# Enhancing the Graphite Froth Flotation Yield

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## Introduction

The vein graphite deposits of Sri Lanka are located in a Precambrian high grade metamorphic terrain dominated by granulite facies rocks. In Sri Lanka Graphite is mainly extracted through underground mining located at Bogala, Kahatagaha and Kolongaha. At the Bogala graphite mine, the Graphite veins are mix with rocks of the granulite and almandine amphibolite metamorphic facies (Cooray, 1984). Graphite has been categorized in industry according to the amount of graphite carbon content. During the present study, graphite having a 82-85% C of Tub-dust, with a low market, has been upgraded to carbon 99+% grade by using flotation that is one such method widely used in the graphite industry. Therefore, high quality graphite is made by the froth flotation process in industrially.

The flotation process has been used in the world widely coal, Graphite, Sulpher, Nickel, iron ore, platinum ore, gold industries to upgrade and extract the minerals. Basically, Froth flotation process is physico-chemical separation method (Barry and Napier-Munn, 1989) However, the purity of ore part has been decreased with time of mining in the word. Because of that, mineral consumption is very higher in the world. Hence, the low grade minerals like nonsulfide metallic minerals, industrial minerals, Coal and Graphite want upgrade and separate as high grade minerals in industrially (Kelly and Spottiswood, 1989). Efficiency of Froth Flotation process should be increased by changingits effective parameters and different physical properties of particles of various minerals for the modern mining and processing industry to produce economically profitable products. In this research, we have made use of local graphite having 85% C grade as the starting point. Air flow rate control the correct float time, particle size and RPM value, pH, right flotation time are some of the identified variables and effective flow sheet for Graphite flotation plant used in this research.

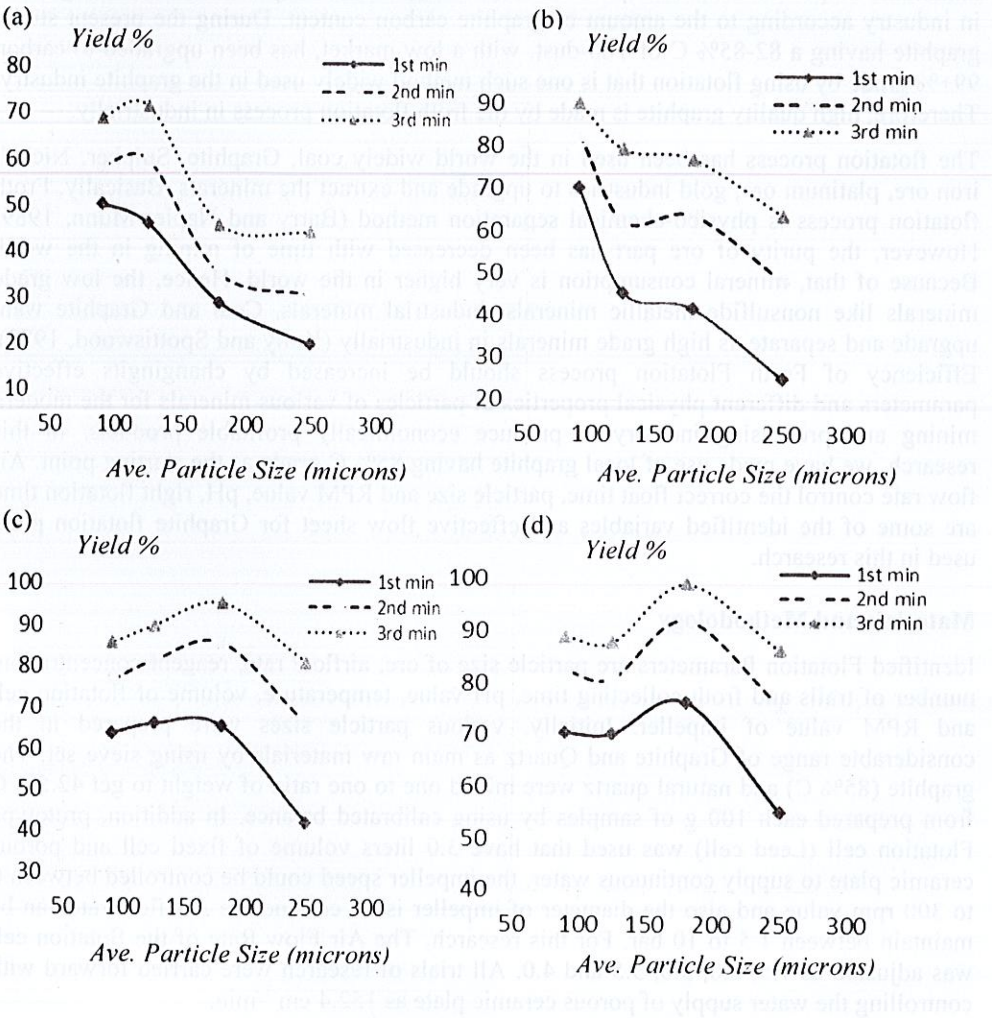
## Materials and Methodology

Identified Flotation Parameters are particle size of ore, airflow rate, reagent concentration, number of trails and froth collecting time, pH value, temperature, volume of flotation cell and RPM value of impeller. Initially, various particle sizes were prepared in the considerable range of Graphite and Quartz as main raw materials by using sieve set. The graphite (85% C) and natural quartz were mixed one to one ratio of weight to get 42.5% C from prepared each 100 g of samples by using calibrated balance. In addition, prototype Flotation cell (Leed cell) was used that have 3.0 liters volume of fixed cell and porous ceramic plate to supply continuous water, the impeller speed could be controlled between 0 to 300 rpm value and also the diameter of impeller is 11 cm and the Air flow rate can be maintain between 1.5 to 10 bar. For this research, The Air Flow Rate of the flotation cell was adjusted as 1.5, 2.0, 3.0, 3.5 and 4.0. All trials of research were carried forward with controlling the water supply of porous ceramic plate as 152.4 $cm^{-3}$/min.

