Technology of obtaining granulated phosphate fertilizers based on municipal sewage sludge ashes and bacteria *Bacillus megaterium*.

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Products of functional properties containing nutrients obtained from natural resources and not being chemical synthesis products have become increasingly sought by customers.

In last decades, consumption of fertilizers have been steadily growing. This growth concerns all main nutrients. Phosphate rocks, which are the basic raw materials used in phosphorus fertilizers production, are non-renewable raw materials and the necessity to recycle phosphorus (P) for further reuse are important issues for agro-industrial management and environmental control. Therefore, attempts to obtain phosphorous from renewable resources including waste raw materials e.g. bone waste, fishbone, and ashes from biomass combustion from waste treatment plants became increasingly significant.

In the study, a description of technology of obtaining granulated phosphate fertilizers from waste raw materials using microbiological solubilization is presented. A simplified flow diagram and mass balance of granulation process using a plate granulator and a compactor are showed. Economical aspects of obtaining these type of fertilizers are also presented. An ash from combustion of municipal sewage sludge was used as a phosphorus raw material. The sewage sludge ash contained 27.4% of P_2O_5 . Dried blood was used as a binding agent and *Bacillus megaterium* was used as solubilization bacteria.

For the semi-technical scale trials of obtaining granulated phosphate fertilizer using waste raw materials, two techniques were used. The first method was a plate granulation at which the plate granulator with diameter of 1.15 m was used. Additionally, an influence of temperature and drying techniques were conducted. Drying the granule formulation was at three temperatures: 60, 80, and 105°C. The studied drying techniques were dryings in a drum dryer and a belt dryer. The second granulation method was a compaction. At this method, the influence of compression strength and quantity and type of a binding agent on granules quality were studied. Dried blood, sodium lignosulphonate, water and their mixtures were used as binders.

The tests were continued until granulates with granules of 2-5 mm were obtained. The obtained granulates were dried and underwent physicochemical analyses. All of the obtained fertilizers were tested with regard to:

- the content of particular forms of P₂O₅,
- compression strength,
- abrasion resistance,
- effectiveness of granulation system.

Exemplary results of physicochemical analyses are presented in Table 1.

| Parameter | Unit | Compactor | Plate granulation |
|-------------------------------------|--------|-----------|-------------------|
| Compressive strength | Ν | 42.1 | 99.1 |
| Abrasion resistance | % | 88.1 | 98.8 |
| Consumption of granulating liquid | % DM | 9 | 50 |
| P ₂ O ₅ total | % mass | 22.8 | 20.1 |

Table 1. Quality of obtained granules and consumption of granulating liquid.

Fertilizers obtained by plate granulation process are characterized by higher compressive strength and abrasion resistance comparing to fertilizers obtained by compaction. However, this is at the expense of decreased P_2O_5 content in a product and significant water consumption during granulation process that generate the costs of drying process.

References:

- 1. Johir et al., 2016
- 2. FAO, 2016
- 3. Saeid et al., 2014
- 4. Stamford et al., 2008

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