Recovery Enhancement of Graphite Tub-dust to 99+ Carbon using a Mill Modification

Samarakkody SATI, Rohitha LPS and *Fernando WLW
Department of Earth Resources Engineering, University of Moratuwa
*Corresponding autor; email: wlwf2002@ yahoo.com.

Abstract: There are many mineral processing methods that are being used in mining and mineral processing industries. One such method very widely used in the graphite industry is froth flotation. During the present study, graphite having a 82- 85% C, with a low market, has been up- graded to Carbon 99% + grade by using flotation. It has been observed that the rod weight in the grinding operation has a major role to play. If the rod weight is increased over and above the critical weight, over grinding takes place. Further, it has been found that pH and the type of collector also play major roles in the graphite processing. Laboratory trials indicate that by using the rod weight of 625kg to 725kg in the rod mill and the particle size range of 75 to 150 microns, maximum recovery of 85% could be achieved at 99% + C grade.

Keywords: Carbon, Froth flotation, Graphite

1. Introduction

Graphite has been categorized in industry according to the amount of graphite Carbon content. Therefore high quality graphite has high volatile carbon which has very wide applications in the nuclear industry but the presence of impurities in graphite detracts its use as a moderator. However, the foundry and steel industry do not require very high quality graphite. In this research we have made use of local graphite having 85% C grade as the starting point. Particle size control with the correct grinding time, collector type, pH and right flotation time are some of the variables used in this research.

2. Methodology

Tub dust was used as the main raw material as at present. In addition, rod mill, spiral classifier and floatation cells were used for the processing at Bogala mines (figures 1a to c). Five graphite samples of the tub-dust grade were sieved and each particle size was used for flotation process. Three trials of flotation were conducted on each sample and an average taken .For this research, the rod weight of the rod mill was changed from 550 to 700 kg in stages and the optimum rod weight required for the maximum grade recovery of graphite was chosen for flotation.

Fernando W.L.W., B.Sc.(Cey), M.Phil.(Leeds), Ph.D.(Leeds), C.Eng.(UK), A.I.Ceram.(UK), M.I.Ref.Eng.(UK), MIMM(UK), F.I.ChemC, C.Chem.(Cey), Senior Professor of the Department of Earth Resources Engineering,
Rohitha.L.P.S. BSc (Eng)(Hons), PGDip.(Sri.J'pura), MSc (Moratuwa) Lecturer in the Department of Earth Resources Engineering,
Samarakkody S.A.T.I Final year undergraduate student in the Department of Earth Resources Engineering, University of Moratuwa.

