



# EVALUATION OF THE PHYSICAL-CHEMICAL PROPERTIES OF OIL AND GAS COMPOSITION IN THE KUMKOL OIL FIELD, KAZAKHSTAN

**A. A. SHUKMANOVA\* and A. S. ABDELMAKSOU**

Institute of Geology and Oil Gas Business After K. Turysova, Kazakh National Technical University  
After Name of K. I. Satpayev, ALMATY, REPUBLIC OF KAZAKHSTAN

## ABSTRACT

Kumkol Oil Field is an oil field located in Kyzylorda Province. It was discovered in 2008 and developed by PetroKazakhstan. The oil field is operated and owned by PetroKazakhstan. The total proven reserves of the Kumkol oil field are around 300 million barrels ( $41 \times 10^6$  tonnes), and production is centered around 78,000 barrels per day ( $12,400 \text{ m}^3/\text{d}$ )<sup>1</sup>.

**Key words:** Kumkol, Oil and gas, Kyzylorda, PetroKazakhstan.

## INTRODUCTION

PetroKazakhstan Kumkol Resources AO (PKKR) is an oil producing company registered in the Republic of Kazakhstan and engaged into development of oil fields and exploration blocks in the South Turgai basin: Kumkol South, South Kumkol, Kyzylkiya, Aryskum, Maibulak, East Kumkol and North Nuraly. During its operation in Kyzylorda Oblast PetroKazakhstan Kumkol Resources produced more than 51 million tons of oil, including 3.1 million tons in 2009.

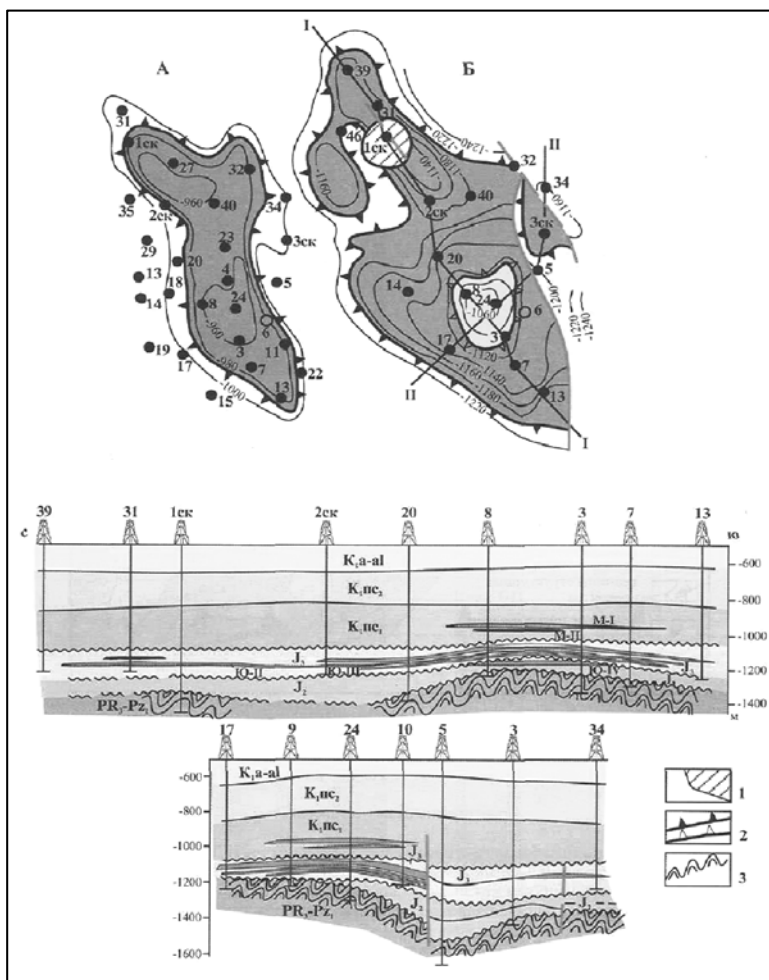
For the purpose of fields and associated infrastructure development PKKR has carried out a number of major projects, including construction of collector systems at the fields, infield motor roads, systems for water injection into reservoirs for the purpose of reservoir pressure maintenance, oil storage tanks, as well as drilling and completion of wells. In 2007 PKKR constructed a 10 inch gas pipeline Kyzylkiya-Aryskum, put into operation an oil gathering system at Aryskum and Kyzylkiya fields, modified the reservoir pressure maintenance system at Kumkol field and also expanded the field camp at Aryskum field to provide accommodation to 200 additional people<sup>2</sup>.

