What is acid mine drainage?

Acid mine drainage is the flow of polluted water from old mining areas. Depending on the area, the water may contain high levels of salts, sulphate, iron, aluminium, toxic heavy metals such as cadmium and cobalt, and some radioactive particles.

West Rand gold fields

How the water gets polluted

In mining areas, both rainwater and groundwater can be contaminated from acid mine drainage. The acid mine water, carrying heavy metals, can contaminate other water sources if it flows into streams, rivers and borehole water.

Box 1: A chemical reaction makes water acid and produces soluble forms of metals

There are metal sulphides in coal and rock that contains gold or other metals. When metal sulphides are exposed to air and water a chemical reaction happens. This produces sulphuric acid and metal cations, which are a form of metal that can be carried in water (in solution).

Acid mine water is often a bright orange colour, as in the picture above. The colour comes from iron oxide, which is like rust. The iron comes from pyrite, which is an iron sulphide found in some types of rock.

Pollution from mine tailings

Mine tailings are the waste materials from mining - what is left over after the valuable minerals, like gold, have been extracted from the rock. They often take the form of heaps of rock that has been crushed and ground into powder.

As rainwater flows through mine tailings, it reacts with the substances in the rock (see Box 1). It becomes acidic and contaminated with the metals from the rock. This contaminated rainwater can pollute soil and water supplies if it soaks into the ground and flows into streams and rivers.

Pollution from underground rocks

Underground, the mineshafts and other holes left from mining exposes rock surfaces to air and water. As groundwater flows through these holes, it becomes acidic and contaminated with metals from the rock (see Box 1).

The danger of old mines

Old mine shafts gradually fill up with water, as rainwater soaks into the ground, and groundwater from other areas flows into the holes. When the water reaches a certain level, the groundwater flows uncontrollably into other areas of non-polluted groundwater and into streams and rivers. This process is called decanting. It can result in huge volumes of acid mine water flowing into water resources (see Fact Sheet 2).

In in the past, mine tailings were left exposed to the wind and rain, with no safeguards to prevent groundwater pollution.

How does acid mine drainage affect us?

Acid mine drainage can affect our health, our environment and our economy (see Boxes 2-5).

Hundreds of people living in informal settlements and farms on the West Rand depend on water from dams, streams and boreholes that are contaminated with acid mine water.. Polluted water should not be used for drinking or irrigating crops.

Children play in Donaldson Dam, West Rand, unaware of the toxic substances in the mud they stir up.

Although communities close to mining activities are most at risk, thousands more could be affected if acid mine water from old mines on the Witwatersrand flows into the Vaal and Limpopo Rivers. Such water has already begun to flow into the streams that feed these rivers. (See Fact Sheet 2)

Box 2: Acid mine water and people's health

Some acid mine water contains very toxic minerals and metals, like arsenic, cadmium, lead and mercury. In the gold mining area of the Witwatersrand, the water may even contain radioactive particles from uranium. These toxins may cause cancer, brain, kidney, liver and nervous system damage. Pregnant mothers and their unborn children are especially at risk.

People may be exposed to the harmful effects of acid mine water either directly through drinking contaminated water, or indirectly through the food chain. When acid mine water is used to irrigate crops the pollutants build up in the soil and can get into the crops that people eat.

The toxic substances can even get into people's bodies through the air. For example, the dust from dried up dams or streams that contained acid mine water can be carried by the wind into the air we breathe.

Box 3: Wildlife and acid mine drainage

Acid mine water damages plants and animals. The heavy metals from the water, or contaminated soil, are taken up by plants and get into animals through the food chain.

Acid mine water seeping into the Tweelopiespruit, which flows through the Krugersdorp nature reserve, has made the stream almost lifeless. Even the treated water discharged from the mines into the Tweelopiespruit is semi-toxic and unfit for use by animals .

Plant and animal communities are also sensitive to changes in pH (a measure of how acidic or alkaline the water is).

During heavy rain storms, untreated acid mine water flows into the Tweelopiespruit - which makes the water very acidic (a pH of 3-4). To make the water less acidic, lime is added and then the water can get very alkaline with a pH of 9. These levels of pH have severe and sometimes fatal impacts on animals.

Acid mine drainage is also affecting the Sterkfontein caves, near the Cradle of Humankind natural heritage site. In Mpumalanga, acid mine water from the coal fields drains into the Olifants River which flows through the Kruger Park.

Box 4: Acid mine water and the built environment
Acid mine water wears away and destroys (through corrosion) concrete and metal structures. It weakens bridges, pipes, culverts and other infrastructure. Even the N14 is at risk of being undermined by cavities (holes) forming in the underlying rock, dolomite. Dolomite is a rock that can be dissolved by acidic water.

Box 5: Acid mine drainage and South Africa's economy
Acid mine drainage threatens the health of our water resources, soil and ecosystems. It has the potential to directly affect the livelihoods of people who depend on food from their gardens, or small farms, to survive. It will also affect commercial agricultural production. If large volumes of acid water flow into the Vaal and Limpopo River systems, heritage sites and wildlife reserves, such as the Kruger Park, could be damaged. This will have an impact on the tourism industry.

Reducing acid mine drainage

It is very difficult and expensive to remove, or clean areas that have been affected by acid mine water. Therefore, it is important that mining companies properly manage their mine tailings and old mining areas.

To avoid the problem of acid mine drainage, contaminated water must be cleaned (treated) or prevented from entering natural water systems. This means that:

- groundwater must be pumped out of the old mine shafts and cleaned, to avoid decanting; and
- rainwater flowing through mine tailings must not be allowed to soak into the ground or flow into streams before it has been cleaned.

These are expensive, but vital, processes. Not all mining companies take their responsibilities to control acid mine drainage seriously. Inappropriate mining practices in the past have resulted in ongoing environmental degradation in the Witwatersrand caused by acid mine drainage.

Useful links to some other initiatives to tackle the acid mine drainage issue
http://www.alternatives.ca/article4833.html?debut_articles_rubrique=120
http://patagonia-under-siege.blogspot.com/2008/02/after-years-ofenvironmentally-friendly.html
http://www.golder.co.za
www.golder.co.za for details about the Western Utilities Corporation mine water reclamation project

See also:
Federation for a Sustainable Environment: http://www.fse.org.za

What you can do

If you are concerned about acid mine drainage:

- Spread the word: talk to your friends and colleagues about the issue
- Tell your local councillor and other government officials about your concerns
- Join Earthlife Africa Johannesburg (ELA Jhb) and support it's Acid Mine Drainage Working Group (see below)

ELA Jhb's *Acid Mine Drainage Working Group* seeks to:

- Raise awareness of the issue of acid mine drainage, especially amongst communities that are most affected
- Hold government and mining companies accountable for the negative consequences of their actions
- Encourage those companies that do take their responsibilities seriously and implement good practice
- Promote practical action, such as rehabilitation projects that members of the public can participate in
- Stimulate debate about the need for South Africa to diversify its industrial base and develop cleaner, more sustainable industries

If you would like to contribute to our work – through offering your comments, ideas, volunteering your time, or making a donation – contact us at: amd.workinggroup@gmail.com.