The treatment of acid effluent from the Grootvlei Mine using novel IX techniques

by R.E. Robinson*, R. Barnard†, and F.J. le Riche*

Synopsis

A novel variation of the GYPCIX process for the treatment of the acid mine effluent water from Grootvlei is described, in which a number of valuable byproducts can be obtained and the product water can be used for a variety of different purposes. A conceptual case study is presented in which the important cost parameters are described and certain critical path activities are indicated in order to derive a Return on Investment evaluation according to methods previously published. The study indicates that the treatment costs can be dramatically reduced, provided that proper utilization of the byproducts is taken into account. There are many possible uses for the water. However, by far the most advantageous contribution to the RDP and the best return on capital is derived if the water is used to establish small-lot farming activities providing work opportunities for thousands of people and contributing several hundred million Rands to the GDP. Vastly improved social conditions will be generated in an area of Gauteng that is in danger of rapid deterioration and a contribution will be made to maintaining mining activities in this area. The environmental impact is positive.

Background

The problem of disposal of acidic water from the Grootvlei Mine on the East Rand has received much attention. It is typical of many operating and abandoned mines on the East and West Witwatersrand. It is also well known in many coal and base metal mining operations around the world.

The contamination of the water arises from the oxidation of pyrite or other sulphides exposed by the mining operations. The rate of oxidation is enhanced by bacterial effects and the considerable hydrostatic pressure of water containing oxygen at depth in the mine. The polluted water contains ferrous, ferric and other metal sulphates and enough sulphuric acid to reduce the pH below 4. The water is, thus, highly corrosive and in operating mines has to be neutralized underground with lime to prevent corrosion of equipment and pipes. Even if a mine has closed down, the water flowing from adjacent areas moves through the old workings, becomes contaminated and can exit from the mine into adjacent streams and underground water aquifers.

After neutralization of the water with lime, the metals are precipitated as hydroxides and after pumping to the surface, the sludge can be thickened in settlers to give a clear overflow which still requires treatment since it contains approximately 2 000 ppm of dissolved solids (mainly calcium sulphate). At one time the sludge and water was simply evaporated on slimes dams but this is no longer permitted and processes are being investigated as a matter of urgency for producing industrial or domestic (potable) water from the mine effluent.

The amounts of effluent involved and the concentration of impurities is, for obvious reasons, highly variable. In this paper, average volumes of 150 megalitres a day at the Grootvlei Mine are used as being typical.

Several methods of treatment have been proposed including reverse osmosis, ion exchange, precipitation methods and anaerobic bacterial techniques. Several of these processes are being tested on a pilot scale at Grootvlei. It is the authors' proposal that prior to selecting the process or even planning a major research and pilot plant development programme, a thorough conceptual analysis should be taken on the options available. This should highlight not only the economic and technical features but should include the potential benefits to the RDP and the probability of these being achieved.

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In this paper, a highly condensed and simplified conceptual analysis is presented of an ion exchange process with novel features which has very attractive economic advantages, which specifically favour contributions to the RDP.

IX Process technology

The process already used by the mine whereby the acidic water is neutralized with lime and the heavy metal sludge has been settled out to provide a reasonably clear overflow, is accepted as the obvious starting point. This overflow, saturated with calcium sulphate, will first be passed through a cation exchange resin in the hydrogen form followed by an anion exchange resin in the hydroxide (or free base) form. The chemical reactions are:

$$2RH + Ca^{++} = R_2Ca + 2H^+$$
$$2R(OH) + SO_4^{=} = R_2SO_4 + 2OH^-$$
$$2H^+ + 2OH^- = 2H_2O.$$

The purity of the final effluent will depend on the extent of the two IX treatments for removing calcium and sulphate which can be controlled to provide whatever may be required. The cation and anion IX resins have to be regenerated using an acid and alkali respectively. In the GYPCIX process developed by ChemEffco, sulphuric acid and lime are used being the lowest cost industrial reagents available. The plant design incorporates a conventional counter current up-flow column (such as the NIMCIX or the Porter system as used at Rössing Mine) to be able to handle the small quantity of solids in the water and the precipitated calcium sulphate formed during the regeneration process. Reasonably accurate cost estimates based on several years of operation of a pilot plant at Western Areas and a demonstration plant at Witbank are available, and the essential cost features are shown in Table I. These data indicate that typical operating costs amount to R1.00 per cu metre, of which 86 cents is the cost of regenerants.

