



Research Brings Clean Water to Rural School

Excessive nitrate and salt levels in groundwater remains one of the main reasons for many resources to be declared unfit for drinking. Unfortunately for many rural communities in South Africa, this is the only source of drinking water available. Lani van Vuuren reports.

Madibogo village is located about 90 km from Mafikeng in the Ditsobotla district of the former Bophuthatswana. The area has a total population of 23 000, who are all dependent on groundwater for their water supply. The water is drawn from several boreholes and fed to a number of reservoirs from where it gravity feeds about 86 communal standpipes. The water is generally not treated prior to distribution, although chlorine is sometimes added to the reservoir water.

In the 1990s, the Department of Water Affairs & Forestry expressed concern over the high levels of nitrate in some water resources in the North West province. As a result, the Water Research Commission (WRC) funded a research project, executed by the North West University (NWU), to survey the extent of nitrogenous pollution of groundwater in the province.

HIGH NITRATE LEVELS

This study confirmed high nitrate levels in the groundwater of some areas, including Madibogo. Nitrate levels up to 23 mg/ℓ were found (the maximum allowed limit in South Africa as set by the South African Bureau of Standards is 10 mg/ℓ). In addition, high levels of calcium, magnesium and phosphates were present in the water. High fluoride levels, which can cause skeletal and dental fluorosis, were also detected in some of the boreholes.

Why are excessive nitrate levels dangerous to human health? When bottle-fed infants digest water containing too much nitrate, this nitrate, when converted to nitrite in the infant's body, interferes with the oxygen carrying capacity of the child's blood (it replaces the oxygen in the red blood cells).

Children with methaemoglobinaemia, as it is known, will show signs of blueness around the mouth, hands and feet, hence the common term 'blue baby syndrome'. These children may also have trouble breathing as well as vomiting and diarrhoea. Expectant mothers are also at risk as spontaneous miscarriage or still birth may occur when too much nitrate is ingested.

Due to the high salt concentrations in their drinking water, the people of Madibogo also experience discolouration of their hair, and skin irritations. Long-term exposure also puts them at risk for kidney and liver ailments as well as increases their risk for cancer. Simply put, the water tastes bad.

It is unclear what exactly causes these high salt levels in the groundwater in the area. It has been

suggested that it may have accumulated naturally, however, other factors, such as livestock sharing the same water resources, and the siting of pit latrines near boreholes cannot be ruled out.

TESTING POSSIBLE TREATMENT

The WRC funded a follow-up study to investigate the applicability of membrane technology (specifically nano-filtration and reverse osmosis) for the treatment of groundwater with high nitrate and salt levels in such a rural area. A 10 000 ℓ/day test unit was set up at Madibogo Bathlaping Primary School.

Dr Mbhuti Hlophe of NWU explained that a cross-flow modular reactor was selected. The cross-flow unit connects to two tanks, one holding the feedwater and the other holding the product water. Raw water is fed through the treatment unit and forced through the membrane. Clean water goes through the membrane, while the pollutants are left behind. The clean water is then stored in a tank for use.

“We managed to bring the nitrate levels down from over 20 ppm to less than 10 ppm as well as removing other pollutants, making the water safe to drink,” said Dr Hlophe. Local people have also been trained in the monitoring, operation and maintenance of the plant.

At an information day held at the school in March, school principal JPT Phologane expressed his delight with the water treatment plant. “Prior to the establishment of the plant, the children had to rely on the salty groundwater. There is a big difference between the untreated water and the treated water, not only in taste, but in the general health of the 800 learners and teachers using the water. We have also instilled in our children the value of this water and the importance of cherishing it rather than just letting it go to waste.”



An untreated water source situated outside school grounds.



The learners of Madibogo Bathlaping Primary School now have ready access to clean water.



The 10 000 ℓ membrane plant erected at Madibogo Bathlaping Primary School to test the applicability of this technology for rural applications.

The social aspects regarding the treatment plant, as well as the use and storage of water in the area, were not neglected during the research project. The attitudes and perceptions of the consumers that use the water were investigated, and based on that a general water education programme was developed, implemented and evaluated to improve health and hygiene in Madibogo. This was executed by the NWU’s Department of Consumer Science.

ADVANTAGES OF RURAL USE

The research project is on the verge of being completed after which the final results will be published. It is believed, however, that the applicability of membrane technology in this case has already been clearly demonstrated.

This kind of water treatment has many advantages, for example, the plants are generally compact making them easier to transport, while membranes can be used to treat virtually any kind of water. In addition, chemicals are only needed when cleaning the membranes.

Dr Gerhard Offringa, WRC Head: Water and Health added that, unlike other technologies that can treat water with high salt contents, such as ion exchange and biological treatment, membranes are generally considered more user-friendly. This is mainly because of the lesser amount of operator input required, making this type of technology more suitable in rural applications.

“Membranes are no longer the ‘alternative’ treatment technology it was thought to be in the past,” noted Dr Offringa. “Its merits and applicability have been well demonstrated in South Africa. We believe membranes can make a valuable contribution towards ensuring that all our communities have access to safe, potable water.”

