Electrochemical treatment of cattle waste with the use of Al-Al electrodes

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Keywords: Cattle waste, electrocoagulation, pollution, waste.
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Abstract

Nowadays, livestock is considered an emerging agronomic sector leading to high quantities of manure. Farming manure is a complex environmental pollutant contributing both to air, water and soil pollution. Greenhouse gases are produced along with the release of excess nitrogen and phosphorus to soil and water. Water contamination with inorganic (e.g. heavy metals) and organic (e.g. chemical oxygen demand (COD), dyes, pharmaceuticals) contaminants is a serious issue, which has a toxic impact on the environment and on human health (Johnson and Hallberg 2005; Gate 2008; Fu and Wang 2011; Simate and Ndlovu 2014). Overall, it has been a key point to treat industrial wastewater with green strategies, which seek to remove pollution with sustainable development and environmental protection in mind (Fu and Wang 2011). Many techniques have been developed until now (Fu and Wang 2011), and electrochemistry is part of them. Electrochemistry, one of the most dynamic branches of chemistry, uses the strong driving force of electricity to activate chemical reactions.

Electrocoagulation (EC) is a well-known electrochemical process for the removal of contaminants in water with many different applications, such as in olive oil (Bensadok et al. 2008; Marmanis et al. 2018), dyeing, painting (Aoudj et al. 2010), slaughterhouse (Abdelhay et al. 2017), metal plating (Akbal and Camcidotless 2011), mining (Johnson and Hallberg 2005; Oncel et al. 2013; Simate and Ndlovu 2014). EC demonstrates a high removal efficiency and low cost for a wide array of applications (Akbal and Camcidotless 2011).

The present study is focused on the employ of EC for the treatment of cattle wastewater, which is considered a critical source of contamination in Cyprus and in the broader Mediterranean area, as well. EC process (using aluminium electrodes) is applied to the liquid fraction (Figure 1) of cattle waste in order to decrease the nitrogen and organic content, eliminate the environmental impacts to soil, groundwater and atmosphere of the surrounding area to meet legal requirements. Operating parameters affecting the efficiency of the process such as current density, electroprocessing time and agitation speed were studied and optimal conditions were applied. Results of the % of removal of COD, Total Nitrogen, N-NO_3, P-PO_4, pH and conductivity shows that EC technique can be effectively used in combination with other steps for the treatment of cattle waste.

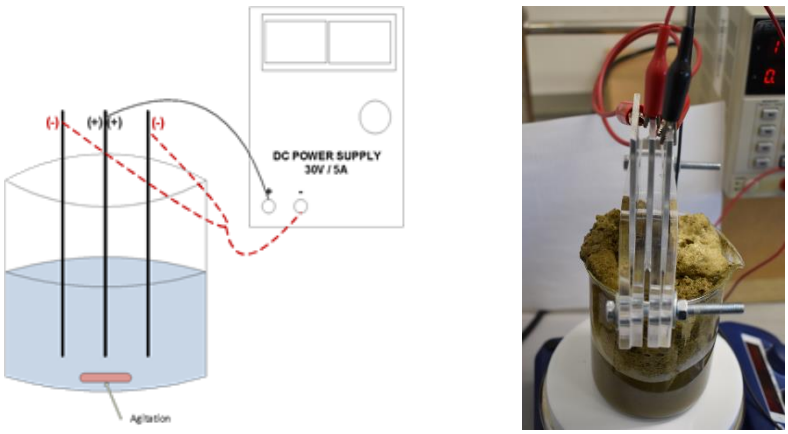

Figure 1: Experimental setup for electrocoagulation

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