Optimization of heavy metal removal method for recycling of paper sludge ash

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INTRODUCTION

Recently, paper production has been continuously increasing worldwide. As of 2015, it produced the largest number of paper in China, with 109 million tons per year And Korea produced 12 million tons (kim et al., 2019). As a result, the amount of paper waste produced also continuously increased. Heavy metal solidification and removal technology can reduce environmental and human harm by treating heavy metals contained in materials to be recycled. This study analyzed the heavy metal content after cleaning the incineration ash using Ethylenediaminetetraacetic acid (EDTA), Citric acid (Ct), Oxalic acid (Ox), and Hydrochloric acid (Hy) to screen for the acid for removing heavy metals from fly ash generated in the papermaking process. Among them, an acid solution with excellent heavy metal removal efficiency was selected and the heavy metal removal efficiency according to the cleaning method was examined by applying (1) Single solution, (2) Mixed solution, and (3) Sequence cleaning method.

MATERIALS AND METHODS

Cleaning with Single solution

The experiment was conducted with a single solution, and experimental conditions are shown in Figure 1.

Cleaning with various methods

By removing heavy metals from paper ash by single solution, an acid solution with excellent removal effect was selected for each type of heavy metal. The selected acid solutions are EDTA and Ox. mixed solution, Sequence A(First step: Ox, Second step: EDTA), and Sequence B(First step: EDTA, Second step: Ox) cleaning were applied to select the method with the best heavy metal removal efficiency from paper ash. The experimental conditions are shown in Figure 2.

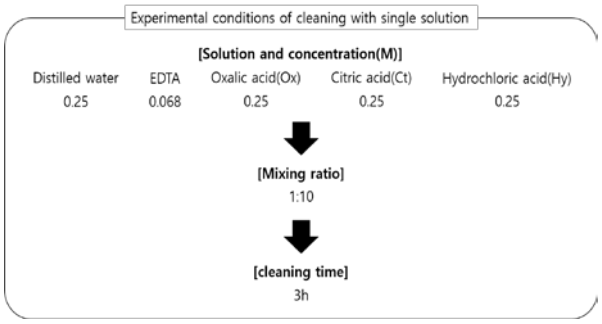

Figure 1 Experimental conditions of cleaning with single solution

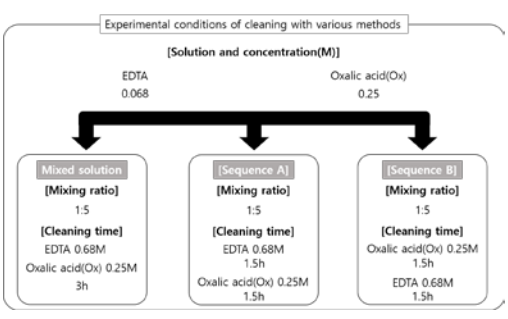

Figure 2 Experimental conditions of cleaning with various methods

RESULTS AND DISCUSSION

Changes in heavy metal content of paper ash by single solution cleaning

In order to examine the effect of removing heavy metals by single solution, Figure 3 shows the removal efficiency of heavy metals according to the type of single solution.

Change of heavy metal content in paper ash according to cleaning method

Figure. 4 shows the removal efficiency of heavy metals according to the cleaning method. The mixed solution showed the highest efficiency for all heavy metals except Hg and Cd.

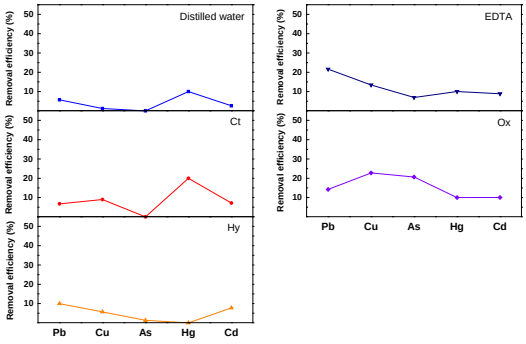

Figure 3 Comparison of removal efficiency of heavy metal content

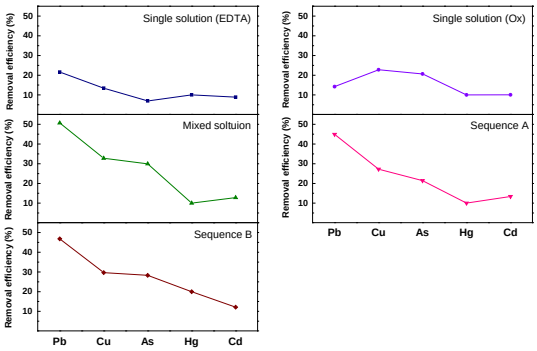

Figure 4 Comparison of removal efficiency of heavy metal content

CONCLUSION

In this study, a single solution with excellent removal efficiency of heavy metal content among EDTA, Ox, Ct, and Hy was selected to remove heavy metals from paper ash generated in the papermaking process. When comparing the removal rates of heavy metals by single solution, Ox was found to be the most effective for removing Cu, As, and Cd, while EDTA for Pb and Ct for Hg removal showed the highest removal rates. In the case of the heavy metal removal rate according to the mixed solution and sequence cleaning method, the highest heavy metal removal effect of Pb, Cu, Hg, and Cd was shown when the mixed solution of EDTA and Ox was washed.

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