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東北地方の４都市の下水汚泥焼却灰の化学的特徴
Chemical Characterization of Sewage Sludge Ash Disposed in Four Cities in Northeastern Japan

首藤 千晶 [1*], 藤巻　宏和 [1]
chiaki shuto[1*], hirokazu fujimaki[1]

[1] 東北大学理学研究科地学専攻
[1]Tohoku University

The amount of disposal sewage sludge ash in Japan is increasing every year and the percentage of sewage sludge waste was 18 percent of the total industrial waste in 2004. In Japan, landfill site is hardly available now and it is difficult to ensure the new landfill site. Therefore, approximately 71 percent of sewage sludge is incinerated to reduce its mass and weight. Because of the limited availability for landfill site, many studies have been undertaken to develop reuse technologies for application to agricultural soil, asphalt roads, construction materials and bricks. On the other hand, hazardous elements such as heavy metals could be concentrated in sewage sludge ash even after it is incinerated. Determination of chemical composition of sewage sludge ash is definitely necessary to evaluate the environmental risk of the ash. Only after we know the chemical composition of the sewage sludge ash, we can decide how to use it. The purpose of this study is to characterize the chemical composition of sewage sludge ash disposed in four cities in Tohoku region, Japan, and to discuss the origin of chemical elements in sewage sludge ash.

In this study, the sewage sludge ashes from the four sewage-processing plants were analyzed for thirteen major elements (Na, Mg, Al, Si, P, S, K, Ca, Ti, Mn, Fe, Zn, Ba) and five trace elements (Cu, As, Sr, Ag, Pb). They were analyzed by XRF milling sample-briquette technique. Surface observation, element mapping, mineral observation were performed by SEM, EDS and polarizing microscope.

The sewage sludge ash in four cities showed almost same pattern of chemical composition: SiO2 component has maximum weight percentage (30wt%), then P2O5 (20wt%), Al2O3 (15wt%), CaO (5 to 10wt%) in order. Chemical composition of sewage sludge ash is not similar to natural rocks or to essential elements of living matter. As sewage sludge is from human sewage; from excreta, kitchen, laundry and bath, they should have random composition among the cities. The highest abundance may possibly be P or Ca. However, Si and P and Al are dominant components of the sewage sludge ash composition in all cities and they all share the same characteristics. We compared the chemical compositions of the sewage sludge ashes of our results with those of the major cities in the world. The differences of the compositions, however, cannot be easily accounted for. The origins of major chemical elements are discussed in this study.

The results of minor elements are as follows: Cu amount was high amount such as 2000 to 4000 ppm, Sr resulted in about 500 ppm, Pb resulted in ca. 200 ppm, As and Ag were both 50 to 100 ppm. All trace elements are concentrated in sewage sludge ash compare to the elements in the crust. Especially, this study reveals that the amount of Ag was 1000 times higher than that of crustal abundance.

Keywords: Sewage sludge ash, XRF milling sample-briquette technique