Table I

Mine water processing—cost summary Standard GYPCIX process

Water quality		Operating cost*	Capital cost†	Total
ppm		Rand/m3		
Potable	250	2.50	1.20	3.7
Discharge	400	2.00	1.10	3.1
Agric	750	1.25	1.00	2.25
Mine proc	1000	1.00	1.00	2.00

†Capital cost (R250-275 million) amortized @ 15% over 10 years for 136 megalitre plant.
*Made up as Sulphuric Acid 42%; Lime 44%; Resin replacement 3%; Power Labour Maintenance 11%.

Alternative regenerants

The novel feature in the proposed alternative IX process is to use nitric or phosphoric acid as the acid and ammonium hydroxide or potassium carbonate as the alkali for regeneration purposes. For example,

$$R_2Ca + 2HNO_3 = 2RH + Ca^{++} + 2NO_3^-$$
$$R_2SO_4 + NH_4OH = 2ROH + NH_4^+ + SO_4^{=}$$
$$Ca^{++} + 2NO_3^- + NH_4^+ + SO_4^{=} = NH_4NO_3 + \underline{CaSO_4 \text{ solid.}}$$

The resins will be converted to the hydrogen and hydroxide forms respectively and the regenerant effluents will contain nitrate and ammonium ions. In this way it is possible to produce a liquid fertilizer (ammonium nitrate) with a value at least equal to the cost of the regenerants. It also becomes possible to produce a high grade calcium sulphate by-product from the regenerant solutions.

The cost of 60% nitric acid is of the order of R800/ton (considerably more than the conventional sulphuric acid). Ammonia gas (which is easily converted to ammonium hydroxide) costs approximately R1526.00/ton which is considerably more than the lime used in GYPCIX. However, after regeneration, a concentrated solution of ammonium nitrate can be produced with close to a 100% recovery and the value of this is somewhat more than the cost of the two reagents. The same applies to the use of phosphoric acid and potassium carbonate or hydroxide which will give rise to phosphate and potassium ions in solution which are again valuable fertilizers. The ion exchange process can be readily adapted to produce any combination of these fertilizer materials so that a complete range of NPK fertilizers could be produced according to agricultural demands.

To take full advantage of the fertilizer production, it is highly beneficial to utilize the purified water for agricultural purposes. In such a case the amount of calcium sulphate that can be left behind in the water is much higher than if used for domestic or industrial purposes. Almost all soils in the country benefit from the addition of reasonable quantities of calcium sulphate. The combined effect of these proposals on the economics of the process is profound, as discussed below.

Production of calcium sulphate

The effluent regenerants can be reacted according to the above equations to produce ammonium nitrate and high purity calcium sulphate. The rate of addition of the two solutions, the temperature, recirculation and seeding effects can be controlled to provide calcium sulphate with different crystal sizes and morphology to suit different applications. The products will not have the undesirable characteristics of 'phosphogypsum'. These are important features of the modified process as compared with GYPCIX since it allows for much greater scope and higher prices in marketing the calcium sulphate by-product. Thus, in the overall treatment process, calcium sulphate will be produced in two forms:

- a crude sludge heavily contaminated with iron oxides and heavy metals arising from the first stage neutralization of the underground water and

- a high purity chemical grade material by precipitation of the regenerants solutions.

By establishing a relatively low cost drying and calcining facility using waste coal fines (if necessary a high sulphur content can be tolerated), the first sludge can be converted at low cost into self-setting material for brick making and other housing purposes. Should this sludge contain traces of radioactive material such as radium, it can be returned as self-setting backfill into safe underground locations in the mine. The cost of drying and calcining this material is probably close to its intrinsic value and the economic viability of such a process depends very much on transport costs to low-cost housing developments. However, the alternative of simply dumping the material at a waste site is also a costly process. If the sludge is radioactive, then there is little choice available other than converting it to an insoluble form that can be stored underground safely.

