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THE EFFECT OF CHEMICAL AND BACTERIAL SUPPRESSION OF PYRITE DURING COAL FLOTATION

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KÖMÜR FLOTASYONU ESNASINDA KİMYASAL VE BAKTERİYEL PİRİT BASTIRMANIN ETKİSİ

ÖZET

Bu çalışma secilmiş kömürlerdeki piritin yüzebilirliği üzerine kimyasal ve biyo-oksidasyon basma etkilerini inceler. Başlangıç deneyleri Leeds laboratuvar flotasyon hücresinde standart bir kömür flotasyon sisteminin optimizasyonunu içermiştir. Bu deneylerin sonuçları daha sonraki mukayeseli testlere temel bilgi oluşturmuştur.

Çesitli kimyasal bastırıcıların flotasyon esnasındaki pirit verimine etkileri belirlenmiş ve bakteriyel yöntemlerdeki piritik kükürtün bastırılması ile mukayese edilmiştir.

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DURING COAL FLOTATION

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ABSTRACT - This work studies the effect of biooxidation and chemical suppression on the flotability of pyrite in selected coals. Initial experimental work involved the optimisation of a standard coal flotation system using a Leeds laboratory flotation cell. The results of this study provided the baseline data for subsequent comparative tests.

The influence of various chemical depressants on pyrite recovery during flotation was determined and compared with bacterial methods for pyritic sulphur depression.

INTRODUCTION

Coal combusted at power stations contains sulphur in various forms. This sulphur can be inorganic (in the mineral form of pyrite or marcasite), organic sulphur and sulphate sulphur (calcium sulphate). The sulphur content of a typical U.K. coal will be 60-70% pyrite and 30-40% organic with negligible quantities of sulphate sulphur.

From available data it can be seen that U.K. coals have an average sulphur content of approximately 1.5% and are therefore not classified as low sulphur content coals¹.

One possible method available to desulphurise coal prior to combustion is froth flotation. Conventional coal flotation techniques have² become widely used in coal preparation plants to upgrade fine coal products². Whilst this technique will reduce the ash content of the clean coal, it will not significantly lower the pyritic sulphur level of the coal because both organic coal and pyrite are hydrophobic and are recovered together in the flotation concentrate.

Therefore, chemical pyrite depressants must be used to reduce the sulphur content of the coal. Investigators³ have shown that the flotability of pyrite particles was reduced by the addition of specific depressants such as calcium hydroxide, sodium hydroxide and calcium chloride.

An alternative to chemical depression is bacterial conditioning. The surface modification of pyrite minerals prior to coal flotation has been undertaken, with the majority of investigations using *Thiobacillus ferrooxidans* as the iron oxidising bacteria^{4,5}.

The object of the bacterial preconditioning with *Thiobacillus ferrooxidans* is to alter the hydrophobic nature of coal pyrite by a combination of direct and indirect bacterial leaching, thus allowing the separation of coal and pyrite during coal flotation.

CHEMICAL DEPRESSION OF PYRITE DURING COAL FLOTATION

Initially a coal flotation system was established using standard coal flotation reagents currently utilised in coal preparation plants for coal cleaning. The data obtained was used to optimise reagent dosages for the two coals used in this work.

Once this baseline data was available various chemical pyrite depressants were added to the system to ascertain the overall effect on the desulphurisation of the clean concentrate.

Results showed that calcium carbonate was one of the most effective reagents used in the test programme. It decreased the total sulphur content of the coal by 34% at an optimum dosage of 50 g/tonne of coal (Figure 1).

Various types of pyrite depressants were added at their optimum dosage to ascertain their effect on coal desulphurisation (Figure 2). The data showed sodium chloride and sodium hydroxide to be the most effective at reducing the sulphur content of the floated high sulphur coal.

BACTERIAL SUPPRESSION OF PYRITE IN COAL FLOTATION

The use of pyrite depressants such as sodium chloride was found to be more effective than the use of biooxidation pretreatment of coal in flotation tests with high sulphur/high ash coal.

However, tests carried out with medium sulphur coal compared favourably with the equivalent chemical coal flotation. The optimum pH for bacterial pretreatment of coal was found to be 1.5 and the optimum conditioning time with the bacteria was one hour.

