Attention! Acid Mine Drainage

Michael Zingel, graduate of the University of Pretoria, holds a BSC Agriculture (Genetics) and MPhil Wildlife Management, and currently doing research into optimising vegetation assessments to facilitate wildlife management.

He is a Registered Professional Scientist consulting in agriculture and wildlife management.

He is a member of numerous scientific societies, including the Land Rehabilitation Society of Southern Africa and is active in the rehabilitation of opencast coal mines.

Formerly CEO of MayFord Seeds, he served on the executive bodies of national and international seed organisations including the International Seed Federation, Nyon, Switzerland.

Acid mine drainage (AMD) is a threat to South Africa's limited water resources. As most AMD is generated in the Vaal River catchment area it endangers the most densely populated and industrialised part of the country. Extensive down-stream agricultural production that is dependent on irrigation is also threatened. There are serious consequences for having paid so little attention to AMD to date.

AMD is water that is polluted by the effect of oxygen and water on iron pyrite. Iron pyrite occurs in association with gold and uranium in the Witwatersrand gold fields. If it becomes exposed to water and air with which it reacts, it yields iron oxide and sulphuric acid. While the iron oxide precipitates and is inert, the sulphuric acid reacts with many elements and compounds that occur with it. AMD is thus characterised by acidity, heavy metal content and elevated sulphates.

Large scale environmental degradation has resulted from mine residues from over a century of mining in the Witwatersrand goldfields and Mpumalanga coal fields. More recently efforts have been made to rehabilitate mine residue areas. Over the years a considerable effort has gone into reprocessing old Witwatersrand mine residue dumps using new technology and to dispose of tailings in ways to reduce AMD generation and radio-active pollution. However, much of the rehabilitation work has been abandoned after mine closure, or is ineffective and, worse, falls short of statutory requirements. Licence requirements are not observed, and court orders are defied.

A serious effort to gain an understanding of the AMD problem has been made by a Johannesburg faith-based community, the Rosebank Roman Catholic parish, through its Justice and Peace group's environmental task team.

Dangerously polluted water

Water is a particular focus of this environment task group. In March each year International Water Week is observed by arranging lectures, demonstrations and tours to raise awareness and identify opportunities for social witness and engagement.

In March 2014 the group asked the Federation for a Sustainable Environment (FSE) to take a delegation on a tour of the West Rand Goldfields to witness AMD pollution and see what remediation there was at that time.

The delegation was shocked at what they saw and drew small comfort from the extent and effectivity of remediation taking place there. The experience has opened the lid on so much more AMD trouble in the country and the extent of associated radioactive pollution from gold and uranium mining.

A health hazard, on the West Rand particularly, is exposure to high levels of radioactivity in water bodies. The delegation saw Robinson Lake, formerly a popular recreation area, cordoned off with radioactivity warning signs attached to the fence.

A view of Robinson Lake with South African Water Research Commission (WRC) insert.
Credit: FSE

Delegates met members of the Tudor Shaft informal settlement, living on the remains of a mining residue dump where the level of radioactivity is higher than the limits set for the Chenobyl exclusion area in Ukraine.

Tudor Shaft informal settlement
Credit: Stephan du Toit, Specialist: Environmental Protection under employment of Mogale City Local Municipality.

According to a Report by the North West University, which was commissioned by the Department of Mineral Resources in 2014, the radioactivity level in certain areas in Tudor Shaft Informal Settlement is 13.14milliSieverts per annum. The regulatory limit per source is 250microSieverts per annum.

The Roman Catholic Justice & Peace movement

In its engagement with the challenges of the modern world, the foundations of contemporary Catholic social teaching were laid by Pope Leo XIII's great encyclical letter on capital and labour (Rerum Novarum) in1891. Successive popes, the Second Vatican Council and other leaders in the Church have added to and developed this body of social teaching, most recently in Pope Francis's encyclical on the environment, Laudato Si (Care for our Common Home).