The same calcining plant can, on a campaign basis, be used to convert the high purity calcium sulphate to an anhydrous or hemi-hydrate form which opens a large market potential ranging from medicinal Plaster of Paris to fillers and binding materials in composites. In the economic analysis that follows a value of R500/ton for the high grade is assumed, which is almost certainly a conservative figure.

Utilizing the water for agricultural purposes

Certain types of soils and crops can tolerate significant quantities of calcium sulphate. Recent work has shown that even the untreated calcium sulphate effluent can be tolerated by certain crops in well-drained sandy soils[1]. However, there is always a danger of too great an accumulation of calcium sulphate if the untreated water were to be used in an intensively irrigated system. Fortunately the modified IX process can produce a range of concentrations according to the requirements of the agricultural and soil system, and a value of 1000ppm is considered typical.

Ideally, crops with large possibilities for evapo-transpiration and large yields that are removed at harvest should be included, so that added nutrients are removed at the same time.

Soil properties obviously also need to be taken into account, both for suitability for irrigation and ability to accommodate salt accumulation, within limits.

Crops/cultivar selection is therefore as important as the identification of suitable soils and their responsible management.

Water containing elements in controlled amounts, albeit that these are sometimes high and might well need diluting, is a resource that needs to be utilized appropriately. Attention should be paid to the possible presence of elements toxic to plant or animal life.

The quantity of water available from Grootvlei is highly significant in terms of irrigation. The best estimate is that on average 150 megalitres/day must be treated. This quantity of water is equivalent to 365mm/annum rainfall over 15 000 hectares. With a relatively small storage dam this additional water can be used as and when required to supplement the natural rainfall of, say, 700 mm/annum. The concentrated fertilizer solutions can be stored in separate reservoirs and can be added to irrigation water according to the crop demand. The possibility thus exists of intense agriculture production of probably two summer crops and one winter crop with intensive planting and fertilization. There are a multitude of crops and associated farming activities that can be considered and a major evolutionary development programme can be undertaken to achieve maximum benefits. A very attractive feature would be to develop the agricultural possibilities in the form of small-lot communal farming units providing job opportunities for the impoverished sections of the population. As indicated later, the number of job opportunities and the income that can be achieved will make a major contribution to the RDP and to the GDP.

It is important to obtain farm land fairly close (say within 50 km) of the mine to avoid excessive pumping costs. The same pipeline delivering the water can be used to deliver the fertilizer solutions on a periodic plug flow basis. Fortunately, in the vicinity of Grootvlei, there are large areas of agricultural land and much unused mining areas that could be converted to agricultural use. The development of a communal farming system-such as the Moshav system—was very successfully used in Boputhatswana in which, say, 3 000 farmer families will utilize the 15 000 hectares of farming land giving an average of 5 hectares per family is proposed as being illustrative. It is further estimated that each hectare will, on average, produce a crop value of R10 000 per annum. Such a farming commune will, of course, require careful planning and a correct and effective business structure—but fortunately, expertise in this management field does exist and there is past experience to provide guidelines.

Fertilizer quantities

The quantity of fertilizer produced is stoichiometrically equivalent to the amount of calcium sulphate and other impurities removed from the effluent. A complete range of NPK fertilizers could be produced but for the purposes of this paper it is assumed that the common 2.1.0. grade will be used. If the calcium sulphate content is reduced to 1000 ppm from 150 megalitres of effluent/day (54.750 million cu metres/annum), 54 750 tons calcium sulphate will be produced per annum and 26 200 tons of NPK 2.1.0. fertilizer. The amount that can be most efficiently consumed on 15 000 ha of intensive irrigated farming has still to be determined in practice. But an illustrative value of 1.0 ton per hectare is assumed in the cost figures quoted and the remaining amount will be sold to adjacent farmers.

