

1-22 石炭フライアッシュからの微量元素溶出液に対する カルシウム化合物の特性

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Calcium compound characteristics on trace element leachates from coal fly ash

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SUMMARY

Calcium has been known has a good decreasing in the leaching concentration of arsenic (As) and selenium (Se). Suppressing material, as the by-product of some industries which contains of high calcium, had been proven in decreasing of arsenic (As) leaching concentration from coal fly ash. This study aims to provide the useful reference in controlling As and Se leaching concentration into the environment through the effect of suppressing material addition. There are three suppressing materials that have been tested, that are: paper sludge ash (PS 3 and PS 4) and filter cake (FC). PS 3 shows the closest effect to $\text{Ca}(\text{OH})_2$ which is used as the standard, it shows almost 85-90% decreasing in As and Se leaching concentration based on ICP analysis. FC did not show an effect in As leaching concentration, but in the contrary with Se leaching concentration, it shows almost 60% decreasing. Calcium oxide has been known as the almost calcium compound which is containing in PS 3 and also known has the best decreasing on As and Se leaching concentration amongst the others calcium compound tested. Could be concluded that CaO is the most wanted calcium compound in controlling the As and Se leaching concentration into the environment.

[1] INTRODUCTION

Fly ash is a by-product of the combustion of pulverized coal in thermal power plants. The large volume of coal fly ash produced around the world is a potentially source of arsenic and selenium. Presently, a substantial amount of these wastes is disposed in landfills and only 16% of total ash worldwide is potentially utilized for various applications such as cement production, mine backfill or road sub-base. If not properly disposed, it can cause soil pollution and damage to either surface water or groundwater.

In this research, leaching experiments have been done by the addition of some amounts of suppressing material into the coal fly ash sample. Suppressing material is by-product of other industries which contains of high calcium contents. This addition is intended to decrease the arsenic and selenium leaching concentration, so that it can be used to control their leaching into the environment. The role of suppressing materials onto As and Se leaching concentration will be verified in this

study. Furthermore, the calcium compound that has influence in the process also will be investigated.

[2] EXPERIMENTAL

The coal fly ash sample H (FA H) which is collected from a coal fired power plant (600MWe) is decided as the sample and three kinds of suppressing material have been tested into FA H sample. They are paper sludge ash, PS3 (46.13%); PS4 (18.77%), filter cake, and FC (59.18%). Calcium hydroxide ($\text{Ca}(\text{OH})_2$) have been chosen as the standard for the suppressing material. The addition ratio of suppressing material is 5% and 10% of total mixture.

Leaching test No. 13 which notified by the Japanese Environment agency were basically employed as the leaching test in this work. Arsenic and selenium leaching concentration in the filtrate was measured by ICP-AES. The final pH of leachate was measured by pH/ION METER D-53, HORIBA. Ethylene glycol extraction insisted with ICP-AES analysis and thermogravimetric analysis had been carried out in the quantitative analysis.

X-Ray photoelectron spectroscopy (XPS-Quanterra SXM-G) analysis was applied into the investigation of calcium compound on the surface of coal fly ash and suppressing material.

[3] RESULT AND DISCUSSION

3.1 The effect of suppressing material into As and Se leaching concentration

Calcium hydroxide ($\text{Ca}(\text{OH})_2$), as the standard calcium to compare the results from the others suppression material shows almost 95% of decreasing compared with the leaching concentration without suppressing material.

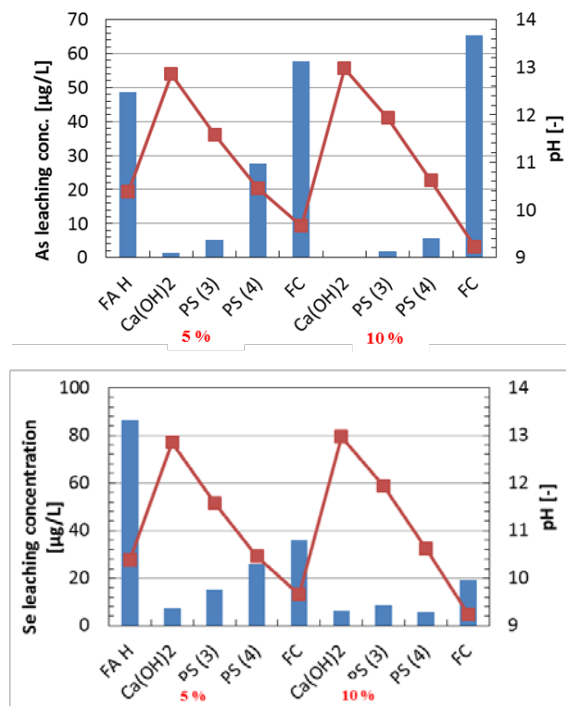


Fig. 1 Suppressing material effect into the leaching concentration of arsenic (above) and selenium (below)

Paper sludge ash (PS3), shows the closest effect with $\text{Ca}(\text{OH})_2$, with the decreasing percentage on leaching concentration is 85-90%, while the PS4 only shows 50% of decreasing. The effect of FC into As leaching concentration could not be detected but in the Se leaching concentration shows almost 60% of decreasing

3.2 Investigating calcium compounds in coal fly ash and suppressing material

Some calcium compounds have been tested as suppressing material into FA H in order to ascertain the effect of calcium into leaching concentration. Based on the results have been known that calcium oxide (CaO) and calcium hydroxide ($\text{Ca}(\text{OH})_2$) give better decreasing on trace elements leaching concentration comparing with calcium carbonate and calcium sulphate..

XPS analysis also have been carried out into calcium compounds, FA H and suppressing material. The binding energy of FA H and suppressing material was compared with the binding energy of calcium compounds. The estimated calcium which contain in PS3 and FC are CaO and CaCO_3 . PS3 was a good suppressing material because it is containing with CaO. Estimated calcium compound in FAH was expressed in percentage of CaCO_3 . The ratio of CaCO_3 and CaSO_4 in coal fly ash sample H in sequentially is 83% and 17%.

3.3 Quantitative analysis for calcium compound in coal fly ash and suppressing materials

The leaching experiment by ethylene glycol analysis has been conducted in order to know the amount of calcium oxide (CaO) and calcium hydroxide ($\text{Ca}(\text{OH})_2$) in FA H and the three suppressing material below. The results of this analysis will be measured by ICP analysis and insisted with thermogravimetric analysis. The result was explained in Figure 2.

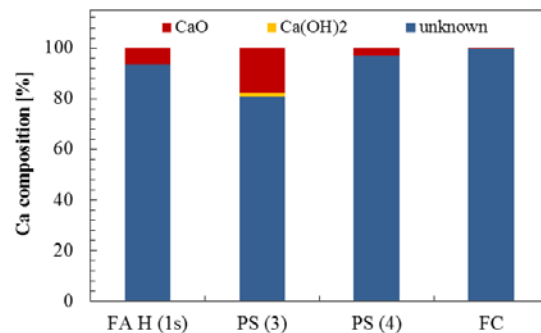


Fig. 2 The calcium compounds ratio in coal fly ash and suppressing materials.

[4] CONCLUSION

Based on this research has been known that suppressing material is affected on As and Se leaching concentration. Since PS 3 was known as the best suppressing material, could be concluded that suppressing material which is consisting of CaO could be good once in order controlling the As and Se leaching concentration into environment.

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