Biocoagulation and Its Potential Application for Graphite Bioprocessing

S.P.B.L. Jayarathna , C.M. Peries *and* A.P. Henegamage
Uva Wellassa University, Passara Road, Badulla, Sri Lanka

Introduction

Sri Lanka is famous for Graphite industry since ancient times around the world. There are three major Graphite mines which are located in Kahatagaha, Bogala and Ragedara. Vein type graphite deposits in Sri Lanka are considered as a unique occurrence of graphite because of its high purity, extensive mineralization and restricted occurrence. Graphite with 95-99% of carbon and gangue minerals such as pyrite, chalcopyrite, calcite, biotite and feldspars are found in each structural type depending on the mode of occurrences and nature of graphite vein (Amarweera*et al*., 2013). Hence, removal of impurities from the graphite can increase the economic value of graphite. Flotation cell is common in Graphite industry to upgrade its carbon grade by removing impurities and it can be used to upgrade over 80 % Graphite in Sri Lanka However, efficiency of the flotation cell separation is not effective for Graphite with small particle sizes (Karr *et al*., 1990). Biocoagulation is the promising method, practiced in all over the world for sorting of small sized mineral particles with the use of microorganisms (Kuyumcu*et al*., 2009). Therefore, this study is focused to increase the carbon recovery in Graphite through the separation of fine particles using the biocoagulation with microorganisms.

Methodology

Three different particle sizes (40µm, 53µm and 72µm) of graphite samples were obtained from Bogala and Kahatagaha mines. Isolation of fungi was carried out from the obtained samples using dilution plate techniques with Potato Dextrose Agar (PDA) medium. Pure cultures of the isolated fungi were obtained using single spore isolation technique with the same medium.

Isolated pure fungi cultures were inoculated in to 20 ml of Potato Dextrose Broth (PDB) and incubated for 48 hours at 30^{0} C. Then the pH values of the each fungi broth cultures were measured separately. Two grams of each different graphite samples with different particle sizes were mixed with the incubated PDB and kept with continuous mixing for the coagulation. After four days of incubation, the number of coagulates in each broth cultures was counted using the light microscope and the fungal broth culture (F3) which was given the highest coagulates number was selected for the further processing.

In order to determine the carbon grade of the sample, coagulates of the selected broth culture were carefully separated out from the broth medium and washed with distilled water for three times. Then the particles with the coagulates were kept in a muffle furnace at 500^{0} C for two hours in order to remove microbial biomass from graphite particles followed by keeping the samples again in muffle furnace at 960^{0} C for further digestion. Initial and the final weights of the sample were measured to calculate the percentage of carbon recovery. Three replicates were maintained for each treatment and data were analyzed using ANOVA with the confidence level of 95% using MINITAB statistical software.

Results and Discussions

Three fungal strains (F1, F2 and F3) were isolated from the graphite samples and one of them (F3) was shown acidic pH range. According to the figure 1, all the three isolated fungi types were formed coagulates with the graphite samples in different particle sizes (40µm, 53µm and 72µm). It was clearly observed that the coagulate formation was decreased with the increment of particle size of the graphite.

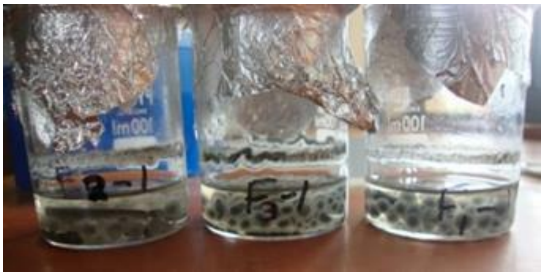

Figure 1. Bio coagulates formation by the isolated fungi.

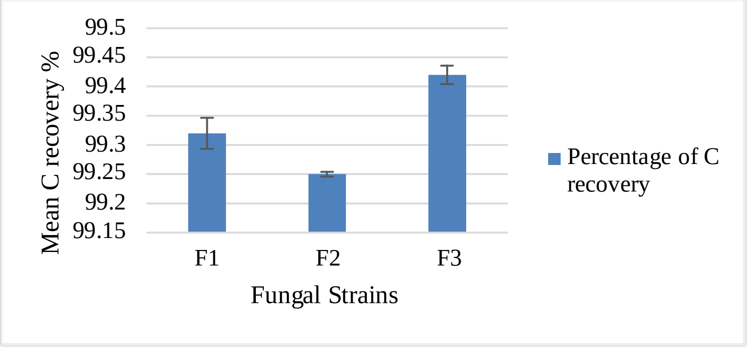

Figure 2. Mean values of recovered carbon grade in 40µm particle sized graphite by fungi after Biocoagulation.

According to the results, fungal strain F3 was significantly affected to form biocoagulates with the graphite particle size 40 µm than that of the other cultures ($p=0.003$). Figure 2 revealed that all the three fungi types showed high carbon recovery percentage for 40 µm particle size. Out of the three different fungal types, F3 fungal type showed the highest performance in carbon recovery compare to other two fungi types.

Conclusions

Biocoagulation is successful with all three isolated fungi from the graphite sample. Coagulate formation is decreased with the increment of particle size of the graphite. F3 fungus was shows the highest recovery of carbon by the biocoagulation process compare to other two fungi.

Acknowledgement

Authors would like to offer their heartiest gratefulness to Mr.Gamini Kuburuhena for giving permission to collect samples from Bogala Graphite Lanka Limited, Mr. David Kalansooriya for giving permission to collect samples from Kahatagaha Graphite Lanka Limited.

References

Amaraweera, T.H.N.G., Balasooriya, N.W.B., Wijayasinghe, H.W.M.A.C. Attanayake, A.N.B., Dissanayake, M.A.K.L., 2013. Purity Enhancement of Sri Lankan Vein Graphite for Lithium -ion Rechargeable Battery Anode. Proceedings to 29th Technical Sessions of Geological Society of Sri Lanka, 101-104.

Karr, C.L., Freeman, L.M., Goldberg, D.E., 1990. Froth Flotation Collision Efficiencies in Strong Force Fields. Bureau of mines. I 28.23:9322.

Kuyumcu, H.Z., Bielig, T., Vilinska, A., Rao, K.H., 2009. Biocoagulation and its Application Potentials for Mineral Bioprocessing. The Open Mineral Processing Journal, 2, 1-11.