PROCEEDINGS: PROF–97
©NML, JAMSHEDPUR; pp.194-201

Response of mineral separator for fine coal beneficiation

S. DEY and K. K. BHATTACHARYYA
National Metallurgical Laboratory, Jamshedpur 831 007.

ABSTRACT

Indian coking coal washeries employ coarse and medium coal gravity concentration techniques for processing of 80-90% of coal and balance being processed by flotation mainly. In case of fine coal also new developments are oriented towards the use of gravity concentration systems. Washability of coal is an important criteria to evaluate the performance of the separating systems. Washability studies consumes expensive reagents like bromoform, carbon tetra-chloride, benzene, acetone etc. Washability of fine coal is still more complicated due to reagent retention, use of heavy liquid centrifuge etc. An attempt has been made to use Mozley Mineral Separator to produce an ash-yield relationship using a coal sample of 36% ash. The results have been compared and analysed against the washability data to find out efficacy of the Mineral Separator. Tabling and flotation studies were also carried out on the same sample. The study reveals that while there is a deviation at low ash level, Mineral Separator can produce an ash-yield relationship nearly similar to washability data at higher ash level. While sink-float provides an ideal separation the mineral separator provides data obtainable in separating system. Studies on tabling and flotation with the sample also indicate that the ash yield relationship is quite close to that of mineral separator.

INTRODUCTION

With the depletion of good grade reserves of coking coal and increased mechanical mining, generation of fines in the coal to be processed is on the increase. Liberation size is also becoming finer as evident from the washery record for past fifty years wherein the top size of coal for processing has been reduced from 76 mm to 13 mm in stages. In future the top size may be further reduced to even 6/3 mm as envisaged in the recommendations of different expert committees constituted by Ministry of Coal, Govt. of India. This eventually will lead to generation of more fines and the load on fines treatment circuit will substantially increase. Flotation is till now the major processing step to treat this fine coal of about 0.5 mm. Modern developments in gravity separation like water only cyclone, slurry jigs etc. are useful for

handling particle size upto 100 micron. Efficiency of any coal washing system is always compared with the washability data of the said coal. Washability studies are carried out to find out the ideal separation for optimum yield and ash content of the products. Developments are taking place to reach this ideal condition through mechanical separation. The washability study involves use of expensive chemicals like bromoform, benzene etc. The mineral separator is an equipment where in water media time dependent gravity fractions are drawn out. In mineral separator the first to flow out is the lightest product and the last to flow out is the heaviest mineral. Thus density gradient product could be obtained [1]. This can be helpful in producing ash–yield relationship for a given sample. Like the washability data this in turn can be used for assessing the performance of different coal cleaning devices. In this paper an attempt has been made to simulate the coal washability data using mineral separator.

EXPERIMENTAL

Sample

The coal sample used for the investigation was the medium coking coal. The as received sample was crushed to -13mm and screened at 590 micron. The -590 micron was taken up for the various studies. The chemical composition of the sample is given in Table 1. The size and ash distribution are shown in Fig. 1.

Table 1 : Proximate analysis of the coal sample

Constituents	Percent
Ash	35.63
Volatile Matter	22.71
Fixed Carbon	40.31
Moisture	01.35

Washability Study

The closed size fraction of the sample were taken up to study the washability characteristics. Sink–float tests were conducted in the specific gravity range of 1.4 to 2.0 in a mixture of bromoform and benzene. Floats and sink products were washed with benzene, dried and weighed. Each product was analysed for ash content.

Mineral Separator

The Mozley Mineral Separator was used to treat the different size fractions of fine coal. Flat deck was used for fine fraction of less than 147 micron and the V-

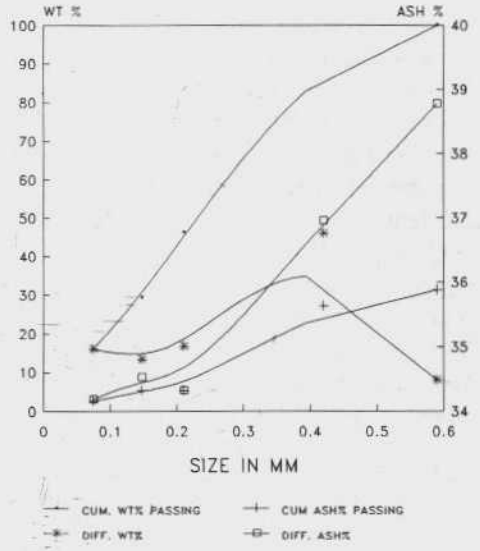

Fig. 1 : Size and ash distribution of the coal sample.

shaped deck was used for +147 micron. Uniform samples were drawn at regular time intervals. The products were dried and analysed for ash content. The parameters varied for this study were wash water, rpm and amplitude of stroke. The slope was kept constant.

Beneficiation Studies

Few tabling and flotation studies were carried out with the sample to obtain an ash yield relationship and the same was compared with the washability and Mineral separator data.

