

Liquid and suspension fertilisers based on alternative raw materials



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Introduction

Suspension and liquid fertilizers are products that generate increasing interest in Europe. They have many advantages, including:

- higher concentration of NPK components,
- availability of nutrients dissolved in the solution,
- prolonged availability of components contained in the solid phase
- ease of application.

At the same time, the modern methods of fertilizers production, with phosphorus recovery from waste materials reducing the intensity of using non-renewable sources of phosphorus, potassium or nitrogen.

In the study conventional and based on alternative raw materials liquid and suspension fertilizers were analyzed.

Research

Tests were conducted on solutions obtained in the processes of metallurgical slag leaching by chemical and biological extraction. Leaching was used to recover microelements useful for fertilization (Cu, Fe, Mn, Zn, Si).

Ammonia water solution (25%), potassium hydroxide, potassium nitrate, and sewage sludge combustion ash (source of phosphorus), meat and bone meal ash (source of phosphorus), and chicken manure ash (source of phosphorus and potassium) were used as neutralizing agents. Ammonium nitrate, MAP, DAP, potassium nitrate, potassium sulphate or potassium chloride were used to supplement the composition of the fertilizer with essential nutrients.

Bentonite was used as an additive to stabilize the suspension.

In order to verify the process of neutralization and suspension of solid components and granulation of solid fertilizers, at the initial stage, work was carried out on model solutions, i.e. pure reagent sulfuric acid of 45 and 60%.

The elemental composition, effect of homogenization time, solid-liquid ratio and ash grain size on the stability of the slurries produced was determined in the obtained suspension fertilizers.

Fertilizer formulations for cucumber, cabbage and oilseed rape were finally proposed.

Table 1. Major nutrients, micronutrients, heavy metals content and NPK ratio in suspension fertilizers

Plant	Sample identification	N, %	P ₂ O ₅ , %	K ₂ O, %	N+P ₂ O ₅ +K ₂ O	N:P ₂ O ₅ :K ₂ O	N:P ₂ O ₅ :K ₂ O required level	Fe, mg/kg	Zn, mg/kg	Cu, mg/kg	Cd, mg/kg	Pb, mg/kg
cucumber	O-Z-3S	7.03	5.36	11.15	23.54	1.3:1:2.1	1.3:1:2.1	9900	2001	1100	0.40	24
oilseed rape	RZ-Z-12S	12.48	5.16	16.77	34.41	2.42:1:3.25	2.42:1:3.25	7880	2000	1000	0.30	20.5
oilseed rape (pure salts)	RZ - CZ-T2	13.61	6.63	18.27	37.51	2.42:1:3.25	2.42:1:3.25	1000	2000	1000	16	45
cucumber (pure salts)	O - CZ-T2	13.25	10.02	20.84	44.11	1.31:1:2.08	1.31:1:2.08	1000	2000	1000	14	40
cabbage (pure salts)	KP-CZ-T1	17.30	4.57	14.15	37.01	3.78:1:3.31	3.78:1:3.31	1000	2000	1000	<10	<45

Observations

The best stability was obtained for mixtures that:

- the solid to liquid ratio was 1:1 with the ash from sewage sludge combustion (from Gdynia incineration plant) grain size of 4-6 μm and homogenization time of 20 minutes at 2500 rpm,
- the solid to liquid ratios of 5:2 and 5:3 with the chicken manure ash contained grains of 47-70 μm for homogenization time of 20 minutes at 2500 rpm,
- meat and bone meal ash contained grains of 4-6 μm at solid to liquid ratios of 5:2 and 5:3 and homogenization time of 20 minutes at 2500 rpm.

The optimum amount of bentonite introduced should be 3-5% by weight of the mixture depending on the alternative raw material used.

Conclusions

Suspension and liquid fertilizers based on alternative sources are focused on critical elements recovery from waste as well as micronutrients.

Application of suspension fertilizers can be attributed to its advantages like:

- lower purity requirements that's allow usage of cheaper, less pure, alternative raw materials like waste,
- possibility of application of fertilizer simultaneously with irrigation,
- possibility of combining fertilizer with pesticides, and as a result application of both simultaneously,
- easier & cheaper production by reduction of process (such as drying, granulation, classification, bagging),
- uniform distribution of fertilizer,
- possibility of soil and foliar application,
- elimination of disposable non-biodegradable packaging.