

## Treatment of Acid Mine Lake by Ultrasonically Modified Fly Ash at Different Frequencies

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**Abstract :** The oxidation of pyrite in water results in the formation of acid mine drainage, which typically forms extremely acid mine lake (AML) in the depression areas of abandoned Etili open-pit coal mine site, Northwest Turkey. Nine acid mine lakes of various sizes have been located in the Etili coal mine site. Hayirtepe AML is one of the oldest lake having a mean pH value of 2.9 and conductivity of 4550  $\mu\text{S}/\text{cm}$ , and containing elevated concentrations of Al, B, Ba, Ca, Cd, Co, Cr, Cu, Fe, K, Mg, Mn, Na, Ni, Pb, and Zn. The water quality of the lake has been deteriorated due to its high chemical composition, in particular, increasing heavy metal pollution. In this study, fly ash (FA), a coal combustion by-product from fluidized bed thermal power plant in the northwestern part of Turkey, was used as an adsorbent for the treatment of Hayirtepe AML. The FA is a relatively abundant and cost effective material, but its use in adsorption processes usually require excessive adsorbent doses. To increase adsorption efficiency and lower the adsorbent dose, we modified the FA by means of ultrasonic treatment (20 kHz and 40 kHz). The images of scanning electron microscopy (SEM) have demonstrated that ultrasonic treatment not only decreased the size of ash particles but also created pits and cracks on their surfaces which in turn led to a significant increase in the BET surface area. Both FA and modified fly ash were later tested for the removal of heavy metals from the AML. The effect of various operating parameters such as ultrasonic power, pH, ash dose, and adsorption contact time were examined to obtain the optimum conditions for the treatment process. The results have demonstrated that removal of heavy metals by ultrasound-modified fly ash requires much shorter treatment times and lower adsorbent doses than those attained by the unmodified fly ash. This research was financially supported by the Scientific and Technological Research Council of Turkey (TUBITAK), (Project no: 116Y510).

**Keywords :** acid mine lake, heavy metal, modified fly ash, ultrasonic treatment

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