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\* Author for correspondence; E-mail: [anar\\_shukmanova@yahoo.com](mailto:anar_shukmanova@yahoo.com)

### General view of the Kumkol field

Within South Turgai basin to the present time there are 17 oil and gas fields, of which 2 fields-Arys and South Konys are gas-condensate, and the rest-oil and gas condensate-oil. The largest oil reserves are Kumkol Ak shabulak and Konys. Brief characteristics of the most common fields provided below (Fig. 1).



**Fig. 1: Kumkol oil field<sup>4</sup>**

PetroKazakhstan has always been trying to replace its production with new commercially valuable discoveries of fields. For instance, the Company continues to implement its exploration program, thus remaining the only large oil company operating in South-Turgai basin obligated to continue this program for complete utilization of the

potential of the region. PKKR currently has six hydrocarbon production contracts for the South-East part of Kumkol, Kumkol South, East Kumkol, Kyzylkiya, Aryskum and Maibulak fields and two hydrocarbon exploration contracts for the fields adjacent to Kumkol field and exploration blocks in Karaganda Oblast (Karabulak, West Karabulak and North Karabulak). The company has material resources, professional qualification, skills, manpower and all other necessary resources to provide services to third parties in the area of production and exploration, including to Kolzhan LLP in production at North-West Kyzylkiya field and exploration of hydrocarbon reserves on exploration blocks Tuzkol, West Tuzkol, Zhanbyrshy and Taskuduk, and to PKVI in exploration of hydrocarbon reserves in Doshan exploration area<sup>3</sup>.

In 2008, gas utilization facilities were commissioned at Kumkol, Aryskum, Kyzylkiya and Maibulak fields: the works related to the gas re-injection at Kumkol field, the gas transportation system from Kyzylkiya to Aryskum field and the gas injection system at Aryskum field was completed. All construction and installation works were also fully completed under the gas utilization project at Maibulak field. On five sites of the gas gathering system at Kumkol field the construction, installation and pre-commissioning operations were completed at the beginning of the 2<sup>nd</sup> quarter, 2009. Within the frameworks of the gas utilization program PKKR invested more than 143 mln USD into its implementation in years 2004-2010. The Company was among the pioneers that started to develop and implement the gas utilization programs in Kazakhstan.

#### **Investments made by PKKR in the associated gas utilization include**

Construction of a gas turbine plant at Kumkol-Associated gas utilization facilities at KAM fields (Kyzylkiya, Aryskum, Maibulak) -Associated gas gathering and utilization facilities at Kumkol. In 2010 together with JV JSC Turgai Petroleum the construction of the two additional gas turbine plants with the total capacity of 50 mW had started at Kumkol oil field. Once this facility is commissioned, the total capacity of the Kumkol field power plant will amount to 100 mW, which will ensure complete putout of flares at Kumkol field.

PetroKazakhstan Kumkol Resources continues to be one of the major sponsors for social and charity projects in Kyzylorda Oblast. During its operation in the republic the company has allocated significant funds for the implementation of sponsorship and charity projects. Total sponsorship in 2011 amounted to 4.8 million USD. The financial support provided by PKKR to schools, kindergartens, summer camp Arai Sunrise, as well as to hospitals, clinics and other institutions, is well known in Kazakhstan. Together with Kyzylorda Oblast Akimat the Company actively participates in strengthening and supporting the social and economic development of Kyzylorda Oblast. As part of the Memorandum of Cooperation signed between PKKR and the Oblast Akimat, in 2011 the company provided

more than 3 million USD for various social, cultural and sports projects in Kyzylorda Oblast, including the support for some children institutions, development of rural settlements and utilities in Kyzylorda city<sup>2</sup>.