Project evaluation procedures and conceptual cost analysis

The methodology proposed by Robinson[2] should be followed in evaluating the merits of this specific proposal and compared with the many others that are being considered. The protocol involved incorporates

- a conceptual economic analysis followed by
- the identification of the most critical experimental and other actions to determine the feasibility of the process
- a critical path planning procedure
- the assessment of probability values for the success of various unknown and uncertain aspects
- a PIDCF evaluation (Probability Influenced Discounted Cash Flow) to obtain a return on the investment involved.

The time available and the scope of this paper does not permit a detailed account of the full procedure. Only a number of essential features and an illustrative example of the cost analysis can be presented.

Critical path planning

The three most strategically important technical aspects which will have to be established on a pilot plant scale are

- the viability of the IX techniques
- the tolerance of the soil towards calcium sulphate, and
- the nature and value of the crops that can be produced.

In the light of previous work by ChemEffco on the cost of the GYPCIX process and the studies by Barnard *et al.*[1] at Pretoria University on the effect of calcium sulphate on crops, it has been possible to assign a high probability of success to these critical aspects.

Other uncertainty factors relate to the value of the by-products and the quantities that can be sold.

The economic model

The protocol requires that an economic model be established in mathematical terms which can be used to do sensitivity analyses so as to identify the most important parameters which must be accurately specified to establish economic feasibility in the eyes of potential investors. The important parameters which form the model are:

- The capital costs of the treatment plant. This is a function of the degree of purification required and fortunately this relationship can be established with relative accuracy
- The total solids content that can be tolerated in the agricultural activities. This is a function of the soil characteristics and the crop varieties. Fortunately, reasonably reliable assumptions can be made in this regard
- The cost of establishing the farming components. This requires definition of precise sites, topography, size and irrigation systems; although not available immediately, these data can be obtained in due course. For the purpose of this paper, reasonable assumptions have been made
- The market size and sales price for by-products. This will require an extensive market survey and a conservative assumption has been made for the purpose of this paper.
- A provision has been made for the expenditure of, say, R50 million at a high probability of success level for a thorough technical feasibility study using the top experts available.

Arising from the above, a set of illustrative values has been selected from a preliminary computer model. These are shown in Tables IIA to IID.

For an investment of R410 million (including, research and pilot plant costs, the purchase of and equipping of farms and other contingencies) an IRR of 12.4% can be achieved with a gross turnover of R223 million, a net benefit of R90 million and the creation of over 3 000 permanent job opportunities.

Social benefits and contribution to RDP

There are profound benefits as regards the creation of job opportunities and the social benefits arising therefrom. They are very difficult to assess in precise economic terms and although work is being undertaken to do so, at this stage it is only possible to make qualitative comparisons. They do represent an unusual way in which mining and metallurgical activities can contribute even more than normally expected to the quality of life of local inhabitants and at the same time solve an invidious environmental problem that is common around the world.

The alternative use of the water would be for domestic or industrial purposes. The domestic use will require an equivalent expenditure on the part of the mine or government of approx. R2 per cubic metre. The industrial use, if measured in terms of providing the same number of job opportunities, would involve a capital expenditure of the order of R5 billion.

There is a strong government resistance to the use of any water for agricultural purposes in Gauteng, on the grounds that all water must be preserved for industrial or domestic use. In this specific instance the argument is not defendable. All resources should be used to promote optimal quality of life for the maximum numbers of the population.

By solving a major environmental problem at no cost to the mine or the taxpayers and thus not forcing its closure and dismissal of many thousands of workers; by providing opportunities for over 3 000 small-lot farmers and their families; by contributing approximately R210 million to the GDP, and providing a net benefit of approximately R 90 million to this community and a rate of return of 12.4% on the capital employed, it is suggested that these proposals deserve most careful consideration as a contributor to the RDP.

