mgr inż. Joanna Muszyńska
Katedra Inżynierii Sanitarnej
Wydział Inżynierii Środowiska, Geodezji i Energetyki Odnawialnej
Politechnika Świętokrzyska

Kielce, 30.05.2023 r.

Abstract of doctoral dissertation

„Comparative analysis of the pre-treatment methods for the leachate from the municipal waste landfill"

This doctoral thesis aims to provide a comparative analysis of treatment methods for municipal landfill leachate. The thesis is composed of seven papers, which complement one another, focused on leachate treatment research. Papers 1 to 5 deal with landfill leachate pretreatment using the classical Fenton process and its modifications. Paper 6 involves pretreatment of landfill leachate with potassium ferrate (VI) (K2FeO4). Paper 7 concerns leachate pretreatment carried out with the use of six sorbents: zeolite, activated carbon, shungite, walnut shells, coffee grounds and sewage sludge. The research was performed on landfill leachate collected from two landfill sites located in the Świętokrzyskie Voivodeship (Poland).

The research reported in the thesis follows recent trends as regards deep transformation in wastewater treatment, including that of landfill leachate. The thesis describes a new model of kinetics of second-order reaction for COD elimination. The transformation rate can be a useful tool in the evaluation of kinetics for the oxidation reaction of organic pollutants found in landfill leachates in the presence of Fe^{2+} for varied oxidant and catalyst concentrations. Additionally, while searching for an alternative to the classical Fenton process, sequential linear and non-linear dosing was chosen to be applied in the landfill leachate treatment. Such dosing improves the process efficiency for both old and young landfill leachates.

The classical Fenton process, and also the Fenton process modified with sodium percarbonate (Na2CO3-1.5H2O2) can both be successfully conducted already at pH=4. The Fenton process modification that involves changes in the oxidant dosing produces encouraging results. In addition, sodium percarbonate implementation can provide an effective alternative to hydrogen peroxide (H2O2) oxidant. Leachate treatment with the use of potassium ferrate (VI), which has the characteristics of both oxidant and coagulant, seems to be a possible option. Proper conditioning of waste materials, including sewage sludge, coffee grounds or nut shells, can significantly improve the effectiveness of these matrices in landfill leachate remediation processes. That contributes to rationality in the use of waste materials.