preserving the integrity of the photo's quality. (Disclaimer: Figure 3 is an exaggerated example since non-disclosure agreements prevent the public from seeing the most recent data. It does not accurately reflect the state of technology today. However, it will illustrate the capabilities of an AI algorithm.)

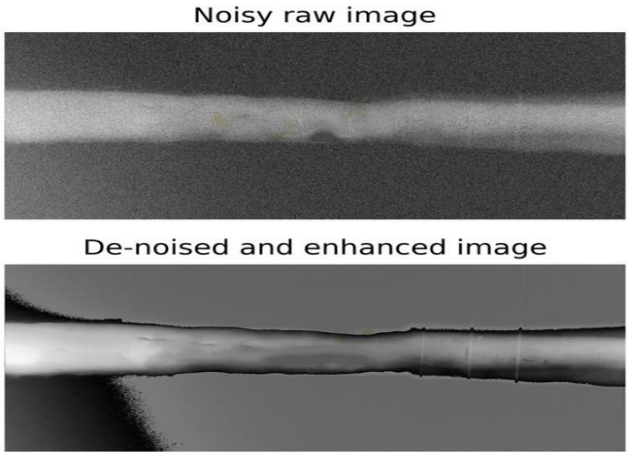

Figure 3. Comparison between noisy and enhanced image

(Automatic) Defect Recognition – ADR. AI is able to immediately detect faults or defects in a picture in addition to image augmentation and denoising. Although the standards have not yet approved this detection, it is still a tool that aids in faster and more accurate detection by human observers. Additionally, the AI performs consistently and is unaffected by things like fatigue.

A supervised AI is utilized for defect recognition. Based on samples of photographs with their accurate labels that are provided, this AI is taught. There are three main categories of AI in supervised vision. They are instance segmentation, object detection, and image classification. One label (fault or no defect) is returned by the first method for each picture. Only use cases where there is only one object present in each image and in which the presence of this defect necessitates the rejection of the entire sample (cracks in most standards) are appropriate for this kind of AI.

A bounding box is drawn around a flaw using object detection. This is helpful when a part may have a number of distinct flaws yet a human observer must determine whether the item is salvageable or not. Instance segmentation, the final one, predicts the precise polygon of a flaw. This approach is ideal for measuring defect even though it requires the most data. For instance, several standards for weld pictures require you to assess faults and make sure they are smaller than a certain threshold. For discovered faults, those geometric coherences may be estimated and samples can be automatically rejected.

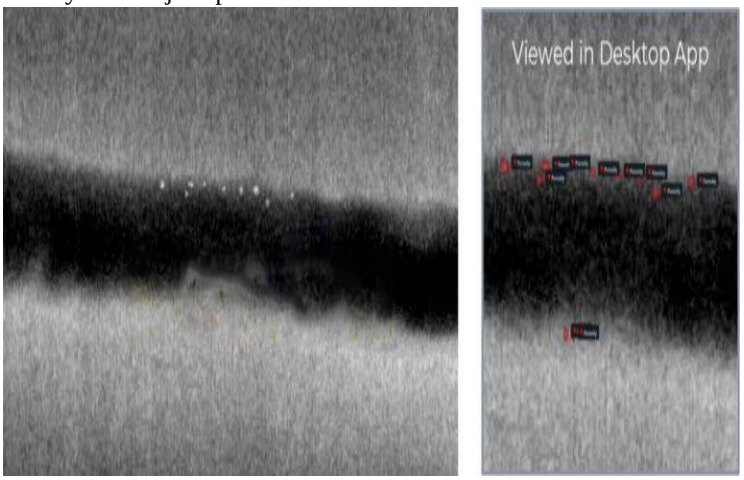

Figure 4. Highlighted porosities in a weld - detected by an AI

An illustration of a weld picture with porosity is shown in Figure 4. It may be shown and emphasized as the right portion of the image using a separate AI technique that can identify flaws or discontinuities. Image denoising and image enhancement are frequently helpful as a pre-processing step to make an algorithm more resilient and decrease the number of photos needed for AI Model training, even if defect detection detects faults immediately. Thus, both AI strategies complement one another well to enable the evaluator to produce their best work.

Even though the training of those algorithms takes a while, once trained, they run very quickly. Depending on the technology being utilized, assessment periods of under 50 milliseconds for photos with a regular size (for example, 1,200 × 1,800 pixels) are to be anticipated.

Artificial Intelligence reducing human factors in NDT. NDT 4.0 is a result of Industry 4.0's use of a broad range of cutting-edge technologies that improve on present NDT techniques. One of the developing technologies of the fourth industrial revolution is augmented reality. Other emerging technologies include cloud computing and storage, artificial intelligence, robotics, big data, blockchain, and robotics.

Any manufacturing process will eventually have flaws. A sufficiently high probability of detection (POD) of known flaws now necessitates manual part inspection and sophisticated statistical techniques (six-sigma). When testing welds, such as in chemical plants where weld seams are manually inspected using X-Rays, this is particularly time-consuming. AI can reduce human mistake and aid inspectors in spotting flaws.

Different opinions may be formed by individuals after viewing the same facts. Human variables like exhaustion may cause even one person's thoughts to diverge. NDT is a task that demands a lot of concentration. When determining the POD, factors such as the inspector's focus and the effectiveness of the inspection system should be taken into account.

Among the most significant human elements influencing the assessment process are the evaluator's personality, previous job experience, training, and exhaustion.

The inspector's judgment is also influenced by their perception as well as their capacity for information processing and memory. The usage of signals or pictures of inadequate quality results in further issues. An inaccurate categorization might lead to the acceptance of a component with more flaws than allowed by the applicable standards (false positive) or the rejection of a part with no problems at all (false negative).

Figure 5 depicts an illustration of an enhanced POD. The intrinsic capacity is the "best" performance a system is capable of achieving with a defect size that has a high likelihood of being identified (90%). What your system actually detects and what it may potentially discover is known as the performance gap. The curve will shift toward the right, getting closer to the optimal performance, narrowing the performance gap, if an AI can assist in detecting things earlier/better (smaller faults). [4]

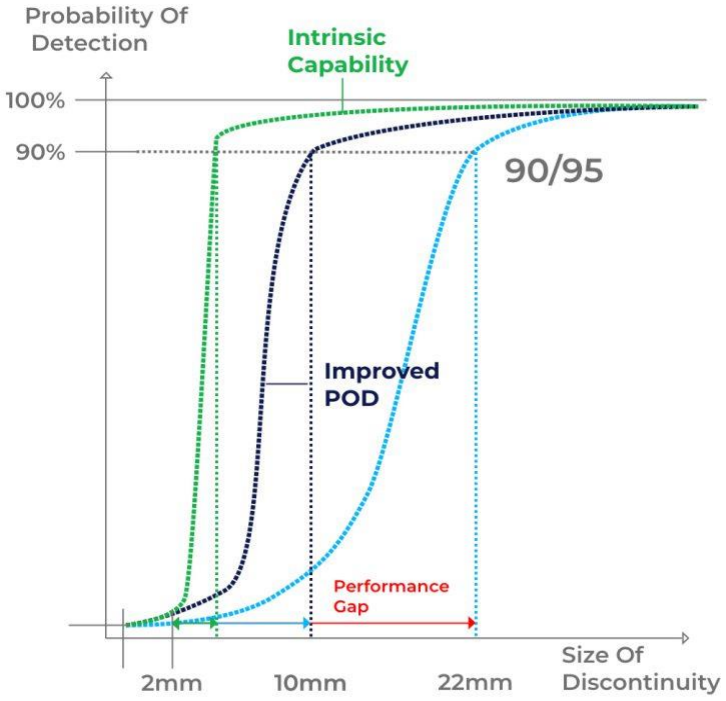

Figure 5. Comparing POD curves and showing the performance gap. Inspired by [4]

When discussing how to enhance the POD, we want to more reliably find smaller flaws. We may do this by minimizing upsetting elements. The next lines concentrate on aspects that may be minimized following picture acquisition so that businesses can use current systems/equipment while just updating the image processing using software.