The flotation yield was collected and weighted with respect to the different airflow rate and particle size range of mixtures at constant impeller speed (125 rpm) and adding concentrate 2 mL of Phenol within known time. Phenol was used as a reagent in the flotation compound, which render selected mineral water-repellent by adsorption of collector molecules. Initial mixture of graphite was weighted then calculated the recovery percentage of froth flotation tests.

**Results and Discussion**

Figure 1 indicates how the Graphite yield percentage varies with the particle size range of graphite in selected Air Flow Rate lower to higher values. When the flotation process was continued by prototype flotation cell and the temperature reading values were collected all trial samples that had different airflow rate values by using thermometer. Those temperatures were close to the 27 to 29 Celsius range in the flotation cell and also the pH values of flotation samples was detected by pH meter at times after finished the all trails. The pH values indicated as 6.3-7.0 range.



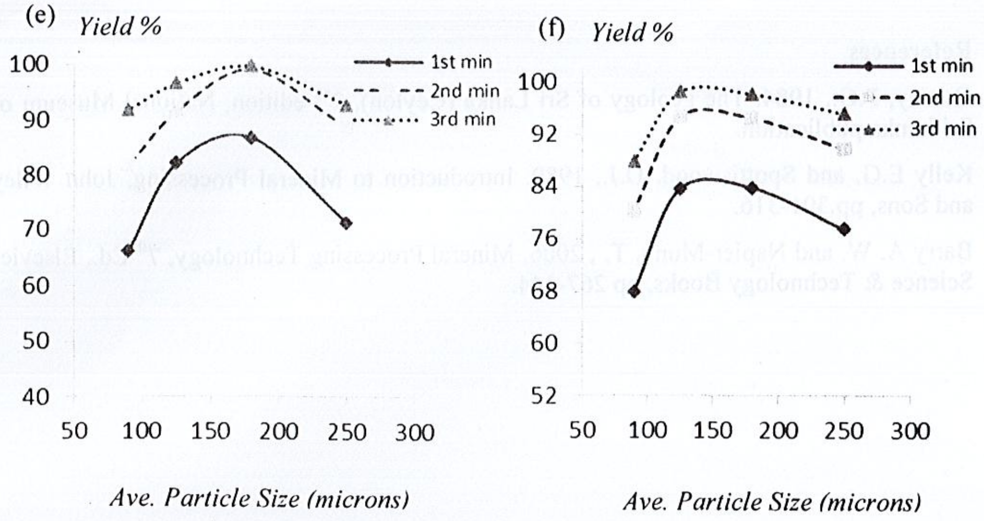



Figure 1; carbon yield percentage for selected air flow rates with respect to the Average particle size ranges within time to time

Graph (a) indicate Yeild perentage varies with the Average particle size when the air flow rate was 1.5 (minimum value) of leed cell. Graph (b) indicate Yeild prcentage varies with the Average particl size when the air flow rate was 2.0 of leed cell. Graph (c) indicate Yeild perentage varies with the Average particle size when the air flow rate was 2.5 of leed cell. Graph (d) indicate Yeild perentage varies with the Average particle size when the air flow rate was 3.0 of leed cell. Graph (e) indicate Yeild perentage varies with the Average particle size when the air flow rate was 3.5 of leed cell. Graph (f) indicate Yeild perentage varies with the Average particle size when the air flow rate was 4.0 of leed cell in constant Water flow rate value (152.4 $cm^{-3}$/min) and volume of cell was 3 liter (Figure 1).

In Graph a and b minimum Air flow rate values are supplied to flotation. Hence, The froth of flotation do not created and spilled rapidlly. The ability of Bubble formation is prohibited But, the fine particles are quickly agitated and spilled when the other parameters are constent. However, the final carbon recovery value is become lower.According to the Graph c, d, e, and f, the yield of Graphite showed a low values at beginning with the particle size. In fist minute, the froth formed rapidly and spilled out from the cell gradually with instant frothing the weight of froth was decreased in second and third minutes. However, the total yield percentages become 100 % and suitable particle size was already screened by peak point of graph within time.

## Conclusion

In this research it was found that the maximum recovery of high grade graphite 99+ % C could be produced from graphite 42.5% C grades by changing its parameters, that is by using higher air flow rate for the flotation process at the normal water flow rate and feed rate and constant Leed cell volume. Optimum particle size of graphite is 150 microns to 200 microns at airflow rate of 2.5 and 3.0 by froth collecting time within time to time in the Leed cell. In Air flow rate of 4.0 the Optimum particle size is 100 microns to 150 microns in Leed cell. The optimum airflow rate and suitable particle size required for the maximum grade recovery of graphite was chose for flotation.

**References**

Cooray, P.G., 1984. The geology of Sri Lanka (Ceylon), 2nd edition, National Museum of Sri Lanka publication.

Kelly E.G. and Spottiswood. D.J., 1989. Introduction to Mineral Processing, John Wiley and Sons, pp.301-316.

Barry A. W. and Napier-Munn. T. , 2006. Mineral Processing Technology, 7th Ed., Elsevier Science & Technology Books, pp 267-344.