### Properties and composition of the oil and gas in the kumkol oil field

During the investigation of physical-chemical properties of oil and gas composition are determined by the results of studies of deep oil well samples taken during 5 horizons sampling M-I and U-II. After performing flowsheet further explore the depths of the sample of oil from wells in 1074 horizon SE-I. Sampling and testing of samples of oil carried two organizations - JSC "NIPIneftegaz" and Pencor International Ltd.<sup>5</sup>

### Properties of oil in the reservoir

#### I site (M-I horizon)

Previous study presents the results of four studies of deep oil samples taken in June 2001 when testing M-I horizon of the perforated interval 1097-1102 m. Three samples were investigated in ZAO "NIPIneftegaz" one - in the laboratory Pencor International Ltd. Results of the study 3 samples obtained in ZAO "NIPIneftegaz" have good convergence between themselves and satisfactory agreement with the data Pencor International Ltd. This allowed for the characterization of most of the parameters of the reservoir oil to use average values (Table 1).

**Table 1: Properties of the oil in reservoir. Horizon M-I**

Name	No. of investigated		Range	Calculated Value
	Wells	Samples		
Reservoir pressure, Mpa	-	-	-	10.1
Reservoir temperature, C	-	-	-	50
Saturation pressure of gas oil, MPa	1	4	0.17-0.29	0.29
gas content, m <sup>3</sup> /m <sup>3</sup>	1	4	0.5-0.74	0.63
m <sup>3</sup> /t	1	4	0.60-0.88	0.75
Volumetric coefficient	1	3	1.019-1.020	1.02
viscosity of oil in reservoir, MPa*c	1	4	4.65-5.3	5.07
Density of reservoir oil, Kg/m <sup>3</sup>	1	4	824.0-825.3	824.6
The average coefficient of compressibility of reservoir oil, 1/MPa*10 <sup>4</sup>	1	3	13.9-16.2	15.4

Saturation pressure ( $P_{nas}$ ) in this report is accepted by the maximum value and 0.29 MPa. Formation oil deposits under consideration in their properties significantly different from the Cretaceous deposits of the main oil Kumkol field. Its main feature is the low gas content-less than  $1 \text{ m}^3/\text{t}$ , contributing to the low value of the saturation pressure and volumetric efficiency<sup>5</sup>.

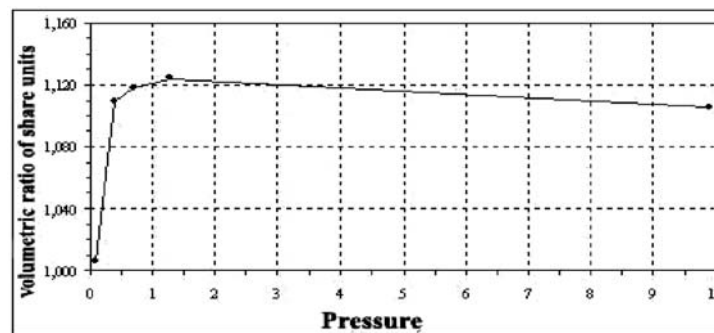
## II sites (SW-I-II horizon)

The second object of development includes Jurassic deposits SE-I and SE-II horizons.