Using ADR to Increase Reliability & Perception. The complete system of tools, protocols, and inspectors must be trustworthy for an NDT process to be dependable. Reliability is increased through technology that may improve perception and minimize the impact of human variables on POD. Artificial intelligence can be useful in this situation. By automatically marking potential flaws using Automatic Defect Recognition (ADR), AI enhances the inspector's perception. This lessens the impact of human variables on POD, such as weariness, motivation, or attention. Additionally, AI offers an unbiased second opinion, which may assist less experienced inspectors and ensure that they are categorizing flaws consistently.

*Improving Perception and Attentiveness with Image Enhancement.*The picture quality is yet another issue that affects how inspectors are seen and motivated, and thus, how the POD functions. The inspector may concentrate on the actual interpretation process rather than manually selecting filters if you can intelligently improve contrasts and decrease noise in photos. The inspector does not need to manually select the appropriate filters if the entire image presents all information in an optimum manner, picking the proper improvement for the right area. This may sharpen their focus and aid less-experienced

inspectors in paying close attention to the finer details of the image and spotting tiny flaws. AI may also be useful for the actual picture capturing. Because the image quality can be improved in detail afterward, it is possible to take pictures more quickly or with lower voltage than with traditional high-pass filters.

3.Conclusion

In conclusion, the integration of artificial intelligence (AI) in non-destructive testing (NDT) has the potential to revolutionize the field by improving inspection speed, accuracy, and reliability. Automated defect detection and classification, as well as data analysis and decision-making, are just some of the promising applications of AI in NDT. However, there are still challenges that need to be addressed, such as the lack of standardization and the need for more robust and reliable AI algorithms.

Additionally, it is important to recognize that AI is not meant to replace human inspectors, but rather to enhance their capabilities and improve the overall efficiency and effectiveness of NDT. As AI continues to advance and evolve, it is likely that we will see more applications of AI in NDT and other fields. It is important to continue researching and developing AI technology to ensure that it is safe, reliable, and effective in enhancing the quality and safety of various materials and structures.

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Biofilter to clean polluted water sources

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Abstract: Biofilters are an innovative and effective technology for cleaning polluted water sources. They rely on naturally occurring microorganisms to break down contaminants, making them an environmentally friendly alternative to traditional water treatment methods. Biofilters work by passing polluted water through a bed of organic material, such as compost, wood chips, or peat moss, that is colonized by microorganisms. These microorganisms consume pollutants such as nitrogen, phosphorus, and organic matter, converting them into harmless compounds. The filtered water is then released back into the environment or reused for various purposes. Biofilters are an economical and low-maintenance solution for treating a variety of water sources, including wastewater from industries and municipal sewage systems. The implementation of biofilters can significantly reduce the environmental impact of water pollution and provide a sustainable solution for water treatment.
Keywords: Biofilter, polluted water, bioremediation, adsorption, common reed, water treatment.

1.Introduction

Water is one of the most precious resources on our planet, and it is essential for all forms of life. Unfortunately, water pollution is becoming an increasingly serious problem, with many sources of water being contaminated with various pollutants. According to the World Health Organization (WHO), water pollution is responsible for 1.8 million deaths each year, and it is estimated that by 2025, half of the world's population will live in water-stressed areas.

One of the most important environmental problems of the Caucasian region is the pollution of the transboundary Okchuchay River (Armenian: Voghji River) by Armenia. The Okchuchay, with a length of 84 kilometers (52 miles), rises in west Zangezur and flows into east Zangezur. The headwater of the river is the mountain Kapacik(3640m, 39°09′ N, 46°01′ E) and the mouth of the river is the Aras river, Mingivan(39°01′ N, 46°45′ E).

The Okchuchay River passes through Armenia's two mining districts. One of them is the Zangezur Copper Molybdenum Combine (ZCMC), which is located upstream of the Okchuchay River in the territory of Kajaran city, in the southeast of Armenia. The second mining district, Kapan Polymetal, is located downstream of the Okchuchay River, 1.5 kilometers east of the town of Kapan in the southeast of Armenia. The Okchuchay River has become a source of pollution due to the flow of heavy metals out of Armenian factories over the past decade. After the liberation of east Zangezur, the Ministry of Ecology of Azerbaijan conducted monitoring in the river and discovered that the level of pollution of the Okchuchay River is higher than other border rivers.

Water pollution has altered the river's ecosystem; many fish species have been killed and some have disappeared altogether. The metals discharged into the Okchuchay pollute not only the river itself but also other nearby rivers. The Okchuchay flows directly into the Aras River, the second largest river of the South Caucasus, thus it is directly affected by the pollution from the Okchuchay.

Figure 1. Okchuchay (created by author)

Traditionally, water treatment has relied on chemical treatment and mechanical filtration to remove contaminants from water. While these methods can be effective, they are often expensive and can be harmful to the environment. Chemical treatment involves adding chemicals such as chlorine and alum to water, which can lead to the formation of harmful byproducts. Mechanical filtration involves passing water through filters to remove contaminants, but this can be energy-intensive and require frequent maintenance.

As regards to previous researches on water treatment, such as oil palm shell (Tan et al., 2008), coconut shells (Cazetta et al., 2011), corn cobs (Kaźmierczak et al., 2013, Sych et al., 2012), globe artichoke leaves (Benadjemia et al., 2011), cotton stalks (Deng et al., 2009), cumin herb wastes (Bazrafshan et al., 2013), Brazilian pine-fruit shell (Royer et al., 2009), Eucalyptus wood (Tancredi et al., 2004), jute fiber (Senthilkumaar et al., 2005), pistachio nut shells (Lua and Yang, 2005), tropical fruit skins (Nowicki et al., 2016), coffee grounds (Reffas et al., 2010), pomelo peel (Peng et al., 2014), pomelo skin (Foo and Hameed, 2011), waste tea (Gokce and Aktas, 2014) and pistachio nut shells (Nowicki et al., 2015), these items have not ever been applied to any rivers.

Therefore, there is a need for sustainable and eco-friendly solutions for cleaning polluted water sources. Biofilters are one such technology that has gained popularity in recent years. They use naturally occurring microorganisms to remove pollutants from water, making them an effective and environmentally friendly alternative to traditional treatment methods.

Biofilters work by providing a suitable environment for microorganisms to grow and thrive. These microorganisms consume contaminants such as nitrogen, phosphorus, and organic matter, breaking them down into harmless compounds. The filtered water is then released back into the environment or reused for various purposes.

One of the main advantages of biofilters is that they are low-maintenance. Once the initial setup is complete, the system requires minimal intervention, with the microorganisms doing most of the work. Biofilters are also cost-effective, as they use natural materials such as compost, wood chips, or peat moss as the filter medium. Additionally, biofilters are sustainable, as they do not require chemicals or energy-intensive processes.

There are several types of biofilters, each with its own unique characteristics and applications. One common type is the up flow biofilter, which is used to treat municipal wastewater and industrial effluent. In an up flow biofilter, water is passed through a bed of filter media, such as sand or gravel, that is colonized by microorganisms. As the water flows upwards, the microorganisms break down the

contaminants in the water, producing clean, filtered water.

Another type of biofilter is the downflow biofilter, which is commonly used to treat stormwater runoff. In a downflow biofilter, water is passed through a bed of organic material, such as compost or wood chips, that is colonized by microorganisms. As the water flows downwards, the microorganisms consume the pollutants in the water, producing clean, filtered water.

Biofilters are also used in constructed wetlands, which are man-made systems that mimic the natural processes of wetlands. In a constructed wetland, water is passed through a bed of soil or gravel that is planted with wetland vegetation. As the water flows through the wetland, the microorganisms and vegetation remove pollutants from the water, producing clean, filtered water.

