Proces przygotowania stabilizatu do odzysku jako element gospodarki cyrkularnej

Process of preparing CLO for recovery as part of circular economy

- Summary -

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Summary

The EU law regarding municipal waste and packaging waste clearly indicated their selective collection as the basic way for recycling waste, which aims at creating a circular economy model for Europe.

The implementation of this model reduces the importance of mechanical biological waste treatment (MBT) technologies on the waste market. Such installations are and will be necessary for many years to come in order to ensure the reduction of landfilling of biodegradable waste and to supplement the achieved level of recycling in areas where the total cost of selective collection systems as well as various local implementation aspects usually provide disappointing results of selective waste collection.

At the beginning of 2017, about 570 MBT installations with the capacity of 55 million Mg were used in Europe. Waste biostabilisation installations were dominant. In these installations, the main product, being stabilised compost, usually accounting for about a quarter of the mass of the input waste stream, regardless of the technology used, is irretrievably disposed of in landfills.

The objective of the study was to assess the technical feasibility of recovering selected stabilised compost material fractions on a process line using processes commonly used in waste sorting plants. To achieve this objective:
- the quantity and morphological composition of the stabilised compost produced from mixed municipal waste in the MBT system in Marszów and in several other systems in the country were determined;
- a technological concept of a system enabling the separation of material fractions suitable for economic use from the stabilised compost was developed;
- in total, 29 measurement series were performed on the stabilised compost processing line and the amounts, morphological composition and selected physical and chemical properties of the separated material fractions were determined;
- the possibilities of using the selected waste material streams were evaluated, taking the quality requirements expected by the recipients into account.

The results of the research were published in a thematically-consistent cycle of five original articles. The study also contained an article presenting the morphological composition of fractions with particle size <80 mm separated from municipal waste delivered in the winter period to 21 MBT installations in Poland. Their properties were characterised by such parameters as: humidity, ignition loss and organic carbon content, as well as humidity and ignition loss of the sieve fractions <10 mm and 10-20 mm occurring in them. The presented research results clarify the very high content of fraction <10 mm in stabilised compost (Article IV). Furnace waste also has a negative impact on the key parameters determining the course of biostabilisation. Problems resulting from the presence of furnace waste in MSW are uncommon in most European countries. This is due to the specific structure of energy consumption in domestic households, compared to other European Union countries, as shown in Chart 1 (Article VI). The conducted research directed the way in which further works are to be performed regarding the methods of managing raw materials contained in this waste stream.

The research objective undertaken in article I was to compare a number of technical and technological indicators achieved by the ZZO Marszów system with the values of those parameters determined for 20 systems covered by the research as part of the third stage of the MBT expertise carried out under the supervision of A. Jędrczak and E. den Boer at the request of the General Directorate for Environmental
Protection in 2015. It described the MBT system in ZZO Marszów, the mass balance of the process in 2018 and 9 technical and technological indicators showing the efficiency of the system in Marszów in 2017 and 2018, as well as the minimum, maximum and average values of these parameters for 20 systems with various technological solutions used in the country. The plant in Marszów turned out to be an innovative unit with great potential to meet the needs of effective management of material flow, in the scope necessary for sustainable resource management.

Article II presents the development of selective collection of waste in a yellow bag in 2016-2019 from the area covered by the activities of the Waste Management Plant (ZZO) in Marszów. The amount of waste collected in the yellow bag in 2016-2019 was increasing gradually: in rural communes by 75.8%, in urban-rural communes by 44.9%, and in urban communes by 17.8%. The effectiveness of collection expressed in the degree of accumulation, was the highest and grew at the fastest pace in rural areas (from 25.1% to 35.5%). In cities, it practically did not change at that time (14.4-15.8%). The results presented in the article show that the pace of increase in the degree of accumulation of plastics is insufficient to reach 55% of the recycling level of municipal waste in 2025. They indicate that the search for other methods to increase waste recovery is not only highly justified, but even necessary. Recovery of material components from the stabilised compost can constitute such a method.