References

1. Jevanoic, N.Z., Barnard, R.O., Rethman, N.F.G., and Annandale, J.G. Crops can be Irrigated with Lime-treated Water, *Water SA.*, 24 No. 2, 1998. p. 113 *et seq.*
2. Robinson, R.E. The Economic Evaluation of Research Projects. *XVth CMMI Congress*, Johannesburg , SAIMM 2, 1994. pp. 359–364. ◆

Table IIA

Economic model for the use of mine water in agriculture

Parameter		Units	Sensitivity Range	Source or Formula	Value
TREATMENT PLANT					
Quantity of water to be treated	Q	megalitres/d	0.5-1.0	input data	150
Calcium sulphate content of raw water	Mi	ppm	0.8-1.0	input data	2000
Calcium sulphate content of treated water	Mo	ppm	0.2-2.0	input data	1000
Calcium sulphate produced by IX plant	Mp	tons/a	calc	Q*(Mi-Mo)*365	54750
FARMING DATA					
Area of farm land	Fl	ha	0.2-2.0	input data	15000
Fertilizer produced (NPK 2.1.0)	Fp	tons/annum	calc	Mp/2.09	26196
Fertilizer additions levels	Fs	tons/hectare	0.2-2.0	input data	1
Fertilizer to commune	Fu	tons/annum	calc	Fs*Fl	15000
Fertilizer—external sales	Fx	tons/annum	calc	(Fp-Fs)	11196
Number of farmer families			0.2-2.0	input data	3000
Crops per hextare	Gh	tons/hectare/a	0.5-2.0	input data	10
Crops produced	G	tons/annum	calc	Gh*Fl	150000
Sales price of crops	Gv	rands/ton	0.5-2.0	input data	1000
Annual value of crops	Gt	rands/million	calc	Gv*Fl	150
Operating cost of farming	Lo	rands/ha	0.5-2.0	input data	1500
Unit cost of farm land	Lc	rands/ha	0.5-2.0	input data	3000
Table IIB					
CAPITAL COST					
Capital cost of farm lands	Cf	rands million	calc	Lc*Fi + 5	50
Capital cost of farm infrastructure @1000R/Ha	Ci	rands million	calc	Fl/1000	15
Capital cost of the IX plant	Cix	rands million	calc	50 + 150*Mp/1000	200
Capital contingency	Cc	rands million	0.5-3.0	input data	25
Capital cost of by-product processing plant	Cb	rands million	0.5-3.0	input data	25
Capital cost of pipeline	Cp	rands million	0.5-3.0	input data	15
Capital cost of dams	Cd	rands million	0.5-3.0	input data	15
Capital cost of irrigation systems	Cr	rands million	0.5-3.0	input data	15
Total capital exp on farms and equipment	Ct	rands millions		sum Cf to Cc	360
Working capital, R & D costs, consultants	Cw	rands million	0.3-3.0	input data	50
Total Capital Expenditure	C			calc sum Ct+Cw	410
Table IIC					
EXPENDITURE AND INCOME					
Nitric acid cost per ton		rand/ton	0.8-1.5	input data	1256
Ammonia cost per ton		rand/ton	0.8-1.5	input data	1546
Phosphoric acid per ton		rand/ton		input data	2500
Cost of nitric acid per annum		R/million/a		calc	35.5
Cost of ammonia per annum		R/million/a		calc	21.5
Cost of phosphoric acid per annum		R/million/a		calc	29.5
Cost of resin replacement @ 10 cents/m^3		R/milliom/a		calc	5.5
All other variable plant costs @ 10 cents/m^3		R/million/a		calc	5.5
Plant fixed costs @ 10 cents/m^3		R/million/a		calc	5.5
Pumping costs @ cents/m^3		R/million/a		calc	5.5
Farming costs (fixed and variable) @ R1500/ha		R/million/a		calc	22.5
Total costs		R/million/a		calc	130.8
Income from farming		R/million/a		calc	150
Income from calcium sulphate sales @ R500/ton		R/million/a		calc	27.4
Income from fertilizer sales @ R3000/ton (NPK)		R/million/a		calc	33.6
Total income	It	R/million/a		calc	211.0
Total income less total costs (PBT)	Ln	R/million/a		calc	80.1

