

Influence of Operating Conditions on Heavy Metal Cation Removal by Fly Ash in Aqueous Solutions

P. Ricou⁽¹⁾, V. Héquet⁽¹⁾, I. Lecuyer⁽²⁾ and P. Le Cloirec⁽¹⁾

(1) Ecole des Mines de Nantes, Dept. Systèmes Energétiques et Environnement, BP 20722, 4 rue Alfred Kastler, 44307 Nantes Cedex 03, France

(2) EDF, Direction de la Recherche, Environnement, Groupe Qualité de l'air, BP 49, quai Watier, 78401 Chatou Cedex, France

KEYWORDS : Fly ash, sorption, metal ions, operating conditions, water treatment

ABSTRACT

Disposal of a growing amount of fly ash creates environmental problems and utilizations of the material has to be developed in industrial fields. Ash is known to remove metal ion from water. However, the best operating conditions have to be found and a better mechanism knowledge has to be approached.

Coal fly ash was used to study adsorption of several cations (Cu^{2+} , Ni^{2+} , Zn^{2+} , Cd^{2+} and Pb^{2+}) within various experimental conditions : dry or wet fly ash, pH, metallic ion/fly ash ratio.

Adsorption isotherms were carried out at room temperature for different pH. It has been shown that alkalinity of fly ash is an important factor and pH control is required. At high pH, precipitation is performed with a complete removal of the ion but a dissolution of alumina sites has been shown. At a pH range between 3 and 6, depending of the hydrolysis properties of the metallic ion, adsorption is the main mechanism. The removal order is $\text{Pb}^{2+} > \text{Cu}^{2+} > \text{Ni}^{2+} > \text{Zn}^{2+} > \text{Cd}^{2+}$. For a $\text{pH} < 3$ a smaller adsorption capacity is found due to a competition between metal cations and hydronium ions. It was also shown that better removal was obtained by using an adsorbent made with a mixture ash/lime 80/20 mass % and performed at pH 5.