Article III is devoted to assessing the technical feasibility of recovering glass contained in the stabilised compost using a proprietary process line built at the Waste Management Plant in Marszów. Stabilised compost produced at the plant (13 measurement series, sample weight from 29.2 to 91.0 Mg) and from several similar systems in Poland (6 measurement series, sample weight from 10.3 to 22.0 Mg) was subjected to processing. The processing of stabilised compost on the designed line allowed to recover on average 69.4±7.0% of the glass it contained in the case of samples from Marszów and on average 58.3±14.2% in the case of samples from other MTB systems. The research showed that the quality of the glass concentrate significantly depends on the humidity of the input material, being the stabilised compost. As part of the research, a concentrate with glass content of 98.0 to 99.5% was obtained for stabilised compost samples with low hydration (for 14 out of 19 samples). This product was accepted by glass recycling plants due to its low level of impurities constituting other materials and the appropriate particle size, representing an important step towards increasing the mass of waste subjected to recycling processes.

In Article IV, the possibility of recovering the mineral fractions contained in the stabilised compost was investigated at a pilot system designed for glass recovery at the MTB plant in Marszów. 29 series of measurements were carried out. Four mineral fractions were separated from the stabilised compost: fraction 0-10 mm, fraction 10-35 mm after laser separation, fraction 10-35 mm after photo optic separator (glass concentrate), and heavy fraction 35-80 mm after air separator. The article presents amounts of these fractions that can be separated from the stabilised compost, as well as their morphological composition and particular properties. The total mass of mineral fractions accounted for approximately 80% of the mass of the stabilised compost in the case of waste from Marszów and approximately 70% in the case of provided waste samples. Fraction <10 mm accounted for nearly half of the stabilised compost mass. Two other mineral wastes, apart from glass, constitute fraction 10-35 mm (approximately 11% of the stabilised compost mass) and fraction 35-80 mm (approximately 3% of the stabilised compost mass), which in terms of materials are a mixture of rocks and debris contaminated with various components. Mineral fractions constituting waste from the process of separating glass were examined in terms of the possibility of their use for winter road maintenance as well as construction aggregate. Tests were also carried out confirming the possibility of
using particular mineral fractions (0-10 mm) from stabilised compost to obtain a waste cement mix useful for constructing road foundations using a standard amount of cement and compaction energy. The obtained test results allow to state that the aggregate obtained from stabilised compost at ZZO (Zakład Zagospodarowania Odpadów Sp. z o.o.) in Marszów may constitute suitable material for use in the mechanical hardening of local dirt roads, assuming an appropriate executive regime and constant supervision over the maintenance of developed roads. In addition, it is possible to use them as a replacement for natural aggregate in concrete products. However, from an economic point of view, at current aggregate prices and the cost of obtaining fraction 5-10 mm from stabilised compost, its use in concrete elements is not justified.

Article V presents the amounts of two high-energy fractions that can be separated from the stabilised compost and their morphological composition and selected properties were determined. Processing the stabilised compost on the glass recovery line made it possible to recover the light fraction 10-35 mm after the ZIG-ZAG (M-1) air separator and the light fraction 35-80 mm after separation on the NIHOT air separator (M-2), as high-energy fractions. In terms of materials, waste is a mixture of organics, paper and plastics. The total recovery of the three components, namely organics, paper and plastics was from 70.2 to 95.0% in the case of the stabilised composts from Marszów and from 76.5 to 94.5% in the case of the provided stabilised composts. It was indicated that these high-energy fractions, produced in the total amount of 19.2% of mass of the processed stabilised composts, with the moisture of <20% and a calorific value of 13.3 MJ/kg t.q. are a good raw material for the production of fuel from waste. According to the SRF classification according to the European Committee for Standardisation (PN-EN 15359:2015), the tested waste can be classified as the following: M-1 waste: 4NCV2C14Hg and M-2 waste: 4NCV1C14Hg.

Based on the conducted research, it can be clearly stated that the developed proprietary technology for the recovery of glass coming from the stabilised compost allows for the effective recovery of mineral and energy fractions contained in the stabilised compost, while providing the opportunity for a real increase in the levels of recycling and recovery of waste at the same time reducing the mass of irretrievably stored waste at present.