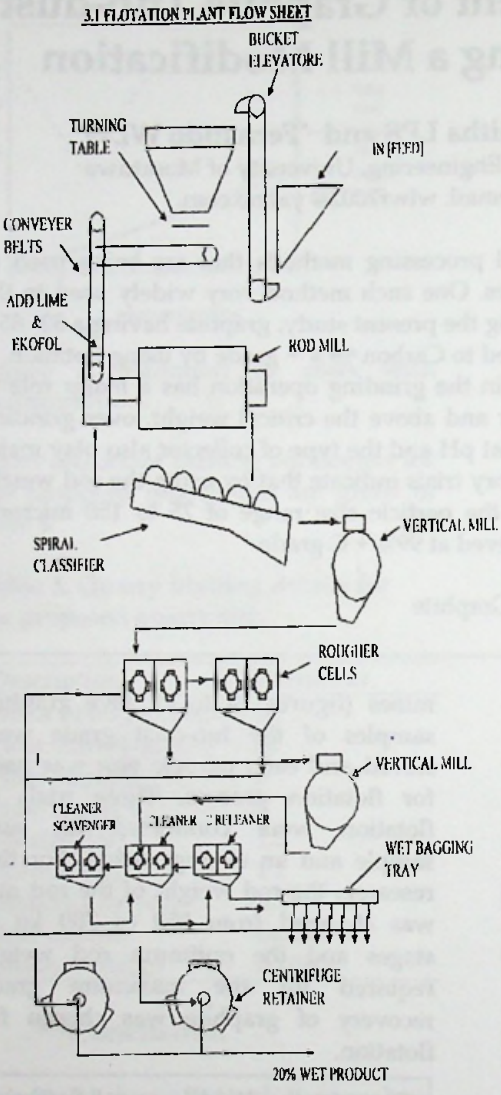

Figure 1a. Bogala Mines Process, Flow sheet-Grinding, flotation and dewatering

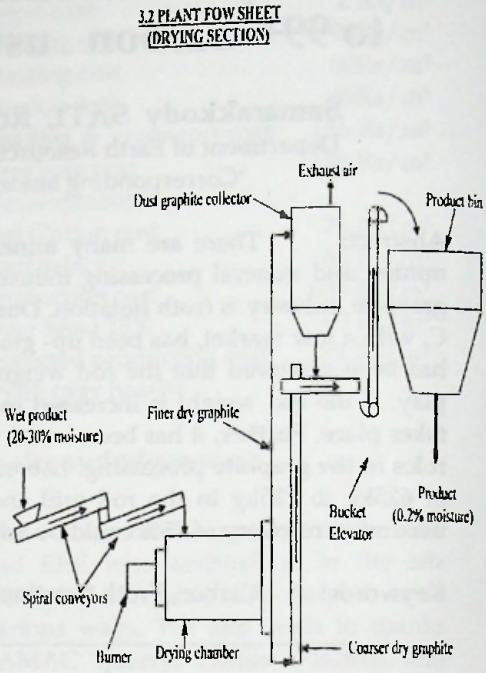

Figure 1b. Drying and bagging flow sheet at Bogala Mines

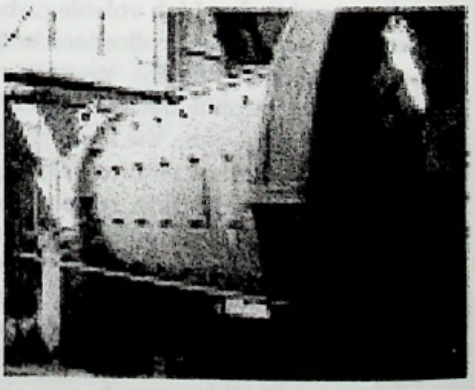

Figure 1c. Rod mill used at Bogala Mines

The theory of froth flotation is complex and is not completely understood. Flotation depends on different physical and chemical surface properties of particles of various minerals. Ekopol was used as a reagent in the flotation cell. This reagent is an organic compound which render selected mineral water-repellent by adsorption of collector molecules. Thereafter mineral particles get adhered on to it as shown in Figure 2.

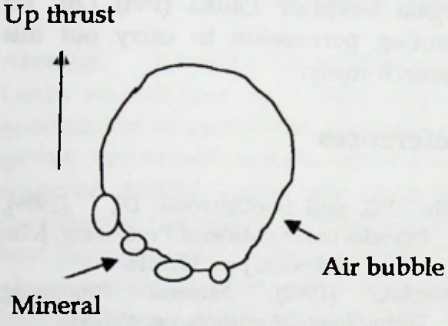

Figure 2. Mineralised froth

3. Results and Discussion

Figure 3 indicates how the final product quality varies with the weight of the rods used in the rod mill. This has been done while the production process was in progress. When greater weights of rods are used there will be an excessive size reduction leading to high percentage of slimes being produced. The effect of this would be to change the quality of the final product as shown. It is clear that the maximum quality of graphite that is produced in the flotation process corresponds to between 600 kg to 700 kg range of rod weight.

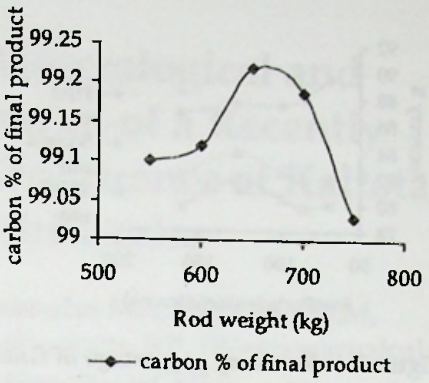

Figure 3. Carbon percentage of final product with respect to rod weight (kg)

Reference to Figure 4, it is clear that the recovery percentage of carbon showed a low value at the beginning with the rod weight and thereafter it became reasonably higher within the range of 625 kg to 725 kg. It fell off afterwards.

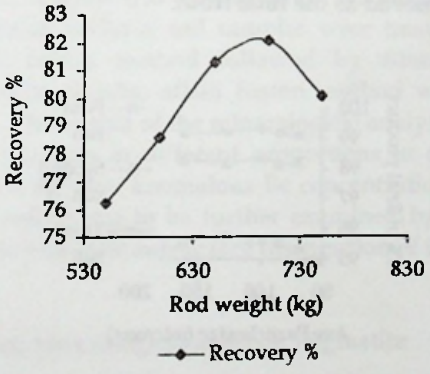

Figure 4. Recovery percentage with respect to rod quantity

When the flotation process was continued by incorporating a cleaner and a re-cleaner in the circuit, it was noted that the recovery percentages increased to 80 to 85 percentage levels for particle size range of 100 to 150 microns. This behaviour is shown in Figure. 5.

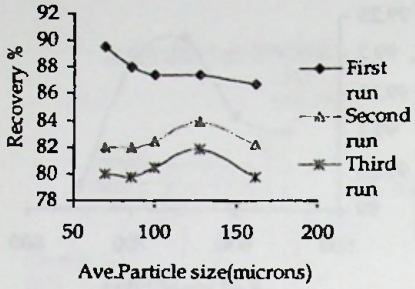

Figure 5. Recovery percentage of final product with respect to average particle size

With regard to the grades of Carbon produced it was noted that 99%+ Carbon grade would be possible for the final product as in Figure 6. When the particle size range had an average of 75 to 150 microns to start with followed by three runs, i.e. by subjecting froth from the rougher to cleaner and cleaner to re-cleaner operations, 99%+C could be achieved as the final froth.

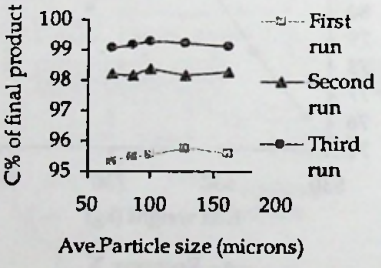

Figure 6. Carbon percentage of final product with respect to average particle size.

4. Conclusion

In this research it was found that the maximum recovery of high grade graphite 99%+ C could be produced from graphite of 85% C grades by making use of modified rod mill parameters, that is by using rod weight in between 625 to 725 kg for the grinding process at the normal feed rate. This would produce an optimum particle size range of 75 microns to 150 microns at its maximum followed by the collector ekopol addition and by subjecting froth from the rougher to cleaner and cleaner to re-cleaner operations. In all operations pH was maintained at 9 with lime addition.

Acknowledgements

Our sincere thanks are due to Management and laboratory staff at Bogala Graphite Lanka (Pvt) Ltd. for granting permission to carry out this research study.

References

Kelly EG, and Spottiswood. DJ, (1989), Introduction to Mineral Processing, John Wiley and Sons, pp. 301-316.

Wills.BA, (1992), Mineral Processing Technology, 5th edition, pp. 491-535.