

Chitosan use in chemical conditioning for dewatering municipal-activated sludge

H. Zemmouri, N. Mameri and H. Lounici

ABSTRACT

This work aims to evaluate the potential use of chitosan as an eco-friendly flocculant in chemical conditioning of municipal-activated sludge. Chitosan effectiveness was compared with synthetic cationic polyelectrolyte Sedipur CF802 (Sed CF802) and ferric chloride (FeCl_3). In this context, raw sludge samples from Beni-Messous wastewater treatment plant (WWTP) were tested. The classic jar test method was used to condition sludge samples. Capillary suction time (CST), specific resistance to filtration (SRF), cakes dry solid content and filtrate turbidity were analyzed to determine filterability, dewatering capacity of conditioned sludge and the optimum dose of each conditioner. Data exhibit that chitosan, FeCl_3 and Sed CF802 improve sludge dewatering. Optimum dosages of chitosan, Sed CF802 and FeCl_3 allowing CST values of 6, 5 and 9 s, were found, respectively, between 2–3, 1.5–3 and 6 kg/t ds. Both polymers have shown faster water removal with more permeable sludge. SRF values were 0.634×10^{12} , 0.932×10^{12} and 2×10^{12} m/kg for Sed CF802, chitosan and FeCl_3 respectively. A reduction of 94.68 and 87.85% of the filtrate turbidity was obtained with optimal dosage of chitosan and Sed CF802, respectively. In contrast, 54.18% of turbidity abatement has been obtained using optimal dosage of FeCl_3 .

Key words | chemical conditioning, chitosan, FeCl_3 , Sed CF802, sludge dewatering

H. Zemmouri (corresponding author)
Laboratoire des Sciences et du Génie des Procédés Industriels, Faculté de Génie Mécanique et Génie des Procédés,
Université des Sciences et de la Technologie
Houari Boumediene,
B.P. 32 El-Alia,
Bab-Ezzouar,
Algiers,
Algeria
E-mail: hassiba_zemmouri@yahoo.fr

N. Mameri
H. Lounici
Ecole Nationale Polytechnique,
Unité de Recherche Ingénierie et Environnement,
10 Avenue Hassen Badi, B.P. 182,
El-Harrach,
Algiers,
Algeria

INTRODUCTION

Sludge, derived from municipal wastewater treatment plants (WWTPs), is a heterogeneous mixture of 50–80% of pollution which contains a high-organic load, colloids, pathogenic germs, mineral particles, cations and heavy metals (Li & Ganczarczyk 1994). These characteristics impact negatively on sludge dewatering. Also, they can pose a serious environmental risk if sludge disposal is inadequately managed. Hence, the main target of sludge treatment is to produce clean bio-solids that could be used beneficially later. The moisture content of final sludge has to be limited for lower costs, and to decrease environmentally harmful impacts caused by pathogenic organisms (Appels *et al.* 2009; Tuan *et al.* 2009). On the other hand, sludge is also a valuable source for the reuse of inorganic material and energy production.

To improve sludge dewatering characteristics and promote the separation of flocs from the liquid phase to achieve a high dry solid content, sludge requires an efficient conditioning which can be a biological, chemical or physical treatment. Chemical conditioning consists of adding

chemical reagents to the sludge in order to assemble the dispersed colloidal particles in larger flocs which further facilitate the solid–liquid separation (Qi *et al.* 2009). Depending on the nature of the solids to be treated, chemical conditioning can reduce, through coagulation flocculation process, 90–99% incoming moisture content to 65–85% (Lee & Liu 2009). Flocculation is one of the most widely used cost-effective techniques for sludge conditioning (Harif *et al.* 2009).

Vast categories of materials used as conditioner agents can be classified broadly into two categories: inorganic and organic. The inorganic chemicals (commonly used are ferric and aluminum salts) effectively flocculate sludge leading to very hard dewaterable and compressible slurry (Qi *et al.* 2009). The organic materials are further classified into natural and synthetic. The synthetic ones may be cationic, anionic or non-ionic. In most cases, they are derived from oil-based and non-renewable raw materials (Suopajarvi *et al.* 2009). A new class of polymeric flocculants, i.e., the graft copolymers (synthesized from natural and synthetic