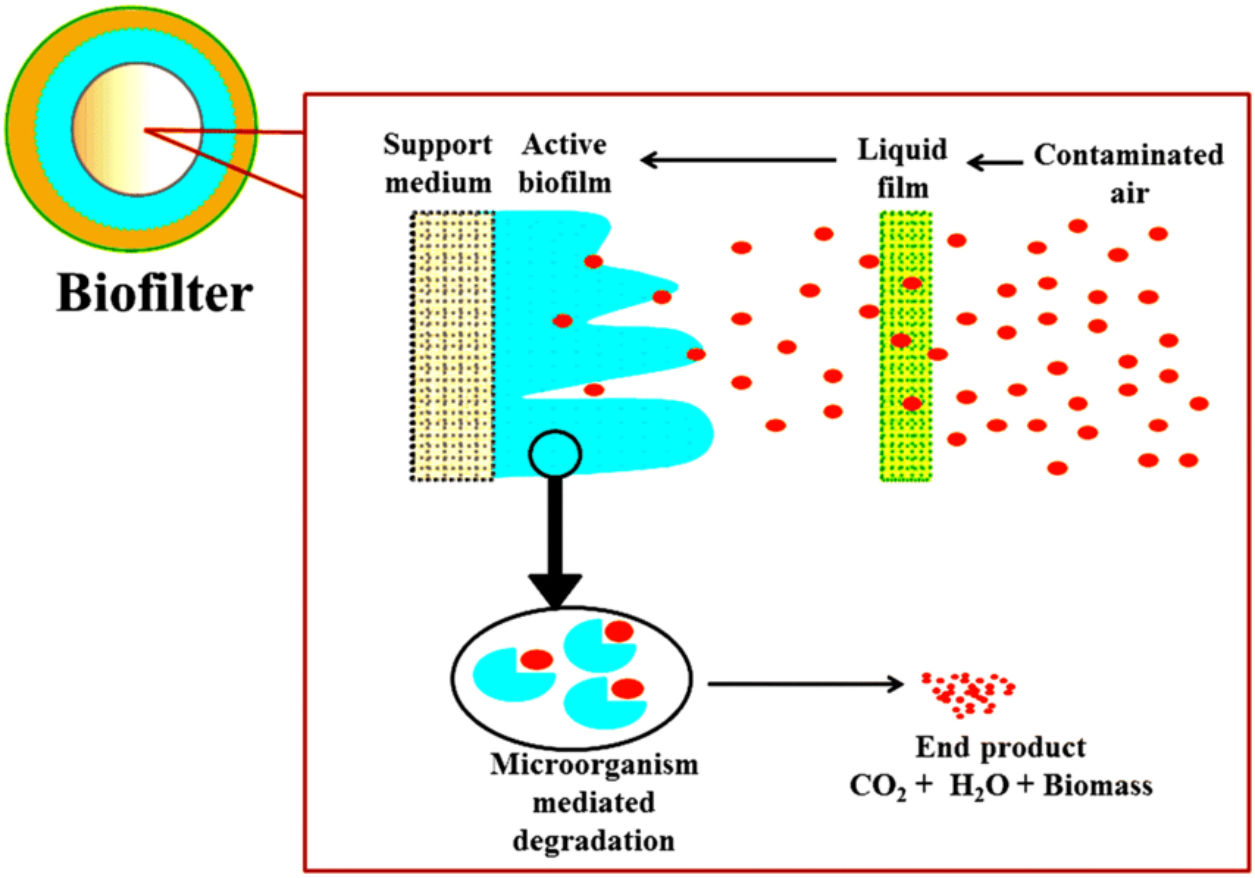


Figure 2. Phenomena involved in the biofiltration process

The implementation of biofilters can significantly reduce the environmental impact of water pollution and provide a sustainable solution for water treatment. Biofilters can be used to treat a variety of water sources, including municipal sewage systems, industrial effluent, and stormwater runoff. Biofilters are also effective in improving water quality in lakes and rivers, which can help to protect aquatic ecosystems and promote biodiversity.

In conclusion, water pollution is a growing global concern, and traditional water treatment methods are often expensive and harmful to the environment. Biofilters are an effective and environmentally friendly alternative to traditional treatment methods, using naturally occurring microorganisms to remove pollutants from water. Biofilters are low-maintenance, cost-effective, and sustainable, making them an ideal solution for treating a variety of water sources.

2. Experimental details

Purpose of project

• Minimizing the damage of the water basin to the ecosystem and the population that will live in that area after treatment

• Minimum financial and energy costs during water treatment

• Reducing chemical treatment and achieving water treatment using fully biological methods

• Despite the fact that the use of other chemical cleaning agents (such as chlorine or ozone) has an irritating and sometimes even lethal effect not only on human health, but also on aquatic organisms, no risks were observed during the use of the system developed in this project.

The biofilter is an effective and eco-friendly technology for treating polluted water sources. In this section, we will discuss the experimental details of using biofilters to clean polluted water sources.

Biofilters consist of a medium that supports the growth of microorganisms, which in turn remove pollutants from the water. The medium can be made of natural materials such as compost, wood chips, or peat moss. The size of the medium used in biofilters can vary depending on the specific application and the contaminants being targeted.

To design a biofilter, the first step is to determine the specific contaminants that need to be removed from the water source. This information can be obtained through water quality analysis and testing. The type of biofilter used will depend on the contaminants present in the water and the desired water quality.

One important factor to consider when designing a biofilter is the hydraulic loading rate (HLR). HLR is the volume of water that is passed through the biofilter per unit of time, and it is an important factor that affects the efficiency of the system. A high HLR can result in poor water quality due to insufficient contact time with the microorganisms in the filter medium, while a low HLR can lead to clogging of the filter medium and a decrease in performance.

Another important factor to consider is the temperature of the water. The efficiency of the microorganisms in the filter medium is affected by the temperature of the water. Generally, higher temperatures increase the activity of the microorganisms, resulting in more efficient pollutant removal.

Once the biofilter design is established, the next step is to construct and install the system. The installation process involves creating a container that will hold the filter medium, installing the plumbing and valves needed to control the water flow, and setting up the pumps needed to circulate the water through the system.

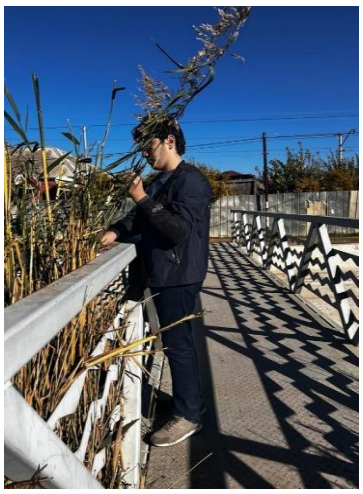
The filter medium is then added to the container, and the microorganisms are introduced into the system. The microorganisms can be obtained from various sources, such as wastewater treatment plants or natural environments. The microorganisms need time to establish themselves in the filter medium and become fully active, which can take several weeks.

The efficiency of the biofilter system can be monitored using a variety of methods, such as water quality testing and measuring the hydraulic loading rate. The effectiveness of the system can also be improved by periodically adding new microorganisms or changing the filter medium.

Biofilters can be used to treat a variety of water sources, including municipal sewage systems, industrial effluent, and stormwater runoff. Municipal sewage systems generate large volumes of wastewater, which can be treated using biofilters. The biofilter system can be designed to remove nitrogen, phosphorus, and organic matter from the wastewater, producing clean, treated water that can be safely discharged into the environment.

Industrial effluent contains a variety of pollutants that can be harmful to the environment and human health. Biofilters can be used to treat industrial effluent by removing contaminants such as heavy metals, oil, and grease. The treated water can be discharged into the environment or reused for various industrial purposes. Biofilters are an effective and eco-friendly technology for treating polluted water sources. The design of a biofilter system involves determining the specific contaminants that need to be removed from the water source, selecting the appropriate filter medium, and considering factors such as the hydraulic loading rate and temperature of the water.

Methods and procedures



№	Component Name	Unit of Measure	Amount of components	Permissible Hardness Limit
1	Phenolic compounds	mg/l	0.001	0.001
2	Copper, Cu	mkg/l	108	1000
3	Ferrum, Fe	mkg/l	**1345**	300
4	Molybdenum, Mo	mkg/l	**328.5**	250
5	Manganese, Mn	mkg/l	**580**	100

Figure 3. When the reed samples are collected (created by author)

Figure 4. P.Balsamica

Figure 5. Collect water from the territory of Okchuchay (created by author)

Work progress

The collected water samples were analyzed by the staff of the Khazar Ecological Laboratory belonging to "AzeLab" LLC (Spektrofotometr Specord 205, UV VİS Spectrophotometer 205). Preliminary. Water analysis results are as follows:

The ready bacterial cultures-Pseudomonas sp. and Bacillus sp. have been taken from Microbiology Institute of Azerbaijan. Two bacterial species cultured from water Pseudomonas sp. and Bacillus sp. were grown for 7 days in phenolic fluid medium (50 ml) which contains K_2HPO_4 (1g), $Na_2S_2O_3$ (150mg), $(NH_4)SO_4$ (300 mg), $CaCl_2$ (20 mg), FeCl (5 mg), Phenol (300 mg), distilled water (1 l).

