

The Prieska experience: Flotation developments in copper-zinc separation*

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Discussion by P.J. Lloyd†

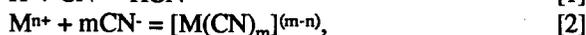
Broekman and Penman describe (*J.S. Afr. Inst. Min. Metall.*, vol. 91, Aug. 1991, p. 261) the addition of sodium cyanide and zinc sulphate to the flotation feed at Prieska. They note that for 'safety sake, lime was added to the rod mill to raise the pH to 9.5', and that 'personnel working in the vicinity of the rod mill were required to wear gas masks'.

All who read De Kok's original paper on the subject of flotation at Prieska (*J.S. Afr. Inst. Min. Metall.*, vol. 72, Jul. 1972, pp. 305 - 321) were struck by the fact that the mine had operated safely with cyanide additions of the order of 550 g of NaCN per ton at pH values as low as 6.4. He noted that 'Free cyanide owes its presence to excess cyanide complexes which are fairly stable but far less so than the cuprocyanides'.

Groenewald and I carried out tests to prove this point, which were reported immediately after De Kok's paper (*op. cit.*, p.321). We found that the concentration of HCN in the atmosphere above NaCN solutions is much more strongly determined by the uncomplexed cyanide concentration than by the pH.

Indeed, raising the pH from 4 to 10 only reduced the HCN concentration by a factor of about 4. In the absence of other factors, it would have remained a hazard at pH10.

The two competing equilibria of interest are



with the HCN form in the first equilibrium being the species so feared for its ability to enter the atmosphere.

Thus, the hazard presented by cyanide solutions arises primarily from the presence of free cyanide ions to take part in the first equilibrium. If a cation M^{n+} is present to which CN^- complexes strongly, then the second equilibrium dominates, the concentration of free cyanide ions is markedly reduced, and the solution presents a very low hazard. If the metal cyano-complex is stable at low pH values, then cyanide may be used in the presence of that cation at low pH values.

Fortunately, there are many transition metals whose cations have this desirable property, of which zinc and copper are but two.

Nevertheless, the important lesson should be remembered: *reliance on alkalis to prevent release of HCN is often misplaced; safety in the use of cyanide depends far more strongly on the presence of suitable cationic complexants.*

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Author reply to P.J. Lloyd

We thank Dr Lloyd for his interesting contribution.

As he correctly points out, the Prieska float had run with cyanide solutions at pH values of 6.4. In fact, it ran safely for extended period with the pH slightly below 6. However, in the last years of operation, the pH of the feed ore dropped as low as 3 at times, so that the use of gas masks was a reasonable precaution for operators who were frequently required to work in confined spaces such as choked rod-mill feed hoppers.

Dr Lloyd's second point, namely that HCN emissions can take place at high pH, is well taken, and should be borne in mind in all operations using cyanide depression.

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