Polish Fertilizers from Ash (PolFerAsh technology) - assessment of technical and environmental conditions (BAT, BATNEEC, LCA)

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Sewage sludge ash (SSA) is one of the secondary phosphorus source due to its high phosphorus content (up to 12 %P), easy collection system and stable, sterile form. Phosphorus can be recovered from SSA via relatively simple wet extraction process (PolFerAsh technology) which allows obtaining high quality fertilizers products (Gorazda et al., 2016) concurrent with circular economy (CE) strategy.

A patented method of phosphorus recovery from SSA with the use of nitric and phosphoric acid, developed by the Cracow University of Technology, is characterized by an efficiency of 80–96%. The final products could be suspension fertilizers, precipitate, NP, PK or NPK multicomponent fertilizers.

The aim of the research was comprehensive technical, environmental and safety assessment for the PolFerAsh Technology. The framework for modelling for LCA analysis was determined, as well as environmental data on all inputs and outputs of the analysed technology, including material and energy balance (e.g. energy demand, raw material consumption, water consumption, etc.). The analysis includes five phases of phosphorus-based fertilizers production as a result of extraction from sewage sludge ash:

- Stage I - phosphorus extraction,
- Stage II - phase separation (filtration),
- Stage III - rinsing of the post-extraction sludge,
- Stage IV - production of fertilizers
- Stage V - granulation and drying (final product).

The analysis was carried out in the SimaPro 8 program, and the life cycle impact assessment was made using the method recommended by the EC for the evaluation of the environmental performance, i.e. ILCD 2011 Midpoint. Two variants of phosphate fertilizer production were analysed, depending on the type and physicochemical properties of ash used in the combustion of sewage sludge. In addition, the analysis includes transport, i.e. the phase of supplying incinerated sewage sludge from their place of to the place where the fertilizer production plant is located (within 100 km), and environmental damage and benefits associated with it.

The results of the LCA analysis obtained for the production of fertilizers based on recovered phosphorus show that the proposed technology contributes to greater environmental benefits than the damages arising at the production stage. The most important benefit resulting from the application of developed technology is the possibility of avoiding the environmental effects of wastewater management (avoiding the municipal sewage sludge and ash from sewage sludge combustion and associated emissions to water, soil and air), and (thanks to the recovery of phosphorus) receiving products that are used in: agriculture - as a component of efficient and ecological fertilizers and construction sector - as potentially valuable and inexpensive components of building materials.

The analysis showed that the proposed solutions have a small influence on the categories of impact from the area of damage to human health. Detailed analysis has also confirmed that there are no threats regarding work safety.

Within conducted research technical conditions were assessed - the methodology for the assessment of BAT, BATNEEC options for management of ash from sewage sludge, with the recovery of phosphorus, which is included as a critical elements was presented. The first of the analysed options concerned the storage of ashes from the combustion of sewage sludge on typical landfills, assuming no investment outlays for their storage. In the second case, the use of ashes from sewage sludge incineration for the production of fertilizers was considered. To this end, the effectiveness of the installation developed for PolFerAsh technology was analysed. Conducting tests on a large-scale and micro-technical scale allowed us to assess the suitability of the obtained fertilizer product. BAT and BATNEEC are solutions guaranteeing the minimum risk to the environment, at the same time as economic profitability of production assessed by the NPV method (for this purpose the potential investment outlays and operating costs of the planned installation were initially estimated). BAT and BATNEEC were evaluated using the expert method, and the criteria used were: technical feasibility, environmental benefits and economic viability. The scope of work included selection of options and criteria for their evaluation. The basis for the option selection were the analysis of waste storage and incineration processes. For the assessment of

the effects of the implementation, the ecological, technical and economic consequences of the implementation of individual options were selected. The first of the analysed options was the storage of ashes from the incineration of municipal sewage sludge in landfills at STUOŚ. The second option was the production of fertilizer based on ash from the incineration of municipal sewage sludge. As the maximum value, the number of points possible to obtain in the expert assessment (140 points) was assumed. The high scoring of the option of producing fertilizers based on sewage sludge ashes, which obtained 113 points (81% of the maximum value), is noteworthy. It can be assumed that it is a technology recognized as the best available technique, eliminating the storage of ashes. On the other hand, the option of storing SSA obtained 31 points (22% of the maximum value).

This approach to the management of sewage sludge ashes is in line with the objectives of the zero waste program for Europe, which emphasizes that sustainable economic growth in Europe and individual countries is possible by moving to a more closed economy.

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References:

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