RESULTS & DISCUSSION

The analysis as mentioned in Table 1 indicate the sample to be of high ash content with above 35% and the Fig 1 indicates that the coarser fractions of above 210 micron were comparatively of higher ash content than the fractions below 210 micron.

Figs. 2 to 7 present results obtained using Mineral Separator vis-a- vis washability data for different size fractions. It is evident from Fig. 2 that the performance of mineral separator is quite comparable with washability at the size of -0.590 + 0.420 mm. It is found from the figure that at higher rpm (70) and lower amplitude the ash level in the product is quite high, the ash is quite low at lower rpm (60) and higher amplitude (2.5 cm) and very close to washability characteristics.

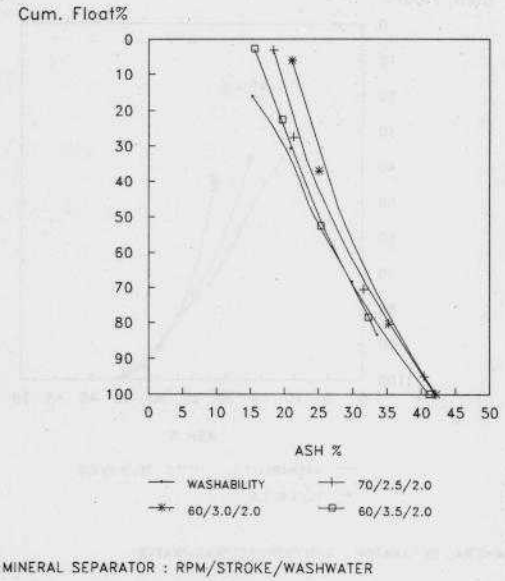

Fig. 2 : Comparison of mineral separator performance with washability data at –0.590+0.42 mm.

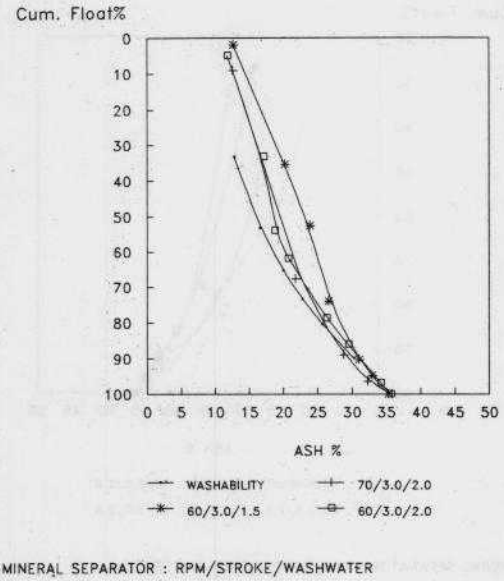

Fig. 3 : Comparison of mineral separator performance with washability data at –0.420+0.210 mm.

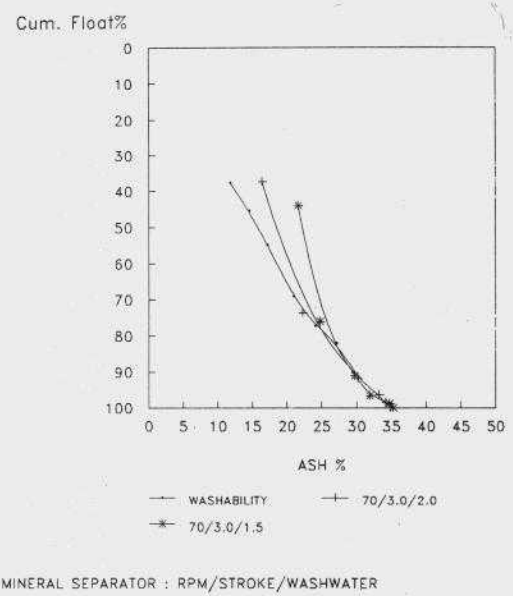

Fig. 4 : Comparison of mineral separator performance with washability data at –0.210 + 0.147 mm.

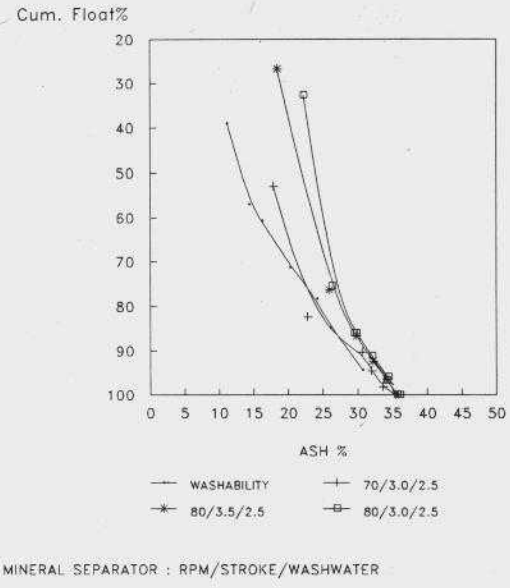

Fig. 5 : Comparison of mineral separator performance with washability data at –0.147 + 0.074 mm.