CONCLUSIONS

Base data on the flotation behaviour of two U.K. coals has been determined and the optimum flotation conditions defined. The effects of a wide range of chemical pyrite depressants on the flotation of coals with sodium chloride and calcium carbonate being found to be the most effective with a 34% total sulphur reduction in clean coal concentrate.

Bacterial methods of sulphur depression have been developed and compared with chemical methods of sulphur depression. Initial test data appears to indicate that bacterial suppression is not as effective as chemical suppression on high ash/high sulphur coals.

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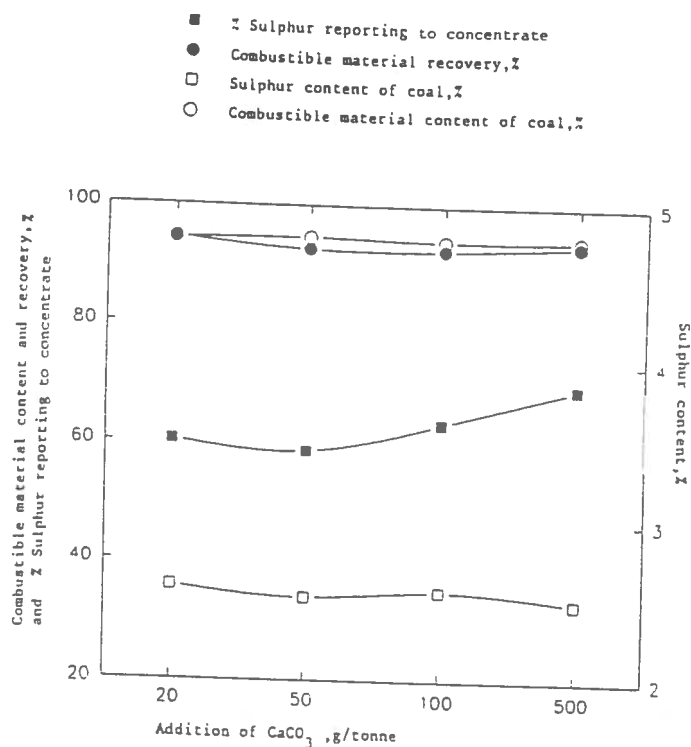


Figure 1 Effect of addition of CaCO₃ as a pyrite depressant on coal flotation

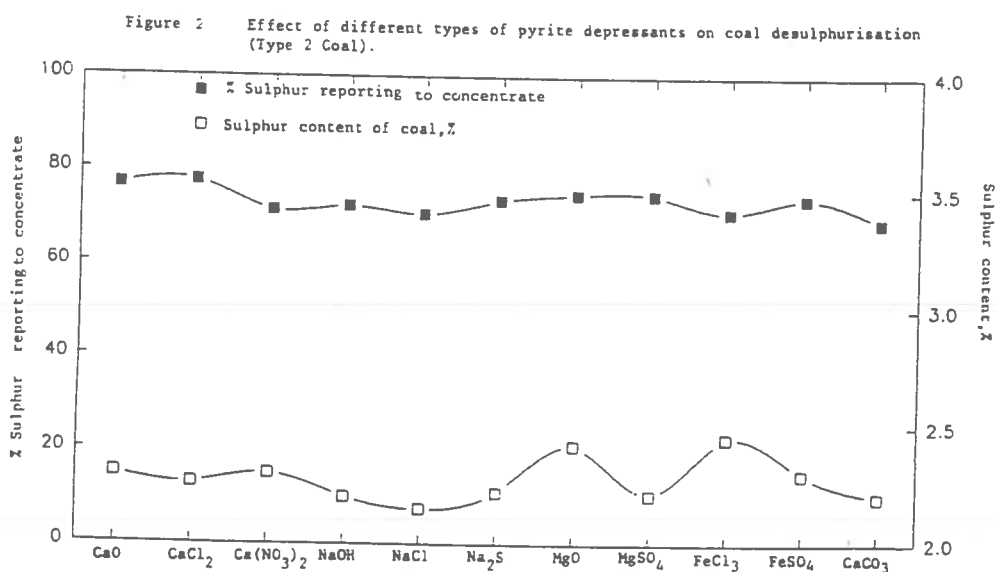


Figure 2 Effect of different types of pyrite depressants on coal desulphurisation (Type 2 Coal).