

The effect of the reactivity of lime on desulphurization efficiency in the basic oxygen furnace

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DISCUSSION

R. E. Leyman*

The authors discuss in detail the effects of transport and storage at the steel plant on the reactivity of lime as measured by the DIN Reactivity Test. They attribute the deterioration in reactivity to the absorption of water vapour and carbon dioxide, but make no mention of the possible role of atmospheric sulphur dioxide in this respect. When one breathes the air of the Witbank area, it is not difficult to conceive that the reduction in the reactivity of burnt lime as a result of storage in the bunkers and handling on the steel plant is partly due to sulphur dioxide.

R. H. Borgwardt¹ measured the rate of reaction of sulphur dioxide with four natural specimens of limestone after calcination at standard-

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ized conditions. He found that reaction occurs initially throughout the particle volume under the isothermal reaction conditions studied, and the internal diffusion becomes limiting only after conversion of at least 20 per cent CaO.

Unfortunately, Borgwardt measured reaction at temperatures above 540 °C, below which competition from carbon dioxide in the flue gas used significantly influences the sulphur dioxide reaction, but there is evidence² that the limestones, even of centuries-old buildings, are still capable of absorbing sulphur dioxide from the air.

It is fairly obvious that absorbed sulphur dioxide is far more harmful to the desulphurizing efficiency of burnt lime than is water vapour or carbon dioxide, and that the addition of slag high in manganous

oxide is a thermally inefficient, but not novel, way of compensating for lime inactivity. Investigation of the role of atmospheric sulphur dioxide in lime inactivation at Highveld appears desirable.

Possibly the industry has already evaluated that the cost of transporting and charging burnt lime in heat-sealed polythene bags is greater than the present practice of bulk lime handling and manganous oxide slag charging. It must not be forgotten that the reducing carbon derived from the polythene bags would help desulphurization, whereas carbon dioxide and water vapour are heat-consuming nuisances.

REFERENCES

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2. BRAUN and WILSON. *Atmos. Environ.*, vol. 4, no. 4. 1970. pp. 371-378.

The significance of the mineralogical and surface characteristics of gold grains in the recovery process

by C. E FEATHER and G. M. KOEN

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AUTHORS' REPLY TO DISCUSSION (Published in the Journal July 1973)

H. P. Carlisle

Mr Carlisle's questions and observations will be dealt with in the same order as they were raised.

1. How were the mass percentages of the grains determined from the sizes measured in polished section?

The volumes of grains can be calculated from their sizes, and these results are directly related to the mass values of the grains. Of course, the size-frequency distribution of a grain population measured in polished section differs somewhat from the true size-frequency distribution in that the finer fractions appear to be enhanced relative to

the coarser fractions. In our investigation, however, we reduced this effect by mounting the grains in transparent plastic and measuring the true size of 'sunken' grains by focusing *below* the polished surface. For reasons to be noted later, the remaining effect can, for present purposes, safely be ignored.

2. Were any precautions taken to avoid errors due to the preferred orientation of flattened gold particles?

If a concentrate consists mainly of flattened gold particles, some preferred orientation of the flakes may develop during preparation of the

mount. However, in almost all of the samples examined, gold forms but an insignificant percentage of the sample. Most of the main constituents (e.g., pyrite) occur as roughly equant grains, and in a polished mount the gold grains disseminated through this aggregate are held in all possible positions, and there is no reason to suspect any significant effects resulting from preferred orientation of the gold. The mixing of flaky or acicular particles in a matrix consisting of grains having no preferred shape is a recognized technique used to avoid the effects of preferred orientation

in certain X-ray determinations.

3. How many gold particles were actually counted for each determination?

As a rule, between 20 and 100 gold grains were measured in each sample, the actual number depending on grade. If an insufficient number of grains were exposed in the polished section, the mount was ground down to expose fresh grains, and re-polished. The number of gold grains counted does not, of course, include gold locked in thucholite. If required, and the size of the sample allowing, this fraction was concentrated separately and assayed for gold.

In view of the practical difficulties in obtaining truly representative samples of the various plant products, it seems meaningless to strive for highly accurate mineralogical results by the counting of large numbers of grains, or by the application of sophisticated corrective measures to the values.

We have frequently been able to compare results obtained by mineralogical techniques with those obtained on duplicate samples by recognized analytical methods. No reason has been found to question the meaningfulness of our, admittedly approximate, results.

4. How were the amounts of locked gold determined, the light fractions probably containing most of the locked particles?

The statement linked to this question has been the subject of considerable research. It suffices to remark at this stage that the bulk of the locked gold is by no means necessarily associated with the light

fractions of the plant products.

If a gold-rich plant product is to be examined, a polished section is merely made from a portion split from the sample, no prior treatment being considered necessary. This permits a simple determination of the relative abundance of locked and free gold.

If, however, the sample is so poor in gold that concentration prior to examination is necessary, polished sections may also be made of the light fraction. If thucholite is present, it is concentrated and assessed separately. Alternatively, the light fraction may be assayed for gold, the result indicating what may be assumed to be the amount of locked gold.

5. It is suggested that the results reported would have been much more convincing if some parallel chemical and analytical work had been undertaken.

Please see items 3 and 4 above.

6. The flattened appearance of so many gold grains has no significance other than confirming that gold is soft and malleable.

The differences in appearance between gold freshly liberated by crushing or ball-milling and gold grains present in the tertiary-cyclone circulating load are there for anyone to see. We do not deny that gold is a soft, malleable metal that may become flattened on milling, but our point is simply that re-milling of a liberated grain of gold is unnecessary milling—milling not only wasteful in terms of money, but a treatment that could produce all kinds of deleterious modifications to the gold particle, resulting in more

difficult recovery or even losses.

7. Is the statement that almost all the gold in the minus 600 μm fraction is free meant to suggest that a grind to minus 600 μm would be optimal?

This question could result from a misunderstanding of what we had tried to convey in the text. Milling to minus 600 μm should certainly liberate almost all the gold, but it does not follow that the remaining, locked, gold should be sent to the residue dump. Our point, once again, is that no useful purpose is served by re-milling of the ore after almost all the gold has been freed. For reasons already stated, the free gold should first be recovered, and only then could attention be given to the remaining gold. In any case, gold associated with constituents such as thucholite, uraninite, sulphides, and arsenides requires special treatment for liberation and is unlikely to become quantitatively recoverable merely by continued milling. The chances are, instead, that much of the already liberated gold in the circuit may, unless first recovered, suffer the deleterious effects of over-milling.

R. J. Ortlepp and G. Smits

We wish to thank Ortlepp and Smits for their valuable and most interesting contribution to the discussion of our paper. Their detailed description of the occurrence of gold in a sample of high-grade washed residue from Blyvooruitzicht that they examined provides welcome support to our views on the importance of thucholite as a cause of gold losses.