ELECTRICAL ENHANCED SLUDGE DEWATERING PROCESS: A SMALL PILOT SCALE STUDY

Ching Yuan*
Department of Civil and Environmental Engineering
National University of Kaohsiung
Kaohsiung City 811, Taiwan

Chih-Huang Weng
Department of Civil Engineering
I-Shou University
Kaohsiung Country 840, Taiwan

Key Words: Electrokinetic process, potential gradient, sludge, sludge dewatering

ABSTRACT

Sludge dewatering can be accomplished by freeze-thaw, centrifuge force, mechanical press and sun-drying. The freeze thaw method is capable of decreasing the water content of sludge to 50\%~60\% and even lower to 43\% once added with polymer electrolytes under a low temperature condition. However, the consumption of energy and polymer electrolytes may become limiting factors for economical consideration. The technology by centrifuge force and mechanical press can not remove the bound water efficiently. Use of sunshine to remove water from sludge is an economical way, but it needs a large space and sufficient time (\textgeq 7 days). In Taiwan, mechanical press and sunshine are the two common sludge dewatering methods being used in wastewater treatment plants. The water content of sludge can be decreased to 65\%~85\% and 60\%~70\% for the above-mentioned methods, respectively. Electrokinetic (EK) process has been demonstrated to be a cost-effective remediation technology to extract heavy metals and organic contaminants from soils and sludge. It applies low voltage DC to a porous medium and the pollutants or water are removed through the electroosmosis (EO) flow, which is driven by an electrical field. Hence it led us to choose the EK process to further improve the mechanical dewatering efficiency.

In this research, a sludge cake (73\% of moisture content) from a wastewater treatment plant was used to investigate the effects of potential gradient on the water removal by EK process. The potential gradient ranging from 2 to 5 V/cm were applied to induce the movement of the bound water within the sludge specimen elapsed for 2 hour. Results showed that the direction of EO flow was from the anode to the cathode. Due to the release of H\(^+\) and OH\(^-\) through electrolysis of water, the sludge pH was maintained at 5.9 ~ 6.8 near on anode side and 9.8 ~ 10.8 near the cathode after EK treatment. As applied potential gradient of 2~5 V/cm for 2 hr, the moisture content of sludge decreased further to 47.5\%. The EO permeability and the power consumption throughout the test period were around 3.04 \times 10^{-5} \text{cm}^2/\text{V-s} and 14.41 ~ 66.84 \text{kWh/m}^3, respectively. We clearly have demonstrated from this research that up to 20.8 ~ 27.9\% of the total disposal cost saving can be achieved with aid of the EK technique. Therefore, the EK process can be effectively and economically utilized to remove bound water from sludge waste.