WATER RESEARCH COMMISSION PROJECT NO. 201

THE TREATMENT OF INORGANIC BRINES AND CONCENTRATES

APPENDIX 14

The Removal of Sulphuric Acid from an Aqueous Medium Containing the Acid

Pollution Research Group
Department of Chemical Engineering
University of Natal
Durban

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CONFIDENTIAL

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STEERING COMMITTEE 1988

APPENDIX 4

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Durban

1987

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Mr. C.A. Buckley,
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Our Ref.:	Your Ref.:	Date.
JP/W 330		31st July 1987.

Dear Chris,

PROPOSED SOUTH AFRICAN PATENT APPLICATION BY: WATER RESEARCH COMMISSION ENTITLED: THE REMOVAL OF SULPHURIC ACID FROM AN AQUEOUS MEDIUM CONTAINING THE ACID

As instructed, I have prepared a draft provisional specification covering your new process. Thank you for your write-up which was extremely useful. A copy of this draft specification is attached for your perusal and comments.

I await your comments before proceeding with the filing of this specification at the Patent Office.

Yours sincerely,

Tony

ANTHONY R.L. HOOPER

Encl:
PAA

SPOOR AND FISHER
PATENT ATTORNEYS
JOHANNESBURG OFFICE

DRAFT PROVISIONAL SPECIFICATION

TITLE OF INVENTION: THE REMOVAL OF SULPHURIC ACID FROM AN AQUEOUS MEDIUM CONTAINING THE ACID

NAME OF APPLICANT: WATER RESEARCH COMMISSION

ADDRESS: 710 VAN DER STEL BUILDING
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BACKGROUND OF THE INVENTION

This invention relates to the removal of sulphuric acid from a process or effluent stream.

Sulphuric acid is one of the cheapest industrial chemicals and is consequently widely used in industry when acidic or anhydrous conditions are required. The per capita use of sulphuric acid can be considered as an index of the technical development of a nation.

The relatively cheap nature of sulphuric acid generally precludes the economic viability of recycling effluents containing sulphuric acid. The usual method of treatment of these effluents prior to discharge is neutralisation with lime. This results in the precipitation of gypsum and the super-saturation of the effluent with calcium sulphate. The presence of excess calcium sulphate results in subsequent precipitation which could lead to scaling of reticulation networks. The recovery of high grade water from such effluents requires the application of techniques such as:

soda lime softening
electrodialysis
seeded slurry evaporation or reverse osmosis.

In all these techniques the precipitation of calcium sulphate presents a problem.

Many mineral deposits are associated with sulphides. The extraction and beneficiation of gold, copper, lead, zinc and platinum ores lead to the production of sulphuric acid.

The natural biological weathering and decomposition of sulphide bearing rock leads to the production of a sulphuric acid leachate. The discharge of these leachates or of neutralised industrial effluents prejudice the natural ecology and degrade the quality of the receiving waters. In South Africa saline effluents are particularly problematic in that the increasing salinity of the rivers and water reticulation systems inhibits recycle or reuse of water.

In all the above cases it would be preferable to remove the sulphuric acid from the stream without the addition of further chemicals.

SUMMARY OF THE INVENTION

According to one aspect of the invention a process for sulphuric acid removal from an aqueous medium containing the acid includes the steps of:

(i) providing a membrane cell in which two compartments are separated from each other by an anion selective membrane;

(ii) passing the sulphuric acid rich aqueous medium into one compartment of the membrane cell;

(iii) recirculating an alkali solution through the other compartment of the membrane cell, the alkali solution containing cations capable of forming an insoluble sulphate; and

(iv) maintaining turbulence in the compartments to minimise precipitation build up on the membrane.

The pH differential across the membrane causes anions from the alkali solution to pass through the membrane and into the compartment containing the sulphuric acid thus neutralising the acid. At the same time, sulphate ions pass in the opposite direction thus deionising the sulphuric acid medium. The cations in the alkali solution are retained in that compartment and form a precipitate with the sulphate ions which pass through the membrane from the sulphuric acid compartment. The precipitate itself may be continually removed and alkali solution added to replenish the supply of the solution.

DETAILED DESCRIPTION OF THE INVENTION

The sulphuric acid medium will preferably be continuously passed through the one compartment of the membrane cell in the form of a stream. The acid is neutralised without any undesirable build up of cations.

The cations of the alkali solution are preferably alkaline earth metal cations, particularly calcium or barium. The alkali solution may be a carbonate or a hydroxide solution. The most preferred alkali solution is calcium hydroxide, particularly a saturated calcium hydroxide solution.

Anions will pass through the membrane until an equilibrium position is arrived at. This equilibrium position can be disturbed by passing an electrical direct current through the cell such that the sulphuric acid compartment is at a negative potential relative to the alkali compartment. Passing such a current through the cell will cause hydrogen gas to be generated at the cathode which will

assist in neutralising the sulphuric acid solution. Simultaneously, oxygen gas will be generated at the anode which will tend to neutralise the alkali solution.

The invention may be used to neutralise sulphuric acid containing effluents or remove sulphuric acid from effluents. It has the advantage over prior art methods that the precipitation of sulphate does not present a problem and there is no undesirable build up of ions in the effluent.