Chapter 2
Predicting Volume and Composition of Municipal Solid Waste Based on ANN and ANFIS Methods and Correlation-Regression Analysis

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2.1 INTRODUCTION

Currently, the issues of forecasting the amount of municipal solid waste (MSW) generation and the analysis of its morphological composition constitute an important task for creating an effective environmental waste management system in the cities. The objective data on MSW volumes and composition are critical for a well-founded policy of solid waste management. Obtaining reliable information about the volume of MSW generation in the settlements should ensure effective planning and control over the waste management system. On the other hand, the analysis of the MSW morphological composition will enable prompt changes to the scheme of primary collection, sorting, transportation, and what is more important – it will help choose the method for processing resource-valuable waste and organic fractions, as well as the final method for the residual MSW disposal.

One of the important characteristics of the MSW generated in settlements includes not just MSW volume but also its morphological composition, which represents the ratio of individual components: cardboard and paper, glass, metal, plastic, construction waste, and some other fractions that are part of MSW. The statistical information on the volume of resource-valuable fractions in the total flow of MSW generated by citizens will make it possible to forecast the estimated level of recycling at both local and regional levels. This, in turn, will allow for efficient MSW processing, which will become a criterion for saving resources and will enable to develop goals of the circular- or closed-loop economy. The concept of the circular economy presupposes saving as much costs of resources, products, and materials as it is possible in order to create the products with long service life and, thus, increasing the sustainability of the world and city economy as well as contributing to the implementation of Paris Agreement and the UN Sustainable Development Goals. Therefore, it is the process of MSW processing, as one of the elements of waste management system that is an important step in establishing and entrenching the principles of the closed-loop economy.

2.2 ANALYSIS OF LITERARY SOURCES AND PROBLEM STATEMENT

The dependence of processing efficiency on the accuracy of forecasting primary MSW collection was noticed more than 20 years ago (Chang and Lin 1997). We have thoroughly analyzed the existing methods. All literature methods for predicting the volume of MSW generation can be divided into several groups:

- Methods based on time series (Denafas et al. 2014, Mwenda et al. 2014, Bridgewater 1986);
- Methods based on deterministic factor and stochastic correlations (Shan 2010, Kolekar et al. 2016, Kumar and Samadder 2017);

2.8 CONCLUSIONS

Forecasting the rate of waste generation is not an easy task. This is mainly due to a lack of up-to-date data and a rapid change of external factors (inflation, political stability, changes in legislation on manufacturer liability). An even more difficult task is to forecast the morphological composition of MSW, which is influenced by an even greater number of factors, including social and behavioral factors that are difficult to forecast.

In the study, we identified the factors that influence the volume of MSW generation and its morphological composition, namely: social and behavioral factors, factors of life potential, personal preference, living conditions, organizational and seasonal factors.

Forecasting was carried out using ANN and ANFIS and correlation-regression dependencies. The final choice of the forecasting method was made by comparing the model's error. The ANN model is the best in terms of forecasting, which is due to its forecasting accuracy and relatively easy application.

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