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BIODEGRADABILITY OF PHENOLIC COMPOUNDS AS SINGLE AND MIXED SUBSTRATES BY ACTIVATED SLUDGE

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ABSTRACT

The aim of this study was to investigate aerobic biodegradability of phenol, p-cresol, o-cresol, resorcinol and 5-methylresorcinol by the activated sludge from the Kohtla-Järve wastewater treatment plant (WWTP). Inoculum was acclimated to phenolic compounds, because the specific WWTP is treating wastewater from the oil shale chemical industry. Biological treatment of wastewater involves degradation of substrate mixtures rather than degradation of single compounds. Therefore the biodegradability tests of phenolic compounds as single substrates as well as mixed substrates at different concentrations were carried out to investigate their impact on each other's biodegradation.

The respirometric method was used for determination of short-term oxygen demand (BOD_{st}) and kinetic parameters characteristic to biodegradation process. The BOD_{st} of studied phenolic compounds formed 10-30% of the theoretical oxygen demand, showing the highest and the lowest values for phenol and *o*-cresol, respectively. The dependence of oxygen uptake rates on substrate concentration was investigated and modelled on the basis of Michaelis-Menten and Haldane kinetics and kinetic parameters, such as the maximum rate of oxygen uptake ($V_{O2,max}$), the maximum rate of substrate bio-oxidation (V_{max}) and half-saturation constant (K_S) were determined. Among the studied substrates phenol and *p*-cresol had the highest values of $V_{O2,max}$, followed by 5-methylresorcinol. Considering that K_S is related to the affinity of the microbial community for the given substrate, the activated sludge showed the highest affinity to *p*-cresol.

The biodegradability of 4 different bi-substrate systems: phenol – *p*-cresol, phenol – resorcinol, phenol – 5-methylresorcinol, phenol – *o*-cresol containing both components at equal concentrations in the range of 0,005 mM - 0,05 mM, and alternatively containing one substrate at concentration 0,1 mM and the other varied in the above-mentioned range, was also studied. The $V_{O2,max}$ values were found by using Michaelis-Menten kinetics and to take into account the concentrations of the both substrates, the random sequential mechanism for enzymatic kinetics was also used for bi-substrate systems. However, for systems containing phenol and *p*-cresol the Haldane model appeared to be suitable to describe the biodegradation process due to the substrate inhibition effect at higher substrate concentration. The results indicated that phenol was more readily oxidised by the microbial community of activated sludge than cresols or resorcinols.