Copper recovery by reverse flotation of Cu-bearing plastic waste generated through air-table separation of the end-of-life copper wires

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1. Introduction

For an effective recycling of the waste copper wire it is generally chopped off, cut, and ground to minus 3 mm size in order to liberate copper from the plastic. The -3 mm size material is then subjected to the gravity separation using the air-table separation process to ensure separation and recovery of copper. The pure copper product and plastic waste bearing about 5wt. % Cu are thus obtained from the air-table separation of the ground copper wire. In view of this it is desired to achieve complete recovery of copper from the Cu-bearing plastic waste (containing about 5 wt % Cu) for the resource conservation and environmental protection.

Therefore, this study aims at examining the flotation behavior of copper and plastics from the Cu-bearing plastic waste (or the crude sample of -3 mm size) generated through the air-table separation to recover the high grade copper product with a minimal loss of the metal in the plastic by reverse flotation.

2. Experimental

2.1. Materials

The Cu-bearing plastic waste (containing about 5 wt % Cu) generated through the air-table separation in the recycling plant of the end-of-life copper wires was used in the study (Fig. 1).

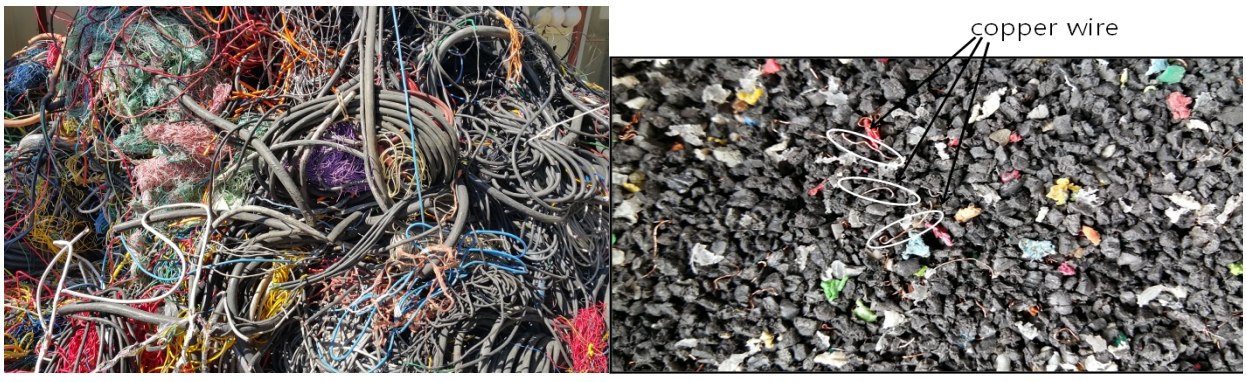

Figure 1. The photos of the end-of-life copper wires (left) and plastic waste sample containing ~ 5 wt % Cu (right)

2.2. Methods

The Cu-bearing plastic waste sample(-3 mm) was classified in to -1.68 mm, -1.40 mm, and -1.0 mm size fractions and then subjected to the reverse flotation to separate copper and plastic using Denver flotation machine (Model D12). Based on the results of flotation of -3 mm size Cu-bearing waste plastic, and also of -1.68 mm, -1.40 mm and -1.0mm size fractions, flotation tests were performed with -1.4 mm size waste plastic to separate and maximize the Cu recovery with minimal loss.

3. Results and discussion

Poor separation results on copper recovery during the flotation of -3 mm size sample prompted to conduct flotation tests at varying particle size (-1.68 mm, -1.40 mm, -1.0 mm) of the waste plastic. As the smaller size fraction resulted in higher recovery, yield and grade of Cu, flotation parameters were optimized for the -1.4 mm size waste plastic (that contains max Cu). Under the optimum conditions of 20 ℃, 1,250 rpm impeller speed, 5 min conditioning time for alkaline conditioners -Na_2SiO_3 (0.4g/L) or NaOH (0.05g/L), or acidic conditioner-H_2SO_4 at pH 4, and frother-AF65 (0.02g/L) dosage, best flotation results were obtained. Thus Cu-products recovered in the flotation cell have 16.5-20.3 wt % yield, 85.17-99.63% Cu grade, and 83.7-97.0% recovery.

4. Conclusions

The air-tabling of –3 mm size waste wires followed by reverse flotation of -1.4 mm size fraction of Cu-bearing waste plastic, could ensure high recovery of Cu with higher grade and yield. The work established the feasibility of recycling waste copper wires (Fig. 2).

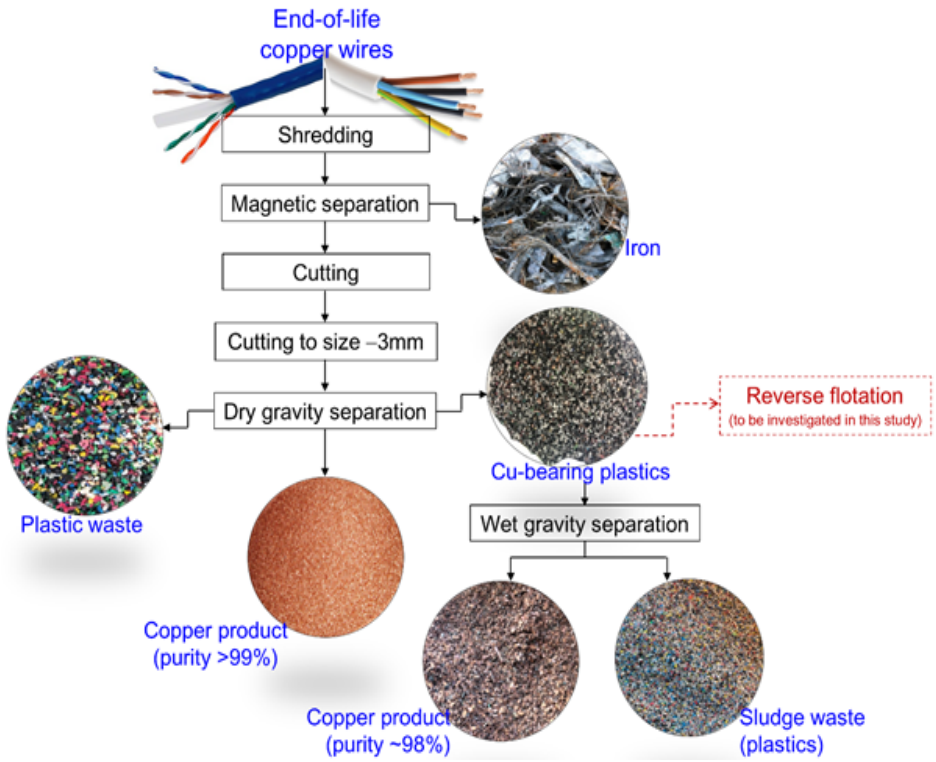

Figure 2. The process flow diagram for recycling of the end-of-life copper wires in Korea.