Table IID

Economic model for the use of mine water in agriculture

Parameter		Units	Sensitivity Range	Source or Formula	Value
CASHFLOW ANALYSIS (PIDCF)					
Probability of success R & D and planning phase		number		calc 0.9^3	0.73
Phasing in period years		years	1-5	input data	3
Cash flow initial cash (probability inflated)		R/millions		calc Cw/Po	-68.6
Cash flow Year 1		R/millions		(C-Cw)/3	-120
Cash flow Year 2		R/millions		(C-Cw)3+Ln/3	-93.3
Cash flow Year 3		R/millions		(C-Cw)/3+2*Ln/3	-66.6
Cash flow Year 4		R/millions		In	80.1
Year 5		R/millions		In	80.1
Year 6		R/millions		In	80.1
Year 7		R/millions		In	80.1
Year 8		R/millions		In	80.1
Year 9		R/millions		In	80.1
Year 10		R/millions		In	80.1
Year 11		R/millions		In	80.1
Year 12		R/millions		In	80.1
Rate of return (PIDCF) (excl tax and interest)				calc IRR	12.4

Fourth annual course on the design of slurry pipeline systems to be held in Cape Town from 24 to 26 March 1999

Paterson & Cooke Consulting Engineers will present the fourth annual course on the design of slurry pipeline systems in March 1999 at the Breakwater Lodge in Cape Town's Victoria & Alfred Waterfront.

To date more than a hundred delegates from the Netherlands, Brazil, Botswana, Namibia, Zimbabwe and South Africa have attended the course. It has proven to be an extremely popular course and is always fully booked. Over the years the course has changed to accommodate the needs of the delegates, and is now a blend of theoretical and practical instruction with slurry flow loop demonstrations during lectures.

The course was established to provide guidance for the design of slurry pipeline systems for the mining and processing industries. Slurry pipeline transportation is not adequately covered in most undergraduate engineering courses. Consequently, engineers are generally ill-equipped when faced with the task of designing a slurry transportation system or establishing why a system does not perform its required duty. The course aims to address this problem by giving delegates a sound understanding of slurry flow mechanisms and an appreciation of the design requirements for a successful slurry pipeline transportation system.

The course covers the following:

- flow behaviour and modelling of different types of slurries
- centrifugal and positive displacement pumps
- pump and pipeline wear
- instrumentation and laboratory techniques
- valves for slurry service
- hydraulic design and other engineering considerations.

Where possible the course is tailored to suit the delegates' requirements. For example additional lectures on the design of backfill distribution systems and high concentration slurry flow may be presented depending on the delegate profile.

A fully instrumented slurry pipeline test loop is used during the lectures to show various aspects of slurry flow. Visual observations of the flow phenomena give delegates an insight into the physical slurry behaviour to clarify theoretical aspects presented during the course. The course concludes with design examples which give the delegates an opportunity to apply the principles and techniques presented during the lectures.

The 1999 course will be held from 24 to 26 March 1999 at the Graduate School of Business, University of Cape Town, Breakwater Lodge, Victoria & Alfred Waterfront, Cape Town.

N.P. for more information please phone Ferial Perin at + 27(021) 683 4734, Fax + 27 (021) 683 4168 or e-mail ferial@pcce.co.za. ◆

Statement by Nicky Oppenheimer on the proposed formation of Anglo American plc and the disposal by De Beers of the portfolio of its interests held jointly with Anglo American*

'De Beers Consolidated Mines, incorporated in South Africa, is the largest shareholder in Anglo American with an interest of some 38%. As such we very much welcome the proposal being put forward today which will allow Anglo American Corporation to take its rightful place as one of the world's great mining companies. Through the creation of Anglo American plc, a great South African company will be transformed into one of the largest international mining and resource companies in the world. De Beers believes that this is a matter of pride for South Africa, especially as its major shareholders, namely De Beers and the interests of the Oppenheimer family are firmly South African.

