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MONITORING OF ORGANIC MATTER REMOVAL EFFICIENCY IN WASTEWATER AND SLUDGE TREATMENT PROCESSES BASED ON DIELECTRIC MEASUREMENTS

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Abstract

Organic compounds and the change of their concentration have effect on the polarizability of water molecules, ionic mobility and dielectric constant and loss. Measurements of dielectric parameters or electrical parameters related to the dielectric behavior (dielectric constant, dielectric loss, loss tangent, reflection coefficient, standing wave ratio, conductivity) can be gaining attention in water and wastewater quality monitoring because they can give non-destructive, rapid, and sensitive insights into changes in composition of multicomponent systems. These specifics allow early detection of process failures and real-time process control in continuously flow systems as well, such as wastewater purification technologies and bioreactors.

In our research wastewater and sludge samples of different types and origins (municipal, industry) as well as those originating from different stages of the purification/treatment process (raw wastewater, samples from clarifier, aeration step), were examined. A ZVL-3 (Rohde&Schwarz) VNA-connected open ended coaxial dielectric sensor (DAK 3.5, Speag) was used to measure the dielectric parameters it the 300-2400 MHz frequency range. The analytical parameters commonly used in wastewater and sludge treatment (pH, TS, TSS, COD, BOD, TN, TP) were also determined.

Our results verify that the change of concentration of organic pollutant (COD, BOD) show good correlation (R^2>0.75) with the dielectric parameters determined them in the frequency range of 400-700 MHz. In this frequency range the effects of ionic conductivity is weaker, the dielectric parameteres are influenced mainly by the polarization of water molecules, organic compounds, and interfacial polarization phenomena. The dielectric behaviour influenced by the polarization of water molecule and its interactions with other compounds, and the change in disruption of hydrogen bonding networks due to the change of dissolved organic matter fractions. These characteristics enable the organic content to be monitored during the process using a rapid, chemical-free dielectric method.

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