Modern Catholic social doctrine has been distinctive in its defence of human dignity and human rights, its consistent critiques of the social and political ideologies of both the left and the right, and its focus on the poorest and most marginalized people.

Institutionally, this was given practical expression in the establishment of the Vatican's Pontifical Commission for Justice & Peace in the 1960s. Local bishops' conferences, dioceses and parishes are encouraged to develop similar bodies.

Mike Zingel, the author of this article, heads the environmental task team of the Justice & Peace group in Rosebank parish, Johannesburg.

See: www.catholicsocialteaching.org.uk

The Rosebank J&P group requested relevant state organisations to investigate the situations that they had identified. These are the Department of Environmental Affairs (DEA), the Department of Water and Sanitation (DWS), the South African Human Rights Commission (SAHRC) and the National Nuclear Regulator (NNR). The requests were variously disregarded, brushed off or dealt with in a high-handed and dismissive manner. Their further enquiries led to close involvement with the FSE. The Rosebank parish's effort has since been backed by the Archdiocese of Johannesburg, and taken up by the Justice and Peace Department of the SA Catholic Bishops Conference (SACBC).

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Rosebank J&P group found that FSE initiatives to improve governance and to expose any wrong doing are being hampered by refusal of DWS to release critical information that should be available to the public. Their objections, with support from the Justice and Peace Department of the SACBC, have been raised with the Public Protector. The hope is that justice will prevail and that essential progress will be made in addressing AMD on the Witwatersrand.

Witwatersrand mining basins

There are three principal groups of mining basins along the Witwatersrand: Eastern, Central and Western. As mines are worked out and close, so dewatering is discontinued. The voids steadily fill and water levels rise. This has already led to decanting of water on the West Rand. Some emerges from the sites of springs from which the Witwatersrand draws its name, but instead of the life sustaining water of the past it is AMD. The threats of decanting in the Central and Eastern basins are not as serious but nevertheless require attention to water levels and to the reduction of acidity.

The current AMD decant from the Western basin is being allowed to enter the adjacent river systems. As it is on the watershed between the Indian and Atlantic oceans, AMD is entering river systems flowing in both directions. These systems are profoundly important for South Africa's agricultural production.

Thus far, the extent of dilution has been sufficient to comply with the regulatory limit of 600 mg/l of sulphates. This limit should be regarded with caution as considerably greater dilution is needed by certain users.

The World Health Organisation (WHO) standard for sulphate in drinking water is 200mg/l. Eskom requires water of between 15 and 40mg/l. In livestock watering, it has been found that sulphate levels above 250 mg/l suppress copper and selenium intake which result in poor fertility and condition.

The potential volume of AMD for the Eastern, Western and Central Basins alone amounts to an estimated 200ML/day (1ML = 1000m^3). Ten times that amount of good quality water is needed to dilute the high salinity in AMD to make it fit for use.

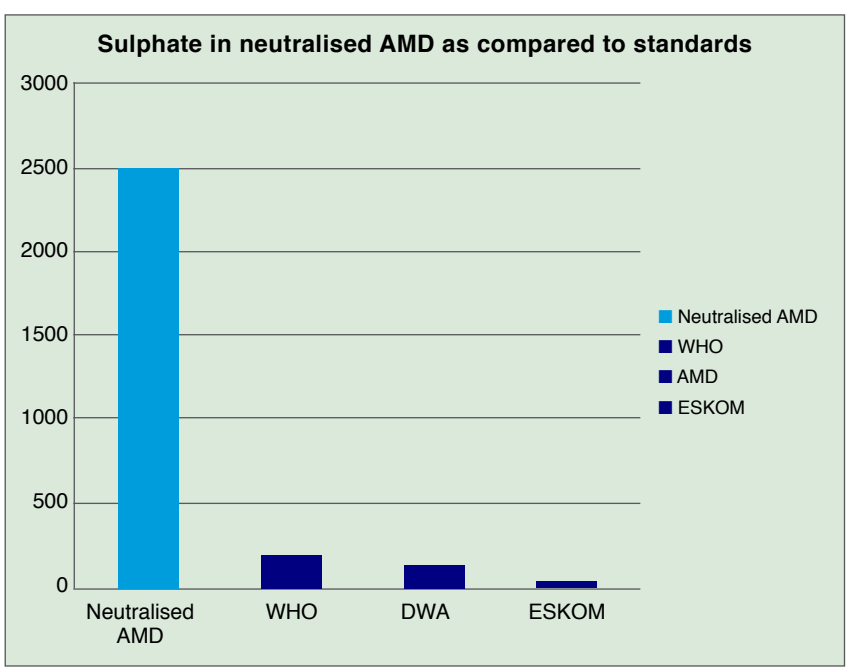
The anticipated increase in AMD will render the dilution effect in some of the rivers concerned, notably the Vaal River system, insufficient by 2015 – 2019, depending on rainfall. Therefore other remediation is an urgent necessity.