1. Two ready bacterial cultures - Pseudomans sp., Bacillus sp. grown in phenolic liquid medium (50ml)-swinging thermostat (t-300 c, 3-7 days).
2. Waste tea and Poplar balsamica leaves have been dried under 70°C for 30 minutes and then kept in cool place for 1 night.

2. Selected as adsorbent - barley straw, pebbles, reed roots and spike, poplar leaves and tea waste (1g of each was weighed on an electronic scale) were first washed in alcohol (50ml) and then in distilled water (100ml). After that, all adsorbents were collected in a prepared bag and placed in 3 separate sterile flasks.
3. 100 ml of research object- Okchuchay was poured into all 4 flasks where the bags fulfilled with adsorbents were placed into three of them and 50 ml of culture liquid was added to two of them (Pseudomonas sp. culture liquid poured into flask №1, and Bacillus sp. culture liquid poured into flask №2) . Flask №3 was taken for finding out effects and efficieny of adsorbents on polluted water without bacterial bioremediation. Flask №4 was the control sample. For incubation, the flasks were placed in a swinging thermostat (t-300 C, 2 days).
1. Control (K) - Okchuchay
2. Flask №1 - Okchuchay - cultural fluid (Pseudomonas sp.) - adsorbent bag
3. Flask №2 - Okchuchay - cultural fluid (Bacillus sp.) - adsorbent bag
4. Flask № 3- Okchuchay – adsorbent bag
4. After incubation, the liquids in each flask were filtered through a sterile filter in order to seperate strange objects, as well as making its colour lighter for not creating problem in analyzing process, and sent to the laboratory for reanalysis.

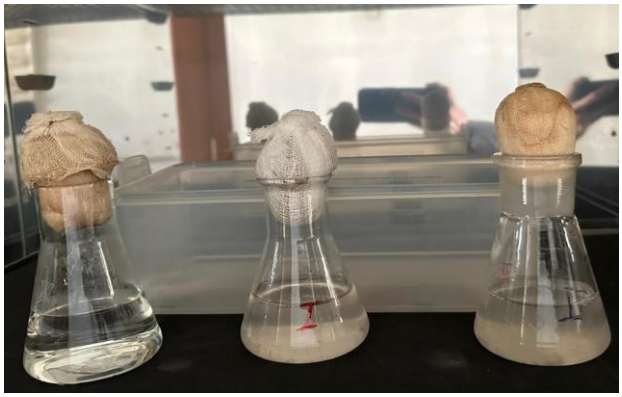


Figure 7. Work progress of analysis (created by author)

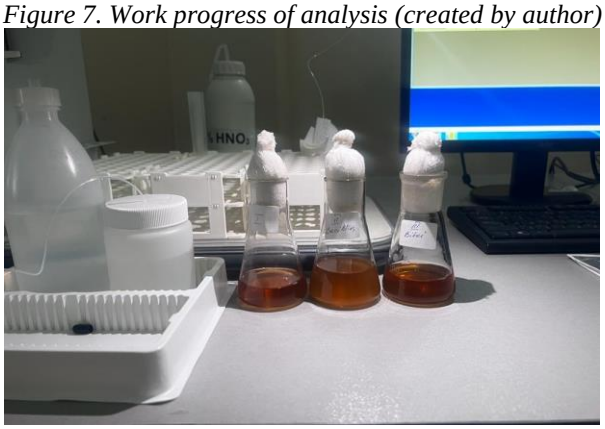
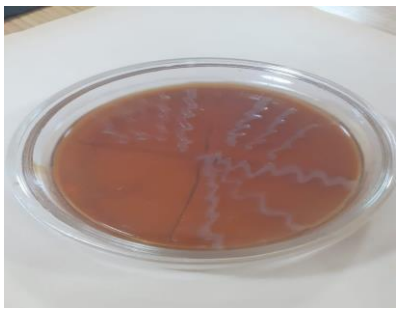


Figure 8. Analysis (created by author)



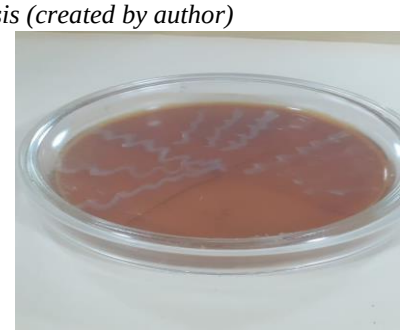


Figure 9. Pseudomonas culture (created by author)

3.Conclusion

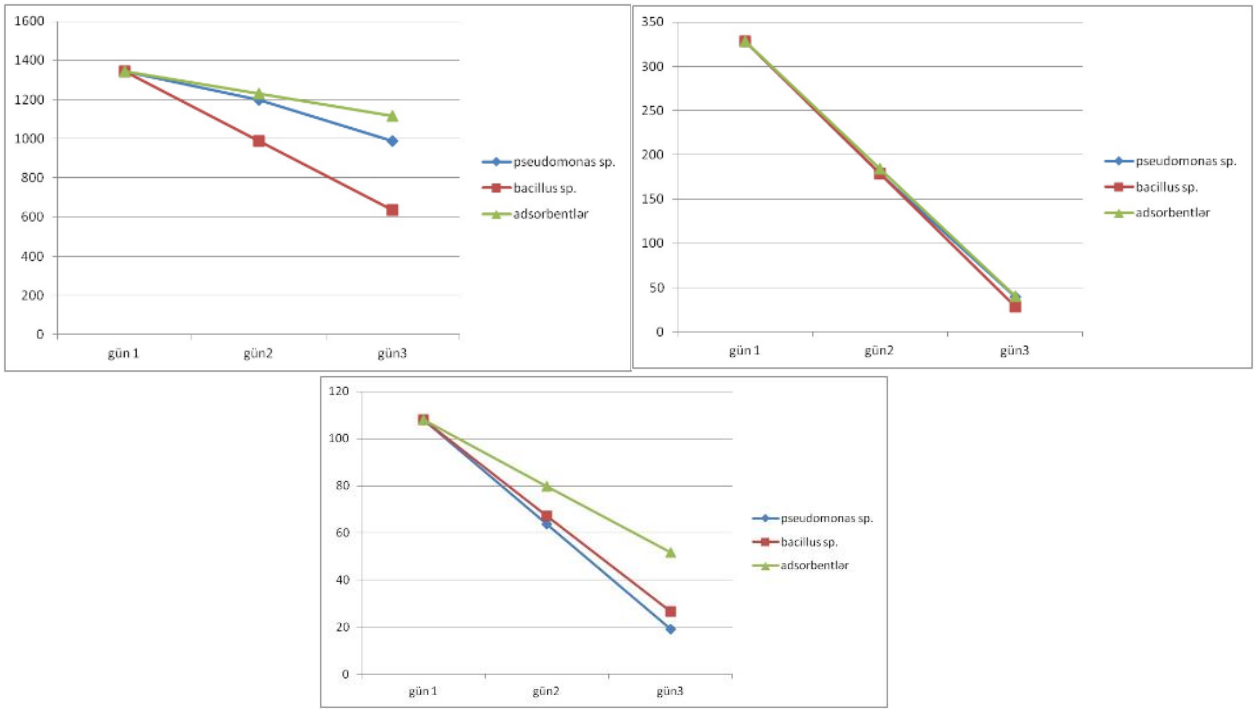
According to the analysis, Fe was 4.5, Mn 5.8 Mo 1.3 times higher than normal, Cu 108 μg/l, Phenol 0.001 mg/l. After the research, Fe 1.36, Mn 1.81, Mo 8.38, Cu 5.63 times decreased in the "Pseudomonas sp. + adsorbents" sample. Fe 2.12, Mn 2.41, Mo 11.45, Cu 4.06 times decreased in "Bacillus sp.+adsorbents"

sample. Fe 1.21, Mn 4.36, Mo 8.21, and Cu decreased 2.09 times in the "Adsorbents" sample. Phenol compounds decreased to 0 in all 3 samples.

