Effective coagulation-flocculation treatment of highly polluted palm oil mill biogas plant wastewater using dual coagulants: decolourisation, kinetics and phytotoxicity studies

ABSTRACT

The performance of several chemical coagulants including ferric chloride, calcium lactate, magnesium hydroxide, aluminium chlorohydrate, and polydiallyldimethylammonium chloride (polyDADMAC) were investigated in removing colour of palm oil mill biogas plant wastewater (POMBPW). The results show that ferric chloride as a sole coagulant can achieve high colour removal of more than 80% without needed for pH adjustment, which indicates the effectiveness of the coagulant to treat palm oil mill biogas plant wastewater (POMBPW). However, dual coagulants i.e. ferric chloride-anionic polyacrylamide (APAM) shows better performance than ferric chloride-polyDADMAC in terms of colour removal, pH, with shorter sedimentation time. The addition of polymer to system not only reduces the ferric chloride dosage, but also increases the colour removal of more than 20%. Comparison between APAM and polyDADMAC as flocculant aids shows that APAM can achieve stable removal at wider pH range and lowest sedimentation time at 20 min while polyDADMAC was at one hour. Both dual coagulants were followed second order kinetic and APAM shows the highest rate over polyDADMAC i.e. $3 \times 10-5$ /PtCo.min and $2 \times 10-5$ /PtCo.min respectively. Addition of polymers reduced phytotoxicity of generated sludge and the sludge has potential to be reused for land application.