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Use of Machine Learning in the Function of Sustainability of Wastewater Treatment Plants

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1 Introduction

Due to the complexity and sensitivity of the treatment process, it is difficult to continuously maintain optimal operating conditions within the wastewater treatment plants (WWTP). Because of this, modelling becomes very useful tool that is often used to simulate and control the operation of the WWTP.

In this paper, machine learning method i.e. model trees was used to obtain a model for the Chemical Oxygen Demand (COD) concentration in the effluent of the WWTP. The value of the COD in the effluent is considered as the best indicator for operation quality for the WWTP, i.e. residual organic loads, which also indicated the efficiency of the treatment process (Čurlin *et al*., 2008; Henze *et al*., 2002; Tchobanoglous *et al*., 2003).

From the given data set, a model of the COD concentration in the effluent of the WWTP was created (Figure 1). The model consists of a total 6 nodes and 7 leaves, which contains the values of the variables measured in the influent of the WWTP. Each leaf contains one equation to calculate the COD concentration in the effluent of the WWTP, depending on the structure of the tree itself. The equations in the individual tree leaves are shown in Table 1. The correlation coefficient R for the obtained model using cross validation method is 0.64.

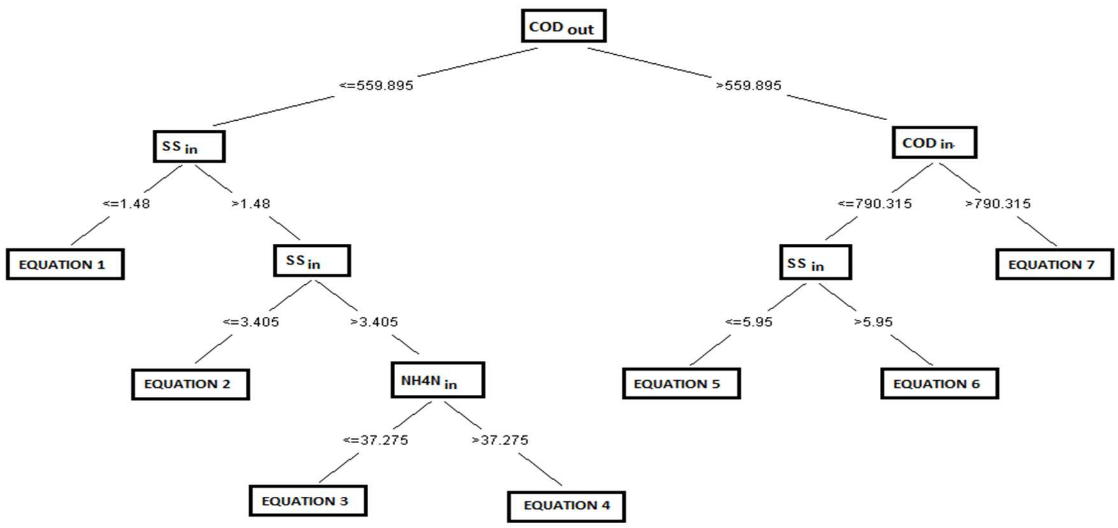

Figure 1. Obtained model for COD concentration.

Table 1. Model equations for COD concentration.

Equation number	Equation
1	COD_{out}=-0,0088*Q_{in} + 0,0954*COD_{in}-1,0529*NH_4N_{in}-0,0215*SS_{in}+45,669
2	COD_{out}=-0,0049*Q_{in}+0,038*COD_{in}-0,1132*NH_4N_{in}-0,0172*SS_{in}+20,0079
3	COD_{out}=-0,0006*Q_{in}+0,0016*COD_{in}-0,0016*NH_4N_{in}-0,0153*SS_{in}+20,1564
4	COD_{out}=-0,0006*Q_{in}+0,0016*COD_{in}-0,0034*NH_4N_{in}-0,0153*SS_{in}+23,1117
5	COD_{out}=-0,0009*Q_{in} +0,0046*COD_{in}+0,1559*NH_4N_{in}-0,0957*SS_{in}+24,0748
6	COD_{out} =-0,0009*Q_{in}+0,0046*COD_{in}+0,1559*NH_4N_{in}-0,0818*SS_{in}+17,0162
7	COD_{out}=-0,0009*Q_{in}+0,005*COD_{in}+1,3378*NH_4N_{in}-0,3479*SS_{in}-7,1299

Use of machine learning tools to create model from database, in this case model trees have been successfully applied to model WWTP, that is, the COD concentration in the effluent of the WWTP which can help in management and sustainability of the modeled WWTP. Obtained model is simple, understandable, and relatively accurate in predicting COD concentrations in the effluent of the WWTP.

Also, it is especially important to emphasize the use of machine learning tools for simpler and more efficient management and sustainability of the WWTP, as shown in this paper.

Future work is recommended to focus on increasing the database so that model accuracy can be increased and other parameters such as nutrients, e.g. nitrogen and phosphorus can be modeled with the enlarged database, where properly managing of nutrients is crucial to improving the sustainability of the WWTP. Thus, new links and patterns among the data could be revealed.

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