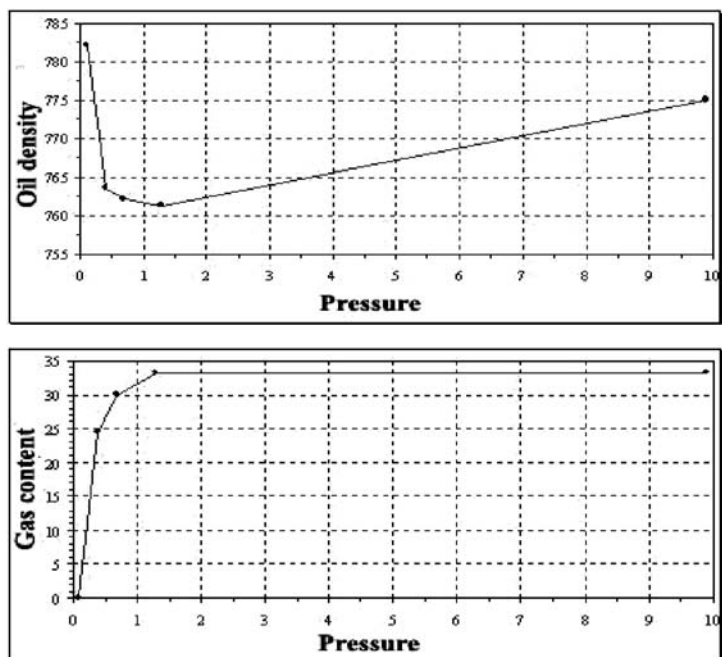
### SE-I horizon

Reservoir fluid properties were taken by analogy with the horizon SE-II. In November 2003, made the selection of the three oil samples from deep wells in 1074 at a depth of 1285 m and selection studies were performed Institute CJSC "NIPIneftegas." All three samples taken in the single-phase state and conditionally recognized. Stock formation energy on samples of more than 8 MPa, which eliminates the risk of the degassing reservoir oil wells in operation upto 2 MPa. Low saturation pressure obtained within 1.28-1.18 MPa due to the "fat" of the dissolved gas composition, where the methane content of less than 10.2 mol %. "Fat" part of the dissolved gas causes a high coefficient of gas solubility in oil equal to an average  $17.1 \text{ MPa}\cdot\text{m}^3/\text{m}^3$ .

On samples of oil parameters vary within: GOR 24.3-27.2  $\text{m}^3/\text{t}$ , the volumetric ratio of 1.078 - 1.095 share units. Density  $\text{Kg}/\text{m}^3$  783.9 - 785.2 reservoir oil viscosity -2.06 - 2.07 mPas. Fig. 2 shows a graph of differential degassing reservoir oil obtained in the borehole 1074, which allows to assess the degree and nature of the changes in the main parameters of the oil while reducing the pressure below the saturation pressure of up to atmospheric pressure<sup>6</sup>.



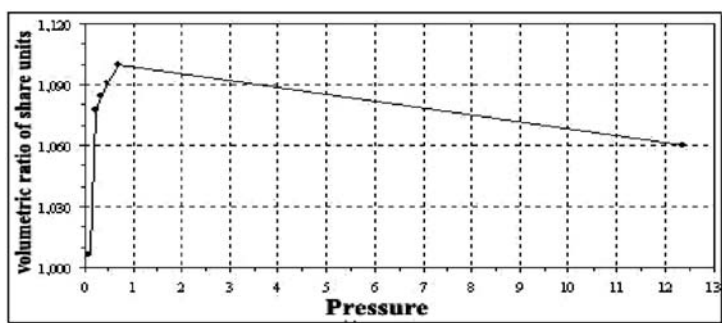
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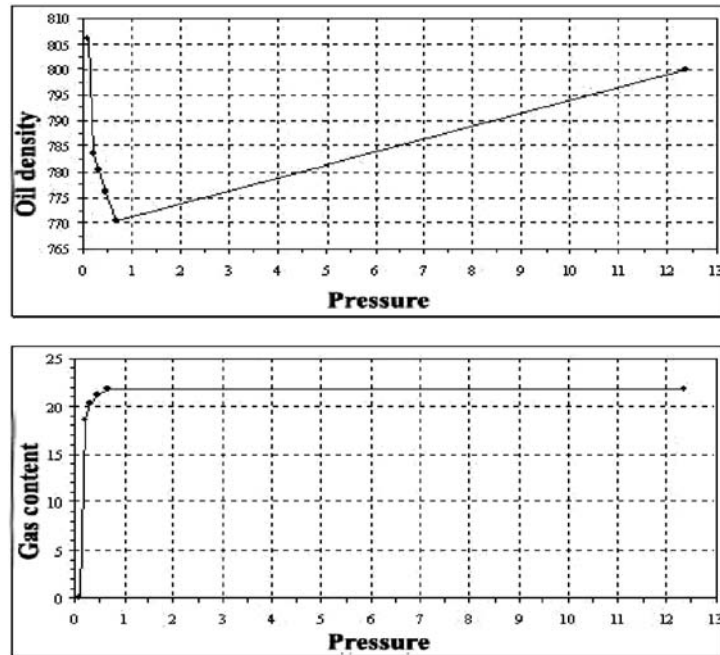
**Fig. 2: Dependence of the properties of reservoir fluid pressure from the well in 1074. Horizon SE 1**

**Yu-II horizon**

Properties of reservoir oil horizon Yu-II of the study examined four samples of reservoir oil, selected in May 2001 from 5 wells with perforated interval 1272-1275 m. Three samples studied in ZAO "NIPIneftgas" one - in the laboratory Pencor International Ltd. Formation oil Yu-II gas saturation horizon less than oil Yu-I horizon, which leads to slightly lower oil characteristics. Thus, the average gas content is 15.4 m<sup>3</sup>/t, the volume coefficient -1.070 share units. Viscosity -1.78 mPa.s, density-786 Kg/m<sup>3</sup>.