'It is of particular personal pleasure that, because of the interests of De Beers and my family, Anglo American plc will have at least as large a South African ownership as the Anglo American Corporation when it was founded by my grandfather in 1917. Anglo American plc is being created at a difficult time in the economic cycle and it could be argued that AAC might have been better off continuing to operate only in its home environment. But there comes a time when companies, at least the really successful ones, must, like human beings, leave the comfort of home and measure themselves against the best in the wider world. For much of its life AAC has dominated the South African corporate scene—a position that often did not endear it to would-be competitors, especially from abroad. Now, if it is to continue to grow, the time has come for it to take its home-grown expertise and the skills it has honed in South Africa and test them on a wider stage. We, at De Beers, believe that this move will benefit not only AAC and all those who work for it, but its stakeholders in the country in which it was born.

'In particular, we believe the formation of Anglo American plc will be a major step down the road to unlocking the significant unrealized value held in the current company structure, reflected in the substantial discount in their market values relative to their underlying net asset values.

'However, the formation of Anglo American plc will, I believe, not only be of importance to Anglo and South Africa but will also be a further key step in the ongoing re-focusing of De Beers. As a result of the actions announced today De Beers will end with only two major areas of interest. The diamond business and its 40%+ investment in Anglo American plc. This will make De Beers more easily understood by both its shareholders and the investing community. Importantly, once Anglo American plc has been established De Beers will be free to focus its full operating attention on its core role, which is the mining and marketing of diamonds and acting as custodian of the world diamond industry.

'De Beers is certain that Anglo American plc will carry forward the high reputation and skills of AAC into the world at large and that this will be to the benefit of all its shareholders and South Africa.' ◆

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Tuks mining explores Zimbabwe

Students and lecturers of the University of Pretoria with personnel of the Shabani Asbestos Mine in Zimbabwe

As part of an excursion programme arranged by the Department of Mining Engineering of the University of Pretoria, the final-year students, accompanied by two lecturers, Messrs Ronny Webber and Piet van Vuuren, recently visited several mines in Zimbabwe. The mines visited included Shangani Nickel Mine, Wankie Collieries, Shabani Asbestos Mine, How Gold Mine and Bikita Lithium Mine. On their way to Zimbabwe the touring party also paid a visit to the Venetia Diamond Mine near Messina. The visits were extremely valuable as it gave the students an insight into the mining activities of one of our neighbouring countries. Prof Andre Fourie, head of the Department of Mining at the University of Pretoria, stated that it was very necessary to expose the students, as soon as possible, to the 'real world' mining environment and that if the visits could include other countries, so much the better. ◆

Dr N.A. Barcza elected chairman of the Mining and Metallurgy Working Group

National Research and Technology Foresight Project

The Department of Arts, Culture, Science and Technology is conducting a National Research and Technology Foresight project to identify technologies and research areas that will be important for South Africa's social and economic development over the next twenty years.

The project was initiated by the Ministerial Committee on Science and Technology, which is chaired by the Deputy President, Thabo Mbeki. The project director is Dr Philemon Mjwara.

The work of the Foresight Project is being directed through a number of sectors representing major areas for Science and Technology in our society. These sectors are Agriculture and Agro-processing, Biodiversity, Energy, Environment, Manufacturing/Materials, Health, Tourism, Youth, Financial & Business Services, Mining and Metallurgy, Information & Communications Technology, and Safety and Security of Citizens and Society.

Each sector has a sector co-ordinator, whose responsibility is to establish a Sector Working Group (SWG), a group of about 25 people who have expertise and/or interest in the subject of the sector and who would lend their combined experience, knowledge and wisdom on the future, as the basis of the sector project. Mr Brian Protheroe of CSIR Miningtek has been appointed as the Sector Co-ordinator for the Mining and Metallurgy Sector.

The foresight programme has been designed to involve stakeholders such as industry, government, labour and civil society. This inclusive participatory approach is an attempt to give ownership of the process to all sectors of our population. Each sector is to develop its own mission and focus areas within the broader science and technology environment.