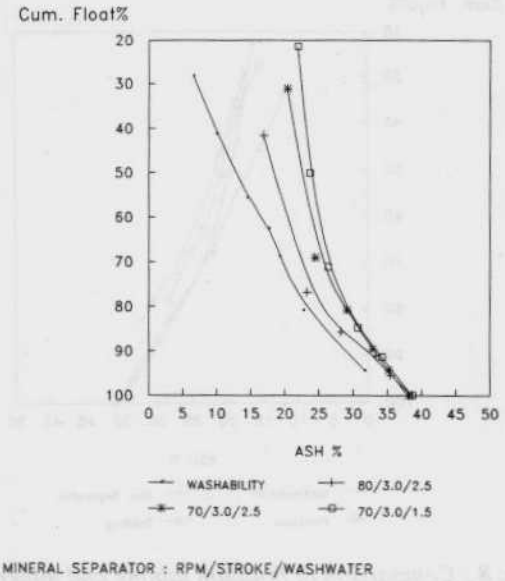

Fig. 6 : Comparison of mineral separator performance with washability data at –0.074 mm.

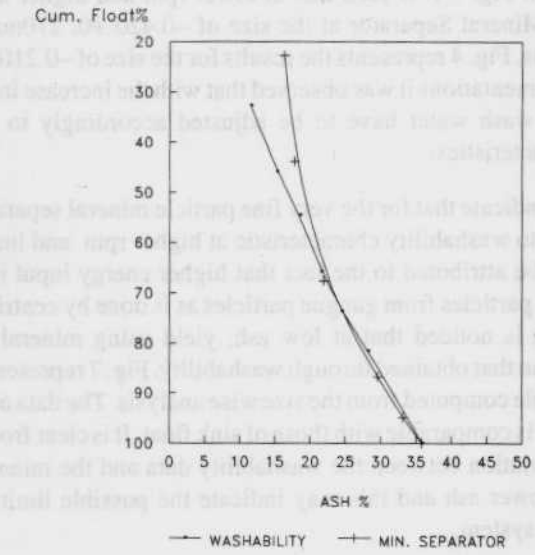

Fig. 7 : Comparison of mineral separator performance with washability for the composite.

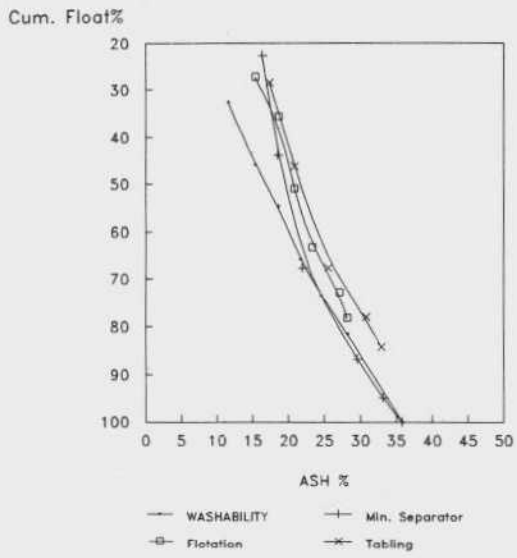

Fig. 8 : Comparison of flotation tabling and mineral separator results with washability data for the sample.

Similarly from Fig. 3 it is seen that at lower rpm and higher amplitude the performance of Mineral Separator at the size of –0.420 +0. 210mm is close to washability results. Fig. 4 represents the results for the size of –0.210 + 0.147 mm. During the experimentations it was observed that with the increase in fineness, the rpm, stroke and wash water have to be adjusted accordingly to obtain near washability characteristics.

Figs. 5 and 6 indicate that for the very fine particle mineral separator performs reasonably close to washability characteristic at higher rpm and increased wash water. This may be attributed to the fact that higher energy input is required to separate fine coal particles from gangue particles as is done by centrifuge for sink - float studies. It is noticed that at low ash, yield using mineral separator is somewhat less than that obtained through washability. Fig. 7 represents the results on complete sample computed from the size wise analysis. The data obtained from mineral separator is comparable with those of sink float. It is clear from the studies that there is a deviation between the washability data and the mineral separator performance at lower ash and this may indicate the possible limitations of the actual separation system.

Results of flotation and tabling studies are presented in the Fig. 8. When compared with washability and mineral separator data, it is seen that performance

during flotation and tabling is quite comparable with mineral separator.

CONCLUSIONS

It can be concluded from the above studies that

i) An ash–yield relationship nearly similar to washability can be obtained through mineral separator

ii) Proper optimization of the mineral separator is essential in respect of wash water, slope, rpm etc.

iii) Dependence on expensive heavy liquid for sink -float can be reduced through the use of mineral separator.

iv) Mineral separator performance may be taken as guidance for evaluating the performance of the separating system.

REFERENCE

[1] Kuzev, L. V., *et. al.*, (1994), 'Proceeding of 12th International coal preparation Congress', May 23-27, Cracow, Poland, pp. 881-892.