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**Fig. 3: Dependence of the properties of reservoir oil pressure hole 5. Horizon SE 11**

Figure 3 is a graph differential liberation reservoir oil well received by 5, which shows the same behavior of the reservoir fluid degassing Jurassic deposits<sup>6</sup>.

Table 2 shows the parameters adopted for the reservoir oil II objects that represent averages calculated from the results of the study of seven samples of Jurassic horizons. For the saturation pressure on the project II accepted maximum  $P_{nas}$  obtained by well-I 1074 SW horizon and constitutes 1.28 MPa.

Analyzing the results of studies of oil East Kumkol should be noted that the oil reservoir of Jurassic horizons, different from the Cretaceous deposits of oil. It has higher values  $R_{nas}$ , Gas content, volumetric efficiency, improved viscosity-density characteristics. However, it does not look like oil Jurassic sediments main Kumkol differing from it low gas saturation and a large margin of reservoir energy ratio of more than 8 MPa.

### **Properties of dead oil**

Dead oil samples were studied in the laboratory of JSC "NIPIneftegaz". They were obtained by degassing depth samples from wells 5. All studies were performed in accordance with current interstate standards. According to the results of oil Jurassic horizon

lighter oil Cretaceous horizon. This is evidenced by viscosity and density characteristics and fractional composition. According to the content of asphalt- tar and paraffin oil Jurassic refers to resinous and highly paraffinic, Cretaceous oil, oil sulfur content of the two horizons relates to low-sulfur. Physico-chemical properties of oil degassed East Kumkol and main Kumkol field close to each other, which suggests the possibility of their joint transport.

**Table 2: Properties of oil in reservoir. SE-1-II horizon**

Name	Number of Investigated		Range	Calculated Value
	Wells	Samples		
Reservoir pressure, MPa	-	-	9.9-12.4	-
Reservoir temperature, C	-	-	56-58	-
Saturation pressure of gas oil, MPa	2	7	0.69-1.28	1.28
gas content, m <sup>3</sup> /m <sup>3</sup>	2	7	8.9-22.3	16.7
m <sup>3</sup> /t	2	7	10.9-27.2	20.5
Volumetric coefficient	2	6	1.066-1.095	1.078
viscosity of oil in reservoir, Mpa.c	2	7	1.69-2.07	1.57
Density of reservoir oil, Kg/m <sup>3</sup>	2	7	775.8-790.0	785.2
Compressibility factor in the reservoir oil P <sub>нн</sub> , 1/MPa . 10 <sup>4</sup>	2	7	11.0-13.59	12.7

## CONCLUSION

The method of calculation of oil and gas volume-genetic-based on quantifiable scale of oil and gas in the oil areas. With it counts the probable reserves in the regions and districts, poorly studied and still unproven commercial oil and gas. Initial data for calculation of the specific density of stocks (in t/km<sup>2</sup> area) or the coefficient of efficiency (CRC t/m<sup>3</sup> sediments) can be obtained, respectively, in two ways: volume-genetic-based on geological study projected district, region, pool, and adopted by analogy as (factor accumulation) and three-statistical-based on the use of the world average data for the same type of sedimentary basins largest CRC (t/km<sup>3</sup> in sediments). The accuracy of estimation of reserves of oil, and hence the optimal development projects depends primarily on the completeness and reliability



of information about the reservoir rocks enclosing deposit, which is particularly important when assessing the reserves and the development of oil deposits in carbonate reservoirs differing usually complex spatial distribution and contrasting changes in geometrical and petrophysical parameters.

## REFERENCES

1. [http://en.wikipedia.org/wiki/Kumkol\\_oil\\_field](http://en.wikipedia.org/wiki/Kumkol_oil_field)
2. [http://www.petrokazakhstan.kz/eng/pages/extractive\\_subdivision.html](http://www.petrokazakhstan.kz/eng/pages/extractive_subdivision.html)
3. [http://www.petrokazakhstan.kz/eng/pages/development\\_of\\_deposits.html](http://www.petrokazakhstan.kz/eng/pages/development_of_deposits.html)
4. <http://dc391.4shared.com/doc/pR58dqR2/preview.html>
5. Uniform Rules for the Development of Oil and Gas Deposits, The Republic of Kazakhstan, Almaty (1996).
6. Technical Instructions for Conducting Geophysical Studies and Work on the Cable in the Oil and Gas Wells, Moscow (2001).

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