№	Component Name	Unit of Measure	Pseudomonas + adsorbents	Bacillus +adsorbents	adsorbents	Permissible Hardness Limit
1	Phenolic compounds	mg/l	0	0	0	0,001
2	Ferrum, Fe	mg/l	990	635	1115	300
3	Manganese, Mn	mkg/l	320	241	133	100
4	Molybdenum, Mo	mkg/l	39,2	28,7	40	250
5	Copper, Cu	mkg/l	19,2	26,6	51,7	1000

Figure 10. Result of analysis (created by author)

What stands out from the table is that Bacillus did more efficient purification rather than other two examples. In the flusk of 'Bioadsorbents', the adsorbents without any bacteria had the least effective cleaning. Pseudomoas sp. made better purification rather than Bioadsorbents. Bacillus demonstrated the most effective cleaning in Mn, Mo, Fe. Pseudomonas showed the most effective cleaning in Cu. All the three materials cleaned the phenolic compounds in the same rate (100%). According to analysis, it has been decided that Bacillus sp. can be used in this device.



To apply these bags into river, a steel device has been designed. The device can carry 6 bags by DC motor(625RPM) with solar panel(6V) or battery (9V) in 2 wheels which connected by a metal stick. During the application of device into Okchuchay, the sizes of the parts of device should grow because of the size of river as below:

Length of stick= width of the river

Length of one of 3 main sticks which make wheels= depth of the river

It should be taken into account that, to achieve complete water saturation, several units of this device should be built in the river basin and to determine the number of units or the distance between two unit, obtaining the river flow speed, depth, and other parameters should be measured.

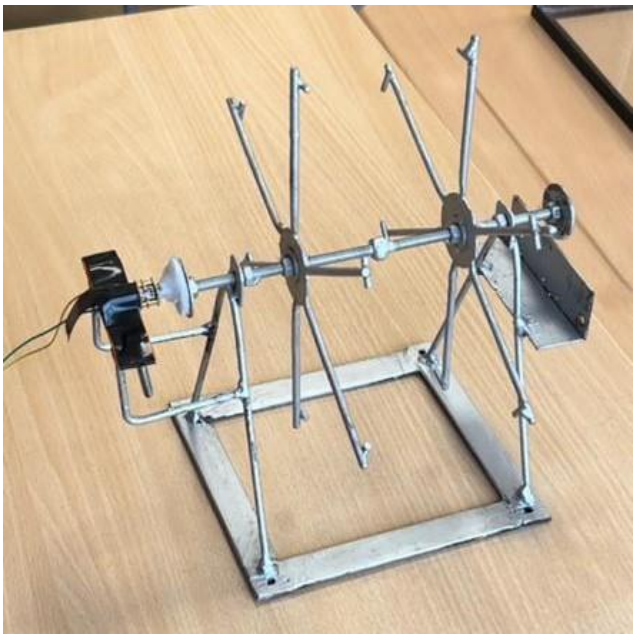


Figure 12. Steel device (created by author)

3. Conclusion

This biofilter is an effective and sustainable solution for cleaning polluted water sources. They use living microorganisms and natural items to break down and remove pollutants from the water, providing a natural and environmentally-friendly way to treat wastewater. The use of biofilter has been shown to be effective in removing a variety of pollutants, including heavy metals, industrial waste, phosphorus, nitrogen and other chemicals. Additionally, one of the main advantages of biofilter is that it is relatively low-cost and require minimal maintenance compared to other treatment methods. Moreover, they do not produce harmful byproducts or require the use of chemicals.Moreover, this biofilter is based on the bioremediation ability of Bacillus sp. and Phragmites australis which is well-known in Azerbaijan flora. Additionally, microbiological experiments demonstrate that adsorbent bags and Bacillus sp. can reduce the number of chemicals in water about 2.55601 times.Overall, biofilters are a promising technology for cleaning polluted water sources and have the potential to play an important role in ensuring access to clean and safe water for communities around the world.

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Enviromental assessment studies of atmospherıc air and soil natural resources of the republic's water resources

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Abstract: Water resources have their own characteristics, and the main ones are people, it plays a special role in the life of society and the development of nature. All of your life water is used in the fields and imagine the development of society without it cannot be done. The role of land resources in different areas of social production is different. Thus, land resources act as a spatial operation in the manufacturing industry and construction, in these areas it acts as a place where the labor process takes place. In the extractive industry, soil reserves act as a special storehouse from the depths of which wealth is extracted.

Keywords: water, soil, atmosphere, people, resources, land, nature.

1.Introduction

The most useful waters for people's life, household and national economy are fresh waters. Therefore, when we say water resources, we mean fresh water resources is held. Fresh water resources on Earth are a tiny fraction of the total water resources and therefore efficient use of those waters preservation should be one of the main problems of today. Water resources have their own characteristics, and the main ones are people, it plays a special role in the life of society and the development of nature. All of your life water is used in the fields and imagine the development of society without it cannot be done. Thus, in all processes on the earth, the surface of the earth in the formation, regulation of heat balance, water resources are special plays a role. Aristotle, along with fire, air and earth, water is the composition of nature considered part.Water resources are unique compared to other natural resources has features. One of these features is the continuous supply of water is restored. Solar energy from ocean, sea and land surface waterevaporates, the evaporated water rises into the atmosphere, in cold layers condenses and falls to the earth's surface in the form of precipitation. This part of the precipitation creates surface and underground flows and again they are poured into the oceans and seas, and some of them evaporate again. Thus, in nature, the water cycle is constantly repeated.

The modern stage of social and economic development of Azerbaijan characterized by greater involvement of water resources in the sphere of activity. With the intensive development of human economic activity in river basins waterlogging of rivers as a result of increased non- recyclable flow has decreased. The water resources of any area are in different phases the total amount of surface and underground water is assumed. However people's economic activity is almost only sweet of the water supply the part related to water is involved. Therefore, the water resources available for use in the assessment of water resources of any area is considered.

Azerbaijan, which has been engaged in irrigated agriculture since ancient times as always, today it has a great need for irrigation water. Our republic is one of the countries with little supply of water. The water supply of the Republic of Azerbaijan per person and per square kilometer of the water resources created within its territory is less than 2.5-8 times compared to the neighboring republics. The volume of water resources changes dramatically according to the seasons. In most of the rivers of the republic, the amount of water flowing from them decreases significantly in the months when the demand for water increases. More than 60% of the water flowing from the rivers (except Lankaran rivers) falls in the spring, spring-summer (March-June) months, and only 10-15% of the water supply falls in the hot months (July-September). The disproportion between the flow regime of the rivers and the water demand is regulated by the construction of water management facilities. Currently, approximately 1.45 million hectares of the territory of the republic are irrigated. Up to 17% of the land is built with underground water, 20% is built outside the river channel. from reservoirs, and the remaining 63% is irrigated through reservoirs built on the Kur-Araz rivers and canals taken from the rivers themselves.

Protection of water resources from pollution and depletion according to the water legislation, all consumers who use water for this purpose must comply with the following general rules:

- should not harm the environment and natural objects, other water should not violate the rights of consumers;

- use water resources efficiently and economically constantly improve its quality;

- should always operate cleaning constructions in good condition, increase their work efficiency;

- water from wastewater containing pollutants taking measures to completely cut off transmission to resources;

- to account for the quantity and quality of used and discharged water acquisition and analysis.

The production method existing in society always determines the nature of land relations and the possibilities of using available land resources. It is known that land resources are limited. The growth of the country's population requires a progressive approach to land resources and efficient use of land resources. The role of land resources in different areas of social production is different. Thus, land resources act as a spatial operation in the manufacturing industry and construction, in these areas it acts as a place where the labor process takes place. In the extractive industry, soil reserves act as a special storehouse from the depths of which wealth is extracted.

Land resources act as a labor subject. Soil resources have rare properties. Land resources are the main means of production in the production of new raw materials with the help of natural resources. Soil resources have many functions. Land resources are the most important part of national wealth. Land is a non-renewable means of production. The difference between land resources and other means of labor is that land resources never wear out. The operational period of the plots of land has not been determined. During the development of productive forces, it is possible to replace most of the means of production. Many means of production are reproduced. Therefore, the evaluation value of those means of production decreases over time, the potential value of their resources increases due to land factors, inflation, regular capital investment, etc.

