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Flotation of low-grade graphite ore using collector derived from low density polyethylene waste

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1. Introduction

Due to depleting high-grade graphite ore, utilization of low-grade ore by beneficiation becomes utmost importance for sustainable development and resource management. Amongst various beneficiation techniques, froth flotation is more suitable for treating fines and naturally hydrophobic ores such as graphite. Flotation is a surface phenomenon based on the differential surface hydrophobicity of the minerals to be separated [1,2,3]. Since graphite is a naturally floatable mineral, this technique was adopted for beneficiation. Flotation reagents such as collector and frother were used to enhance the efficiency of the separation process [4]. The chemical reagents commonly used in graphite flotation are hydrocarbon oils such as diesel, kerosene along with a frothing agent such as methyl isobutyl carbinol (MIBC) which are not cost effective due to continuous escalation in price when consumed in large quantities at industrialscale processing of the ore [5,6]. Hence in this work, a new collector for graphite flotationwas developed utilizing low-density polyethylene waste as an alternative to conventional hydrocarbon oils. In this study, beneficiation of a low-grade graphite ore (run-of mine) from Tamil Nadu, India by flotation was carried out using the new collector derived from LDPE waste (collector-PE) and also diesel as collector. The flotation performance efficacy of this collector PE was evaluated in comparison with diesel as collector. MIBC was used as frother in both the cases.

2. Material and Methods

A low-grade graphite (run-of mine, R.O.M) ore from Tamil Nadu, Indiawas utilized in this study for recovery of graphite by flotation. Commercial grade diesel, MIBC (LR grade), collector PE (derivedfrom LDPE waste) was used. The tests pertaining to optimization of process parameters such as mesh-of-grind, collector and frother dosages to recover graphite with reduced ash content were conducted.

3. Results and Discussion

3.1 Characterization of graphite ore

The low-grade graphite ore (R.O.M) was characterized for mineralogical studies by x-ray diffraction, morphological studies using scanning electron microscopy, fixed carbon and ash by proximate analysis.The x-ray diffraction studies (Figure 1) revealed that graphite phase was accompanied predominantly by quartz. Kaolinite and muscovite formed the minor phases.The proximate analysis of R.O.M graphite ore was analysed with a moisture content of 0.4%, 1.10% volatile matter, 88.59% ash and fixed carbon of 9.85%. Themorphological study of graphite ore is carried out using Scanning electron microscopy (Fig. 2). The FTIR analyses of the flotation reagents diesel and collector PE were carried out.

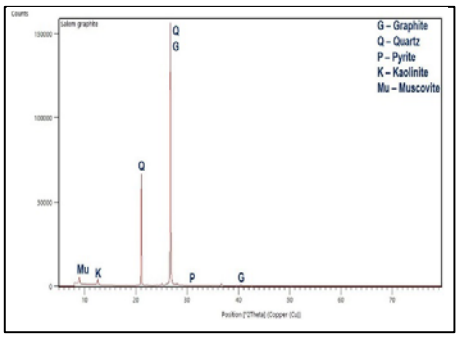

Fig.1: X-ray diffractogram of graphite ore

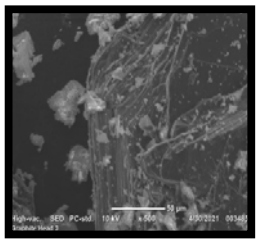

Figure 2: SEM image of graphite ore

3.2 Results of flotation studies of graphite ore

The flotation experiments on low-grade graphite ore analyzing 9.85% fixed carbon and 88.59% ash content were carried out for optimization of process parameters such as mesh of grind, diesel dosage, MIBC dosage and collector PE dosage. At the optimized mesh-of-grind of240 µm (d_{80}), a concentrate of 12.6% weight recovery and 8.7% ash could be obtained at 0.85 kg/t of diesel and 0.05 kg/t of MIBC. At the same mesh-of-grind, a concentrate of 13.4% weight recovery at 8.9 % ash could be achieved with 0.46 kg/t of collector PE and 0.05kg/t of MIBC.

4. Conclusion

The flotation performance efficacy of collector PE in combination with MIBC as frother in low-grade graphite flotation was evaluated and compared with that of conventional diesel and MIBC frother combination. Graphite ore with 86.84% ash when treated with new reagent as collector and MIBC as frother yields a final concentrate of 13.4% with 8.9 % ash as compared to 12.6% with 8.7 % ash using diesel as collector and MIBC as frother after 2-stage cleaning of rougher concentrate.

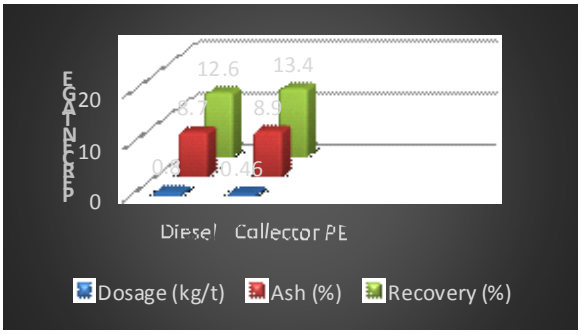

Figure 3: Comparison of dosage (Kg/t), Recovery (%) and ash (%) using diesel and PE oil

From the results, it can be concluded that at equivalent concentrate recovery and grade, the newly developed reagent has an equal performance at half the dosage of diesel. Thus, the newly developed collector for graphite flotation could be cost effective, as an effective means of utilization of LDPE waste and also as a better alternative to diesel.

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