

EXECUTIVE SUMMARY

The steadily increasing salt concentration in the Vaal River drainage system is becoming a serious problem due to the large scale recirculation of water, and the fact that conventional water treatment processes do not significantly reduce inorganic pollutants.

Three mines were found to contribute 55 % of the salt load to the Klip River (or 30 % to the Vaal system), the major anion being sulphate, which results from oxidation of pyrite.

A laboratory investigation has shown that these effluents can be desalinated by treatment with barium carbonate and lime.

The reaction kinetics of barium carbonate with aqueous calcium, magnesium and sodium sulphates have been investigated. Where magnesium or sodium cations are present, calcium hydroxide is required in addition to achieve complete sulphate removal.

Barium carbonate is a relatively expensive reagent, and for its use to be economically viable, it will be necessary to recover it for reuse. This could be carried out at a central facility, where barium sulphate would be reduced with coal to barium sulphide. This would be leached with water, and the solution treated with carbon dioxide to regenerate barium carbonate and generating a by-product stream of hydrogen sulphide gas. Elemental sulphur can be produced from hydrogen sulphide gas using conventional technology. High temperature reaction studies were carried out which established the basic technical feasibility of the barium recovery scheme.

The chemistry of the process has been shown to be feasible. The raw materials (coal and barium sulphate) are abundant in the Republic of South Africa while the products (water and sulphur) are in demand. Implementing the process will decrease the total dissolved solids in the Vaal Barrage benefiting all water consumers in the Pretoria-Witwatersrand-Vereeniging-Sasolburg area.

The economic benefits which would arise on implementing the system include :- 14 000 tons of sulphur (R5 600 000 - 1986); 30 000 Ml of water (R7 700 000 - 1985) and value added in removing 62 000 tons TDS from the Vaal Barrage (R24 800 000 - 1982) per year.

The following recommendations were made :-

- A chemical speciation program similar to Stasoft be prepared in order to aid the design of treatment processes.
- A detailed cost/benefit study be carried out in order to aid decision makers in the evaluation of the process.
- A firm of engineering contractors should assess the process technically and economically.

After a cost/benefit study and technoeconomic assessment has been undertaken, decisions can be made as to the need and direction of any further research, pilot plant evaluations or process demonstration.