2.Experimental details

In accordance with the legislation in force in the Republic, state bodies, municipalities, individuals and legal entities in connection with the land resources market during its cycle in the process of buying and selling, pledging and donating land resources, as well as changes in ownership and lease rights in other forms is a system of economic relations formed between

Valuation of land resources market as defined the necessity of the activity can be related to the following reasons:

- purchase and sale of land resources;

- transfer of land resources to the statutory fund;

- pledge of land resources;

- change of land resources;

- donation of land and resources;

- the transfer or transfer of ownership of land resources to others in accordance with the order of inheritance;

- transfer of land resources use and lease rights to other persons.

Land market objects include the mentioned land resources and land-related rights:

- land resources given to private ownership;

- land resources that are owned by municipalities and can be privatized;

- land resources acting as collateral;

- in the process of privatization of state-owned objects, the land resources where it is located;

- use and lease rights on land resources in different types of ownership.

In accordance with the existing land relations in our country, legal relations such as buying and selling land resources at market prices, donating, changing, pledging, leasing to other subjects have been formed. In addition, the inheritance of the cycle of land resources it also includes rights such as free land resources at a certain stage of the reform for use in the agrarian field. In connection with the deals conducted on land resources, requests are made about the necessity of the form provided for in the current legislation, the state notarial approval and registration.

All the main requirements for the purchase and sale of land plots have been defined in the current legislation related to the evaluation of land resources. Maintaining the intended purpose of land resources

and it consists in observing the border dimensions of the land plots determined by the current legislation.

There are the following basic principles of land resource valuation under market conditions:

- demand and supply principle;

- more efficient and best use option;

- the principle of surplus productivity;

- the principle of change;

- the principle of waiting results.

It is clear that it is possible to determine the real market value of any type of property through the interaction of supply and demand factors. This, in turn, is reflected in the market values of that type of property. Supply and demand ratios, including the value of demand and the value of supply, in the evaluation of land resources is of special importance. Because the supply of land resources is a fixed quantity. In general, the values of land resources in a specific area are determined by demand factors. For example, population density and economic development rates, levels of employment and profits, capacity of the local transportation system, mortgage interest rates, etc.

The principle of using land resources in the best possible and most efficient way is one of the main principles of land resources assessment. The market value of land resources property depends on the current use option as well as the potential use options in parallel. This principle once again shows itself more clearly in determining the market value of land resources that have been appropriated at a certain time. The more profitable the degree of potential use of land resources, the more land the volume of demand formed for its reserves and its real market value will be higher. The value of land resources appropriated by owners in urban areas will always and always be higher than the value of land resources in the countryside.

3.Conclusion

and their use in Azerbaijan were investigated. The ecological condition of water resources was also discussed. Information about the factors influencing the assessment of land resources is also reflected.

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Technologies for the extraction of graphene-based memory elements

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Abstract: Technologies for obtaining graphene-based memory elements have been garnering considerable attention in recent years due to their offerings of high speed, compact size, high durability, and energy efficiency. The atomic layer structure of graphene, combined with its unique physical and chemical properties, paves the way for vast opportunities in the design and development of memory devices. A recent research development in this area has transformed the unipolar graphene transistor into a novel memory device, allowing rapid transitions between electron and hole channels. Another application leverages the ferroelectric properties of graphene, enabling the creation of a memory device that can be directly written to and read from. All these studies promise new horizons in the technology for producing graphene-based memory devices. Higher speeds in the writing and reading of data, higher data storage levels, and lower energy consumption are anticipated. Additionally, this research also foresees applications in a broader spectrum, impacting various industries ranging from optoelectronics, sensors, nanotechnology, and beyond.
Key words: Semiconductor, Nanotechnology, Memory Elements, Lithography, Chemical Vapor Deposition (CVD), Epitaxy, Heterostructures, Diodes, Transistors.

• **Preparation of Graphene Material**: First and foremost, the preparation of graphene is required. This can occur through methods such as Chemical Vapor Deposition (CVD), exfoliation, or chemical reduction of oxidized graphene (GO).
• **Processing of the Material**: Subsequently, using nanotechnology processes like electron lithography or laser etching, we modify graphene to the desired shape and dimensions. This stage determines the primary characteristics of such a device.
• **Device Fabrication**: Leveraging the semiconductor properties of graphene, we transform this material into a memory structure. This can be achieved, for example, through the installation of connectors or memory elements.
• **Device Examination and Testing**: Next, we examine the device's operation and test it to identify any potential issues. This can be conducted via methods like electron spectroscopy and colorless laser spectroscopy.
• **Optimization**: Finally, we make modifications to optimize the device's features. This might involve, for instance, using nanotechnology to improve connections between layers of graphene.
• **Application Deployment**: The optimized structure is then applied in real-world scenarios. This could be in computers, sensors, or energy storage systems.

1.Introduction

Grafene's exceptional properties transform it into a significant innovator in electronics, energy, chemistry, nanotechnology, and numerous other domains. Owing to its impressive electrical and thermal conductivity, substantial mechanical strength, as well as optical and magnetic features, graphene plays a pivotal role in the development of next-generation semiconductors, superconductors, and optoelectronic materials. The creation of graphene-based memory elements offers substantial possibilities in the application of computers and mobile devices. These technologies are underpinned by memory elements that exploit graphene's outstanding characteristics. Graphene's electrical conductivity and ultra-high-speed electron transport make it enticing for advanced electronic devices. Using graphene in lieu of silicon in modern transistors can lead to the development of smaller, more agile devices with reduced energy demands. This can also accelerate computer processing speeds, reduce their energy requirements, and potentially transform existing batteries into devices that can operate for extended durations. This introduction will precede an article elucidating the technologies behind producing graphene-based memory elements. This article will explain what graphene is, its electronic properties, and the significance it bears in electronic memory devices. Additionally, it will provide examples from profound research and innovative applications, aiding readers in understanding the potential of graphene-based memory and how it could revolutionize our daily lives.

Preparation of Graphene Material. Graphene is a material made up of carbon atoms arranged in a flat sheet, just one atom thick. It was first studied in 2004 by Andre Geim and Kostya Novoselov at the University of Manchester. This discovery earned them the Nobel Prize in Physics in 2010.

There are several methods for producing graphene, but among the most common are mechanical exfoliation, chemical vapor deposition, and sedimentation using chemical vapor deposition.

Mechanical Exfoliation Method: This method was employed by Novoselov and Geim when they first researched graphene.

Table 1. Description of Procedure Steps.

Procedure Steps	Description
Graphite Exfoliation Using Tape	A piece of graphite is exfoliated using ordinary adhesive tape. This causes the carbon atoms on the graphite to stick to the adhesive surface of the tape.
Taping the Adhesive Surface onto Another Material	The peeled tape is then adhered to a pre-selected substrate (e.g., silicon dioxide). This provides a stable base for obtaining graphene.
Repeated Peeling of the Tape	By repeatedly peeling the tape, it's possible to reduce many layers of the graphite. With each peel, several layers of the graphite are removed, and as a result, graphene sheets of one atom thickness remain. (Figure 1)
Result	Ultimately, graphene sheets of one atom thickness are obtained. These sheets constitute high-quality graphene that can be used in the production of electronic and optoelectronic devices.

In this process, a piece of graphite is exfoliated using tape. The surface of the tape is then adhered to another material (e.g., silicon dioxide) and the graphite on the tape is reduced by repeatedly peeling it off. As a result, graphene sheets of a single atom thickness are obtained.

Table 1 -shows how the Mechanical Exfoliation Method prepares graphene. The simplicity of this method makes it popular among researchers worldwide, but it has several limitations. These include the limited size of the graphene obtained, the waste of a significant amount of graphite, and the inability to replicate the process.

