Reply to the comments made by J.M. Schaekers* and D.W. Dew* on the paper 'Neutralization of bioleach liquors' by B.M. Nyombolo, J.W. Neale, and P.J. van Staden

The interest shown in our paper by Drs Schaekers and Dew, and their favourable comments, are appreciated. However, some of their remarks require a response.

Stability testing procedures

Regarding the issue of stability-testing procedures, we concur that no long-term procedure has been accepted by either environmentalists or the mining/processing industry as a valid method to test the long-term stability of solid wastes. We agree that the method we used is no exception, and we certainly did not claim that it should be recognized as such. What we did attempt to portray was that we had designed the test procedure in an attempt to simulate, at a very small scale, a tailings dam environment.

The effect of storage pH level

The fact that solid wastes may undergo chemical changes with time is one of the prime reasons why a short-term procedure is unsuitable for characterizing their long-term behaviour. A major feature of the work we presented was to demonstrate the effect of the storage pH level on the long-term stability of iron- and arsenic-bearing precipitates, particularly those with a molar iron-to-arsenic ratio close to 3:1. The precipitates we tested (and are continuing to test) were obtained from liquors generated in continuously-operated bioleach pilot plants treating refractory gold-bearing concentrates. They are, therefore, representative of precipitates that would be produced in industrial plants treating such concentrates. The fact that the materials we tested may have undergone chemical changes in the early stages of the tests conducted at pH levels of 7 and 9 is an important finding, because similar behaviour could reasonably be expected to be obtained in practice.

Our conclusion, that the arsenic stability of precipitates with molar iron-to-arsenic ratios of around 3:1 cannot be guaranteed at pH levels of 7 or more, is certainly valid and justified based on the results we have presented. Obviously, each individual waste material is likely to behave differently and therefore requires testing. However, a stated purpose of our paper was to highlight that claims of stability based on short-term tests may be invalid. It is interesting to note that Billiton admits that previous claims they have made in this regard were based mainly on short-term tests, while at the same time conceding that short-term tests have 'potential problems'. We suggest that one of the major problems with the short-term U.S. EPA-TCLP test is that it is conducted at a single pH level of 4.93.

The Billiton-MIRO publication

We are interested to note that Billiton, in conjunction with MIRO, has recently published[4] preliminary results of long-term column-leach stability tests on a number of synthetic and industrial waste materials. (At the time of writing of our paper in June 2000, we were not aware of this publication.) The molar iron-to-arsenic ratios of the industrial waste materials tested by Billiton-MIRO were all considerably in excess of 3:1, and therefore it is no surprise that these materials displayed good arsenic stability. The synthetic waste materials tested by Billiton-MIRO included two that had molar iron-to-arsenic ratios less than 3:1. The material with a molar iron-to-arsenic ratio of 1:1 was found to be very unstable, but the material with a molar iron-to-arsenic ratio of 2.5:1 was found to be stable. However, what concerns us is that the pH levels in these tests were not reported in the Billiton-MIRO publication. The work we have published highlights the crucial effect of this parameter on the arsenic stability of such waste materials. This pH dependence has previously been reported by several investigators[1,2,3], which the authors of the Billiton-MIRO paper fail to mention.

Conclusions

Clearly, we do not agree with the assertion by Drs Schaekers and Dew that the samples tested by Mintek exhibited any 'unusual characteristics', since the results we have presented are in agreement with those of previous studies. It is our contention that both the storage pH level and the molar iron-to-arsenic ratio of arsenic-bearing wastes are factors that affect their stability. For example, waste materials with molar iron-to-arsenic ratios greater than 3:1 will have greater stability at higher pH levels. Billiton undoubtedly has access to a wealth of data from operating plants, and the possible publication of relevant data from these plants in due time is, we are sure, keenly awaited by all interested parties.

The long-term arsenic stability test work that gave rise to our published results was begun many years ago, in support of the development of Mintek's refractory gold bioleach technology. Mintek shares national and international concern about environmental issues, and recognizes environmental

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management as a key to sustainable development. Mintek is committed to establishing practices for conducting its affairs in an environmentally sensitive and economically sound manner, and to assisting the mining, minerals, metallurgical, and related industries to do the same. Mintek will continue to undertake research in this field, to ensure that the processes and technologies that it develops are environmentally sound, and for the benefit of industry.

References

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Welding engineering in South Africa*

Arnold Benade, Hartmut de Wet and Pieter Smit have completed a Welding Engineering course run by the School of Process and Materials Engineering at the University of the Witwatersrand in collaboration with the South African Institute of Welding (SAIW). Welding has become the main process for the fabrication of metal structures, especially those made out of steel, said Professor Andreas Koursaris, course coordinator. Riveting of steel structures has practically become extinct and bolting constitutes a small fraction of the fabrication market.

Riveting maintains a strong presence in the fabrication of non-ferrous metal structures, which suffer severe metallurgical alterations when remelted or reheated. On the completion of all 12 modules candidates are awarded a Masters degree in Welding Engineering and become eligible for the European Welding Engineer qualification.

Early problems encountered with welded steel structures have been overcome and a host of processes have been developed over the years to meet every conceivable demand. At the same time strong developments in both destructive and non-destructive testing methods and equipment have given the engineer the necessary confidence to specify welding of structures.

The simultaneous developments in the fields of steel making and flux formulations have combined to bring the art of welding to its present unique position as the major fabrication process.

In addition to meeting the necessary mechanical requirements welding has aided the combating of some severe limitations associated with bolting and riveting. Welding reduces material requirements and is infinitely faster and more reliable than riveting. Welded structures are less prone to corrosion problems and easier to maintain and service.

The need for good education and training in welding was recognized a long time ago and metallurgy/materials courses at universities and technikons have included elements of welding engineering and technology. The formation of the South African Institute of Welding gave great impetus to developments in the field through its extensive and intensive involvement in all aspects of welding education, training and consultancy.

Two serious limitations to all efforts in the field of welding remained. Firstly, none of the universities or the SAIW trained welding personnel to the level of welding engineer, and secondly the numbers trained were inadequate for the needs of the country. These problems came into sharp focus in the recent past with the Mossgas and Sasol projects which required welding personnel of all levels of training and in numbers unavailable in the country.

These problems led to two natural reactions: To import expertise from abroad and to put together quick-fix training solutions in the country.

In 1997 a milestone was set when the School of Process and Materials Engineering at Wits joined forces with the SAIW and instituted a Graduate Diploma/M.Sc. Welding Engineering programme at Wits. It was decided to align the programme to that of The Welding Institute in Britain and to seek accreditation from the TWI, which was duly obtained. This enables suitably qualified candidates to take the European Welding Engineer's examinations and qualify as such.

The GDE/M.Sc. programme of WITS comprises twelve modules and runs on a block release basis over two years.

Entry requirements for the GDE/M.Sc. course are a B.Sc. Eng. or equivalent qualification. This may be an HND/B-Tech plus six years of relevant experience at an appropriate level.

To date the WITS/SAIW partnership has qualified nine welding engineers of whom three successfully attempted the EWF examinations. ◆

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