DETECTION OF BIODEGRADATION DEGREE OF SLUDGE USING DIELECTRIC MEASUREMENT

SÁNDOR BESZÉDES, KATALIN PAPP-SZILÁDI, GÁBOR KESZTHELYI-SZABÓ, CECILIA HODÚR

University of Szeged Faculty of Engineering, Institute of Process Engineering
Szeged, Hungary
beszedes@mk.u-szeged.hu

Pre-treatments applied before biological sludge utilization technologies aim to modify the sludge structure for enhanced disintegration degree and biodegradability. Among the thermal pre-treatments methods, microwave irradiation is suitable to degrade the polymeric structure of sludge, and to increase the solubility of organic matters. These effects can be manifested in enhanced biodegradability under aerobic and anaerobic condition. Energetic efficiency of microwave heating is mainly determined by the dielectric properties, such as dielectric constant and dielectric loss factor. Dielectric properties are influenced by the frequency, temperature; composition and consistency of irradiated material, state and bond of water etc. Therefore, physicochemical changes of sludge structure; e.g. hydrolysis of macromolecules, degradation of cell wall of microorganisms, aggregation of particles; contribute to the change of dielectric parameters, as well.
In our work, we investigated the correlation between the dielectric parameters and structural change and biodegradability indicators. For the experiments a tailor made dielectrometer was developed operating in continuously flow mode. In the case of municipal wastewater, the change of organic matter removal efficiency during wastewater purification technology at a wastewater treatment plant can be detected by the change of dielectric constant. Results related to sludge processing show, that change of organic matter solubility and aerobic biodegradability correlate the change of dielectric loss factor and dielectric constant. With the degradation of polymeric structure of sludge matrix and decomposition of macromolecules caused by thermal effects or chemical pre-treatments led to increased mobility of ions and enhanced polarization of molecules. These effects led to increased dielectric constant and loss factor, what make possible to pre-indicate the efficiency of sludge pre-treatment processes by an in line and real time measurement method.

Acknowledgements: This project was supported by the János Bolyai Research Scholarship of the Hungarian Academy of Sciences.