Efforts at remediation on the West Rand are concentrated on treating AMD with lime, thereby raising pH and precipitating heavy metals including uranium. However the sulphates remain and are discharged into the river systems.

AMD is a clear liquid but treatment with lime to neutralise it causes precipitation of heavy metals that discolour the liquid as shown. The precipitate is captured as sludge in a settling dam, while dissolved sulphate flows on for dilution downstream.

Credit: Stephan du Toit, Specialist: Environmental Protection under employment of Mogale City Local Municipality.

The World Health Organisation (WHO) standard for sulphate in drinking water is 200mg/l. Slightly higher is the standard of the Department of Water Affairs (DWA), while Eskom requires water between 15 and 40mg/l.



The treatment capacity of the plant on the West Rand is insufficient to deal with all the AMD from the Western basin. The treatment plant within the Western basin can treat 30 million litres per day but during rainfall events equivalent volumes of raw AMD may flow untreated into the receiving environment.

The scientific community have recently identified a number of flow pathways along which AMD is generated. They have also identified points along these pathways where uranium enters, and conditions of the water that render it more or less radioactively dangerous.

Confused policy and practice

There are many contributing factors to AMD generation – a whole complex of consequences (real and imagined) and confusion surrounding action that should be taken. Consequently responsibility for addressing the threat, the funding required and political will to take action are seriously lacking.

This situation has led to many years of cover-ups, denial, shifting of responsibility and similar behaviour that has allowed AMD to escalate. The consequences are a hardening of attitudes in government and mining circles brought on by an atmosphere of suspicion fostered by confusion, incompetence and malpractice and an anxious society that is wide open to sensational information and misinformation.

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The identification of these pathways can facilitate the formulation of solutions as each pathway differs considerably from the others. This will reduce confusion. It will assist in the identification of who was responsible for AMD in the first place and who are responsible at the present time. It also points to what needs to be done in respect of each pathway. The relative importance of each pathway differs between the three principal gold mining basins so that the extent of the problems differ as do their solutions. Unfortunately there is resistance to the acceptance of such discoveries.

This resistance, hardened attitudes in the mining industry and government and societal anxiety threaten to demotivate the scientific community. There is a crying need to clear the air by exposing current malpractice and bad governance and to open the way for transparency, shared responsibility and giving credence to scientific advances.

Current thought in mining land reclamation in South Africa is shifting from compliance with cost as the over-riding consideration to business development with community empowerment. The objectives are job and wealth creation that will continue after mine closure. This shift will provide an enabling environment for a broad social consensus to back the necessary remedies for the AMD problem.

AMD is undoubtedly a severe problem and a threat to our country's future. However, a problem clearly understood and equitably shared can be turned into a set of opportunities. Cleaning up our current situation and embracing the positive shift in rehabilitation thought will go a long way to allowing scientifically sound approaches to AMD to materialise and win popular support. The prize is to secure the physical environment of the powerhouse of South Africa and, quite literally, the downstream economy.