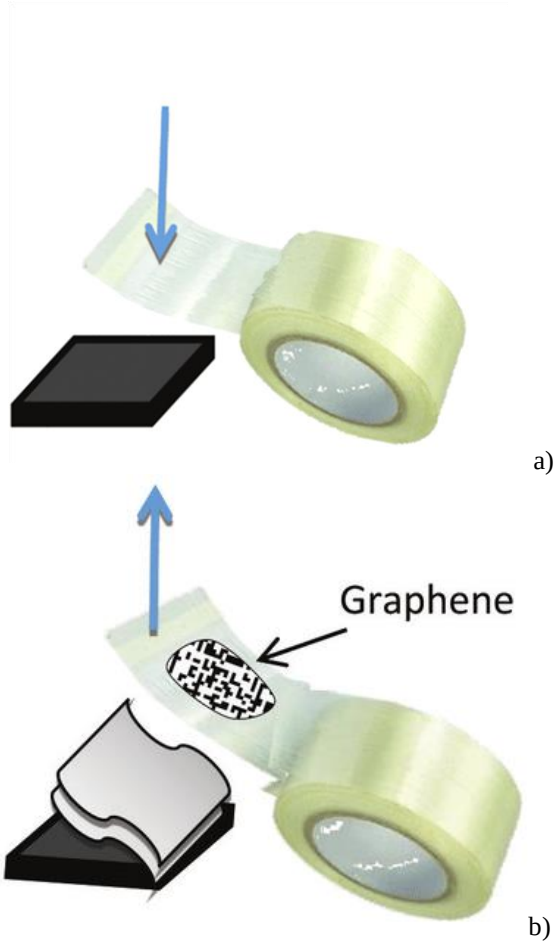

Fig 1. Scotch tape method for graphite exfoliation

Nevertheless, this method is still widely used in laboratories and research.

Chemical Vapor Deposition Method: In this process, methane or another carbon source is heated

to a high temperature and then deposited onto a substrate (e.g., heated wafers) (Table 2). Although it's more efficient compared to the mechanical exfoliation method, controlling this process is challenging and ensuring the quality of graphene over large areas is difficult.

Table 2. Characteristics of the Chemical Vapor Deposition Method

Procedure Steps	Description
1. Choice of Carbon Source	The first step involves selecting a carbon source, like methane. This carbon source constitutes the primary component of graphene in the chemical vapor deposition process.
2. Heating	The carbon source is heated to high temperatures (approximately 1000°C). This heating ensures the conversion of carbon into its gaseous state, facilitating the formation of graphene sheets.
3. Choice of Substrate	A substrate, such as a heated wafer, is chosen. This substrate will serve as the platform on which the forming graphene sheets are deposited.
4. Deposition	The highly heated carbon gas is deposited onto the substrate, resulting in the formation of graphene sheets.

Chemical Vapor Deposition (CVD) Method: In this process, we prepare a solution of graphene oxide, and then agitate this solution with ultrasonic waves, leading to the fragmentation of the graphene oxide into smaller particles. (table 4) These particles are then reduced by coming into contact with hydrogen, resulting in the production of graphene.

Table 3. Chemical Vapor Deposition (CVD) Method - Advantages and Disadvantages.

Advantages	Disadvantages
1. Large-scale production of graphene is possible.	**1. Controlling the process is difficult.**
2. It's a relatively cost-effective method.	**2. Ensuring the quality of graphene for large areas is challenging.**
3. Quick production of graphene is possible.	**3. Precise thickness control is required.**

Table 3 can serve as a source to learn about the main features of the Chemical Vapor Deposition Method and the advantages and limitations of this method.

Table 4. Highlights the key features of the Chemical Vapor Deposition Method.

Feature	Description
Method	Chemical Vapor Deposition (CVD)
Process	Methane or another carbon source is heated to a high temperature and then deposited onto a substrate (e.g., heated metal plates).
Duration of Operation	This method is relatively fast and graphene can be obtained in a few minutes.
Efficiency	Although this method is more efficient than the mechanical exfoliation method, controlling the process is challenging.
Quality	The quality of graphene obtained by this method is lower compared to the mechanical exfoliation method. It's challenging to ensure the quality of graphene over large areas.
Applications	This method is mostly used to produce graphene over a large area, for instance, in commercial control systems and electronic devices.

Material Processing: Scientific research indicates that with the use of graphene oxide (GO), it is possible to create next-generation semiconductors and diodes. Various processes are employed for the creation of these materials, with material processing being one of the most crucial.

Material Processing The process of material processing ensures that graphene undergoes specific modifications that determine the fundamental properties of a given device. This encompasses nanotechnology processes such as electron lithography, laser ablation, chemical vapor deposition, and physico-chemical processes.

Electron Lithography Electron lithography is a process that shapes graphene into desired forms and dimensions. It's executed with an electron gun, where the electrons target a specified graphene region, subsequently altering the graphene's structure and electrical transmission properties.

Laser Ablation Laser ablation also modifies the forms and dimensions of graphene. This takes place through the application of a high-intensity laser beam which impacts the targeted region of the graphene, altering its structure and properties.

Chemical Vapor Deposition The chemical vapor deposition process is where a carbon source is utilized at high temperatures. This method is ideal for producing graphene over large areas, but controlling and maintaining its quality can be challenging.

Physico-Chemical Processes These are a set of processes used to optimize graphene's electrical transmission properties. By influencing graphene's

temperature and pressure conditions, these processes modify its characteristics.

These processes follow a sequential order, meaning each is crucial for ensuring the success of the subsequent one. For instance, electron lithography and laser ablation are initial processes for transforming graphene into the desired shape. The chemical vapor deposition process provides the initial material for subsequent processes by ensuring the production of large-area graphene. Physico-chemical processes, on the other hand, serve as the final process for enhancing device characteristics.

In new applications, these processes are vital for studying the alterations in transmission properties of graphene oxide affected by radioactive radiation. These changes might modify the function, efficiency, and other properties of diodes.

In conclusion, scientific studies involving the use of graphene oxide (GO) unveil new possibilities to develop next-generation diodes by altering this unique material's electrical transmission properties.

3. Utilization of Graphene in Electronic Components: The use of graphene in electronic components like semiconductors and diodes is made possible due to its unique properties. These properties encompass high electron mobility, superior thermal conductivity, quadratic energy spectrum, among others.

Structural Implementation: The semi-conductive properties of graphene make it an ideal material for electronic device memory elements. (Fig.2) This process converts the material into a memory structure, ideally through the integration or implementation of connecting or memory elements.

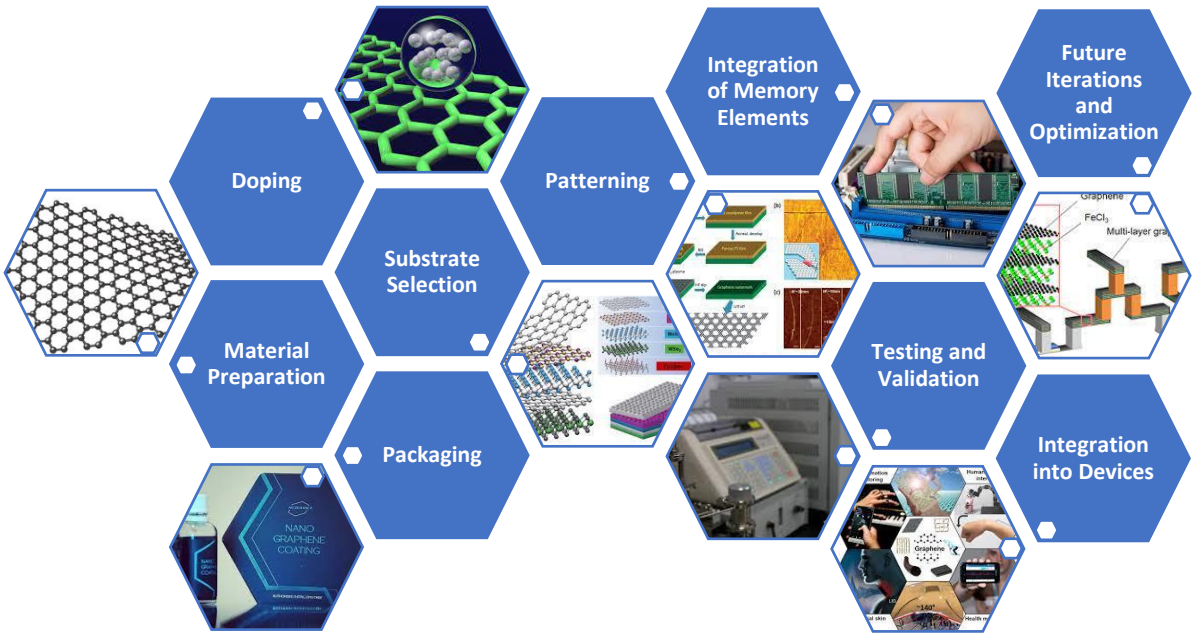

Fig 2. The main stages of graphene material include the following

Material Preparation: The initial step involves obtaining high-quality graphene, often through methods like chemical vapor deposition (CVD) or mechanical exfoliation. The purity and structure of the graphene are crucial for its electrical properties.

