The production of suspended fertilizers based on ashes from combustion of sewage sludge with the use of phosphate solubilization with Bacilius 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 [1)].

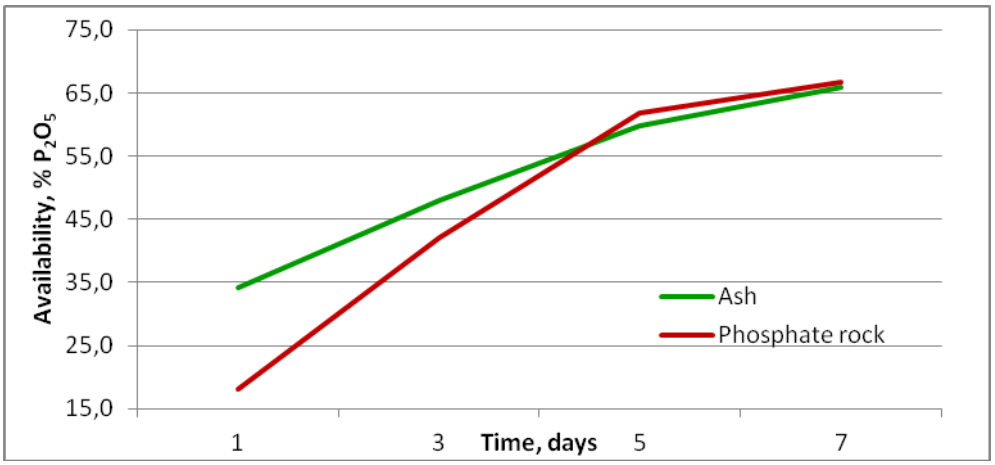
Phosphate rock, which are non-renewable, constitute the primary source of raw materials for phosphate fertilizers. In the environment, phosphorpus is obtained from ore (phosphorites, apatite) and effectively scattered in agricultural management [2)]. There is no substitute for phosphorous, however it does not disappear after being used and it can be recycled. Therefore, attempts to obtain phosphorous from renewable resources including wastage e.g. bone waste, fishbone, and ashes from biomass combustion from waste treatment plants[3)] became increasingly significant.

Semi pilot experiments of the production of suspended fertilizers were presented in this paper. Ashes from biomass combustion from treatment plant with grade III were used as raw material. Ashes underwent microbiological solubilization with the use of Bacillus megaterium in order to produce phosphate fertilizers. Morocco phosphate rock was used as reference raw material. Raw material composition was presented in Table 1.

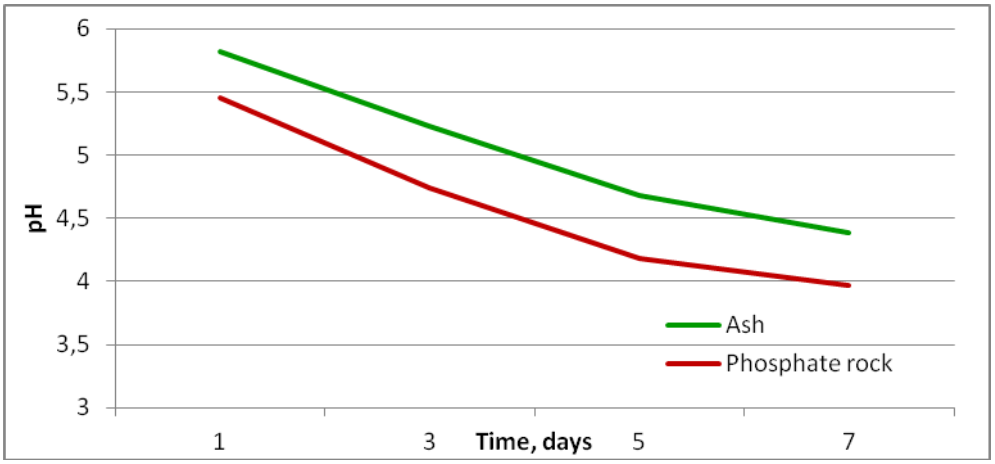
Table 1. The content of particular P_2O_5 in particular raw materials.

P_2O_5	**Content in ash, % weight**	**Content in phosphate rock, % weight**
Total	24,7	26,8
Soluble in ammonium citrate	7,2	1,3
Soluble in water	Below determination limit	0,5

The preparation of bacterial growth medium for Bacillus megaterium was the first stage of suspended fertilizers production process. Particular components of bacterial growth medium were introduced into the appropriate amount of water and then the obtained solution was boiled for sterilization. Afterwards, the solution was left to cool down. After cooling, reactor feed was inoculated with suspension. Such bacterial culturing was carried out at 35 °C. During culturing, additional portions of bacterial growth medium were added, which were 10-fold more concentrated than the basic growth medium for Bacillus megaterium. Once the process was completed, pH of the solution was adjusted to 7 using bentonite which was used also for suspension stabilization. The values of pH in the reactor and content variations of available phosphorous expressed as the ratio of P_2O_5 soluble in neutral ammonium citrate to the total P_2O_5 were measured in order to evaluate the process. Measurement results were presented on drawings 1 and 2.



Drawing 1. Content variations of P_2O_5 soluble in ammonium citrate compared to total P_2O_5 in suspended fertilizers based on Bacillus megaterium.



Drawing 2. pH variations during the production of suspended fertilizers based on Bacillus megaterium.

In phosphate rock based fertilizer, growth dynamics of the content of P_2O_5 soluble in ammonium citrate is higher than in case of ash based fertilizer, however in both cases the final content of P_2O_5 soluble in ammonium citrate is similar. In both cases pH variations were similar. For phosphate rock based fertilizer lower pH value throughout the entire processes was observed.

The possibility of the production of phosphate suspended fertilizers with the use of phosphate solubilizing bacteria Bacillus megaterium was proved during the conducted semi technical experiments and no serious problems connected with conducting the process were observed by operators .

References:

1. .Schroeder and Grzesiak (2014)
2. Saeid *et al.* (2012)
3. Stamford, *et al (*2003)

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