The procedure for the projects is that the working group becomes the operational arm of the project and is tasked to carry out the analysis, identify the issues and direct the findings for that sector. This process of appointing the SWG is in progress and the Sector Co-ordinator, Brian Protheroe, is, through a process of co-nomination, obtaining nominations. In addition to the SWG, a group of sector stakeholders is to be established, who will give input to the process and comment on the outputs by means of a survey process through the Internet and other media.

The SWG will be tasked to carry out analysis and research in close collaboration with the Chairperson of the SWG, on the issues affecting the sector. The 'leg work' is to be done by the Sector Co-ordinator, who is responsible for driving the project and facilitating progress. Dr N.A. Barcza, General Manager, Business Development and Technology Commercialization at Mintek, has accepted the nomination of Chairperson of the Mining and Metallurgy Sector Working Group.

The technologies identified in the foresight programme are to be used as a basis for the research and skills development that should be done now to prepare the country, particularly in the area of maintaining a commercially viable, sustainable and environmentally aware mining industry in the future. ◆

Metallurgical Engineering student of U.P. receives Golden Jubilee Merit Bursary from the Chamber of Mines*

The Golden Jubilee Merit Bursary, worth R20 000 from the Chamber of Mines was awarded to Mr Thys Vermaak from the Department of Metallurgical Engineering at the University of Pretoria.

This merit bursary is awarded annually to a candidate nominated by the university, who achieved a Bachelor's degree with a distinction in Mining Engineering, Extraction Metallurgy or Chemical Engineering.

This bursary implies that Mr Vermaak can undertake an educational tour abroad or further his studies locally or abroad.

Mr Vermaak will do research in vanadium recovery during the electro-aluminothermic production of ferrovanadium. ◆

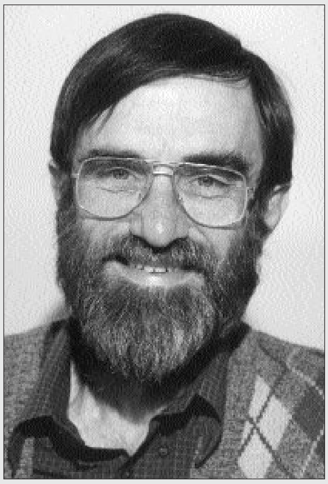
* *Contact: Ronel Pienaar, Faculty of Engineering, University of Pretoria*

Appointments at the University of Witwatersrand

School of Process and Materials Engineering*

Professor Hurman Eric has been appointed head of the School of Process and Materials Engineering in the Faculty of Engineering, University of the Witwatersrand. 'Not only will I strive to maintain the present high standards of the School but my hope is that we will be responsive to the challenges of change. In future I anticipate an even stronger increase in course work at post-graduate level and increased collaboration with the Technikon Witwatersrand and South African industry'. Prof. Hurman Eric. ◆

* *Issued by: Lynne Hancock Communications, P.O. Box 180 Witkoppen 2068, Tel: (011) 460-1000*



Professor Michael Moys has been promoted to a full Professor in the School of Process and Materials Engineering, Faculty of Engineering, University of the Witwatersrand. ◆

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Dr Frank Crundwell has been promoted to Reader and also appointed an Associate Professor in the School of Process and Materials Engineering, Faculty of Engineering, University of the Witwatersrand. ◆

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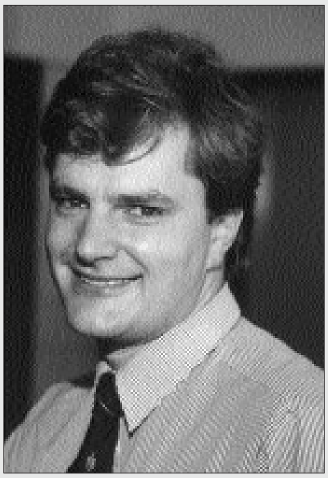

Dr Andre van Bennekom has been promoted to senior lecturer in the School of Process and Materials Engineering, Faculty of Engineering, at the University of the Witwatersrand. ◆

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