Substrate Selection: Depending on the intended application, an appropriate substrate (such as silicon wafer, boron nitride, or other) is chosen to support the graphene layer and to facilitate integration into electronic devices.

Doping: Introducing specific atoms or molecules (dopants) into the graphene structure can modify its electronic properties, making it more suitable as a semiconductor. This step can be achieved through chemical or thermal methods.

Patterning: Electron-beam or photolithography techniques can be employed to design specific patterns or structures on the graphene, which will define the layout of the memory elements.

Integration of Memory Elements: Depending on the technology used (e.g., flash, DRAM, or resistive RAM), various memory elements or cells can be incorporated into the patterned graphene.

Interconnection: Conductive paths are established, usually by depositing metal layers, to connect individual memory cells, allowing them to work in conjunction and be accessed by external circuits.

Testing and Validation: Once the memory structure is complete, it undergoes rigorous testing to ensure

data storage, retrieval, endurance, and overall performance meet the required standards.

Packaging: To protect the memory structure from environmental factors and to facilitate its integration into devices, it is encapsulated in a protective layer or chip casing.

Integration into Devices: The final graphene-based memory element is then integrated into electronic devices, where it can store and retrieve data as needed.

Future Iterations and Optimization: Post-production, there's continuous research and development to refine the process, improve efficiency, reduce costs, and enhance performance. Feedback from testing, as well as real-world application, will guide these enhancements.

The steps shown in the figure represent the comprehensive process of converting graphene, which has unique semiconductor properties, into functional memory elements for electronic devices. This advance highlights the potential of graphene to revolutionize the electronics industry, offering memory solutions that are faster, more efficient and potentially more durable than many of today's conventional technologies.

The Impact of Processes on Graphene-Based Memory Devices and Their Evolution

These processes follow one another and each step ensures the successful outcome of the subsequent phase. Each phase significantly influences the quality, efficiency, and other attributes of the memory structure. Subjecting graphene oxide to these processes enhances its potential utility for memory devices, offering the possibility of creating storage structures that are compact, highly efficient, energy-conservative, and have extended data retention capabilities.

If the effect of radioactive radiation on these properties of graphene oxide were fully understood, it could aid in devising more effective strategies in the fabrication and application of diodes and semiconductors.

with colorless laser spectroscopy, one can discern the optical properties of the material and its reaction to radiation.

This information aids in understanding the device's functioning, optimizing its performance, and addressing any underlying issues. Consequently, these processes are pivotal for the enhancement of graphene oxide-based device operations.

Ongoing research paves the way for an expanding range of applications for graphene oxide-based devices. With their unique properties and broad application domains, these devices play a significant role in the future technologies of this generation. As research progresses and technologies evolve, the potential of these devices continues to expand.

5. Using graphene oxide in the production of semiconductor materials, the final stage is optimization. This stage applies changes to maximize the performance of the device.

Optimization. Optimization is applied to measure the impact of all changes made in the production process on performance. This stage encompasses analyzing the effect of each element that alters the device's properties. The optimization process is carried out through nanotechnology. For instance, various modifications can be made using lasers, electrons, or chemical reagents to create better connections between layers of graphene.(Fig 3) Optimization also covers changes needed to enhance the device's energy efficiency, reduce heat-emitting components, and maximize performance. This involves several steps:

2.Experimental details

Post-fabrication of graphene oxide-based devices, the most critical phase is their examination and testing. Examination is conducted to analyze the device's structural, microscopic properties, and electrical transmission attributes. Tests are executed to verify the operation of the device, measure its operational characteristics, and identify any underlying issues.

Diverse technologies are utilized for executing these two processes. Examination processes employ techniques such as electron spectroscopy, colorless laser spectroscopy, X-rays, and ultra-analysis spectroscopy. Testing processes include a variety of tests, like measuring electrical transmission properties, changes due to radiation exposure, among other analysis methods.

Electron Spectroscopy Electron spectroscopy is a technique used to analyze the electronic structure and chemical composition of materials, offering insights into the material's internal structure and its influence on its functionality.

Colorless Laser Spectroscopy Colorless laser spectroscopy is employed to measure a material's optical properties. This helps in understanding how the material responds to radiation exposure and its consequent impact on the device's operation.

With these two techniques, one can gather substantial information regarding the functionality of the device. For instance, electron spectroscopy provides insights into the electronic structure of the material and its electrical transmission properties. Simultaneously,

Fig.3. Optimization process

Optimization through Nanotechnology: This encompasses the enhancement of connections between graphene layers using tools such as lasers, electrons, or chemical reagents.

Energy Efficiency: Energy efficiency of a device is an indicator measuring the ratio of a device's energy consumption to its performance. To enhance a device's energy efficiency, it's crucial to optimize the parts of the device that consume the most energy.

Reducing Heat-emitting Elements: The heat-emitting elements of a device can affect the device's performance. To reduce these elements, it is essential to optimize the parts of the device that emit the most heat.

Maximizing Performance: To maximize a device's performance, the elements that consume the most energy and emit the most heat should be optimized.

The optimization process requires the application of all these elements to maximize the device's performance. This process is essential to maximize the device's performance, increase energy efficiency, and reduce heat-emitting elements.

Consequently, the optimization process is imperative to utilize the electrical transmission properties of graphene oxide (GO) to their fullest. This is essential for maximizing the performance of graphene oxide as a semiconductor material. This also broadens the potential application fields of graphene oxide, meaning its fundamental properties can potentially change its application in new devices.

6. Applications of Graphene Oxide (GO): The application of graphene oxide (GO) offers unique opportunities for optimizing electronic devices like semiconductors and diodes. These optimized structures are implemented in real-world settings, transitioning from theory to reality.

Computer Technologies: Graphene oxide plays a significant role in the development of computer technologies. For instance, it's used in processors and memory chips. The electrical transmission properties of graphene oxide enhance the processing speed of processors and improve the capability of memory chips. Additionally, graphene oxide reduces the energy consumption of the computer and improves its heat distribution.

Sensors: Graphene oxide is used in various sensors. These can range from motion, pressure, atmospheric pressure, humidity, temperature, to chemical sensors. The unique properties of graphene oxide increase the sensitivity and accuracy of these sensors. Moreover, its usage prolongs the lifespan of the sensors and reduces their energy consumption.

Energy Storage Systems: Graphene oxide also finds extensive applications in energy storage systems. It's used in devices like batteries and supercapacitors. The high electrical transmission properties of graphene oxide enhance the energy storage capability of these devices. Furthermore, graphene oxide improves the heat distribution of energy storage systems and extends their lifespan.

These applications highlight the potential of graphene oxide. Its application can foster advancements in various fields like computer technologies, sensors, and energy storage systems. However, extensive research and scientific investigations are required to expand and optimize these applications.

3.Conclusion

The production technologies of graphene-based memory elements are among the most fascinating areas in the fields of nanotechnology, semiconductors, and physics. In recent years, scientific research has focused on processes that alter graphene's electrical transmission properties. These processes include electron lithography, laser ablation, chemical vapor deposition, and physico-chemical processes.

These processes, by modifying the transmission properties of graphene oxide, open up vast opportunities for the production of new generation semiconductor elements and diodes. Moreover, these processes change the reaction of graphene oxide diodes to radioactive radiation, altering the operating characteristics of these diodes.

As a result, the application of these processes has led to the development of new technologies in the production of graphene-based memory elements. These technologies ensure the emergence of new applications in the semiconductor materials field, offering opportunities to enhance the performance of electronics and computer systems.

Furthermore, these processes make the production of new-generation graphene-based memory elements more efficient, safer, and more reliable. This opens intriguing prospects for both researchers and engineers working in the industrial sector.

In conclusion, scientific research with the use of graphene oxide (GO) unveils new possibilities by modifying this unique material's electrical transmission properties, paving the way for creating new generation diodes and memory elements. This presents a perfect opportunity to reach new heights in the fields of electronics and nanotechnology.

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