NEW CHEMICAL SYNTHESES INSTITUTE

STUDY OF THE POSSIBILITY OF USING MEAT AND BONE MEAL ASH FOR THE PRODUCTION OF GRANULAR FERTILIZERS

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REGULATION (EU) .../...

OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL

of ...

laying down rules on the making available on the market of *EU* fertilising products and amending Regulations (EC) No 1069/2009 and (EC) No 1107/2009 *and repealing Regulation (EC) No 2003/2003*

Component Material Categories (CMCs)

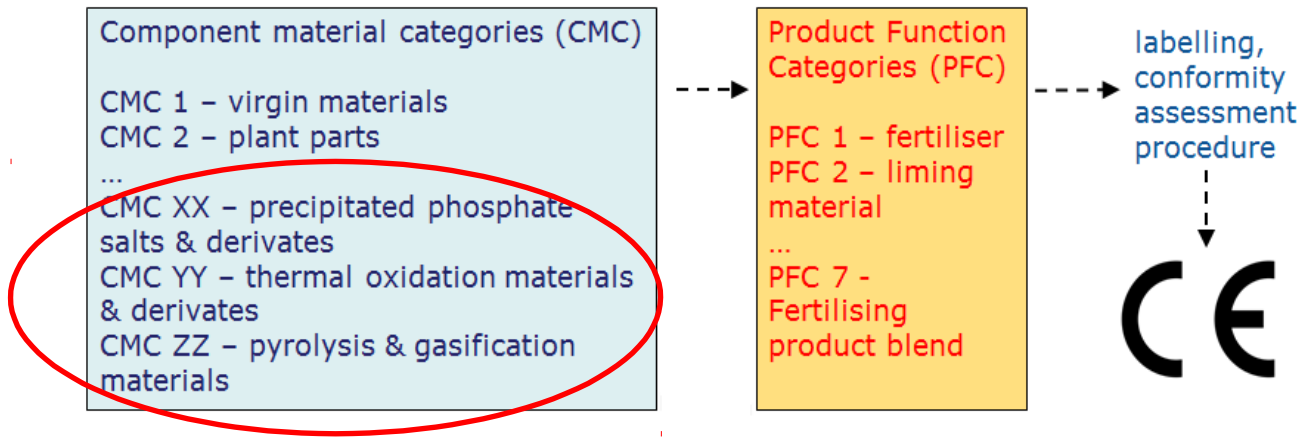
- CMC 1: Non-polymer virgin materials
- CMC 2: Simple plant parts or extracts
- CMC 3: Compost
- CMC 4: Energy crop digestate
- CMC 5: Other digestate
- CMC 6: Food industry by-products
- CMC 7: Micro-organisms
- CMC 8: Agronomic additives
- CMC 9: Nutrient polymers
- CMC 10: Other polymers
- CMC 11: Animal By-products

Product Function Categories ('PFC')

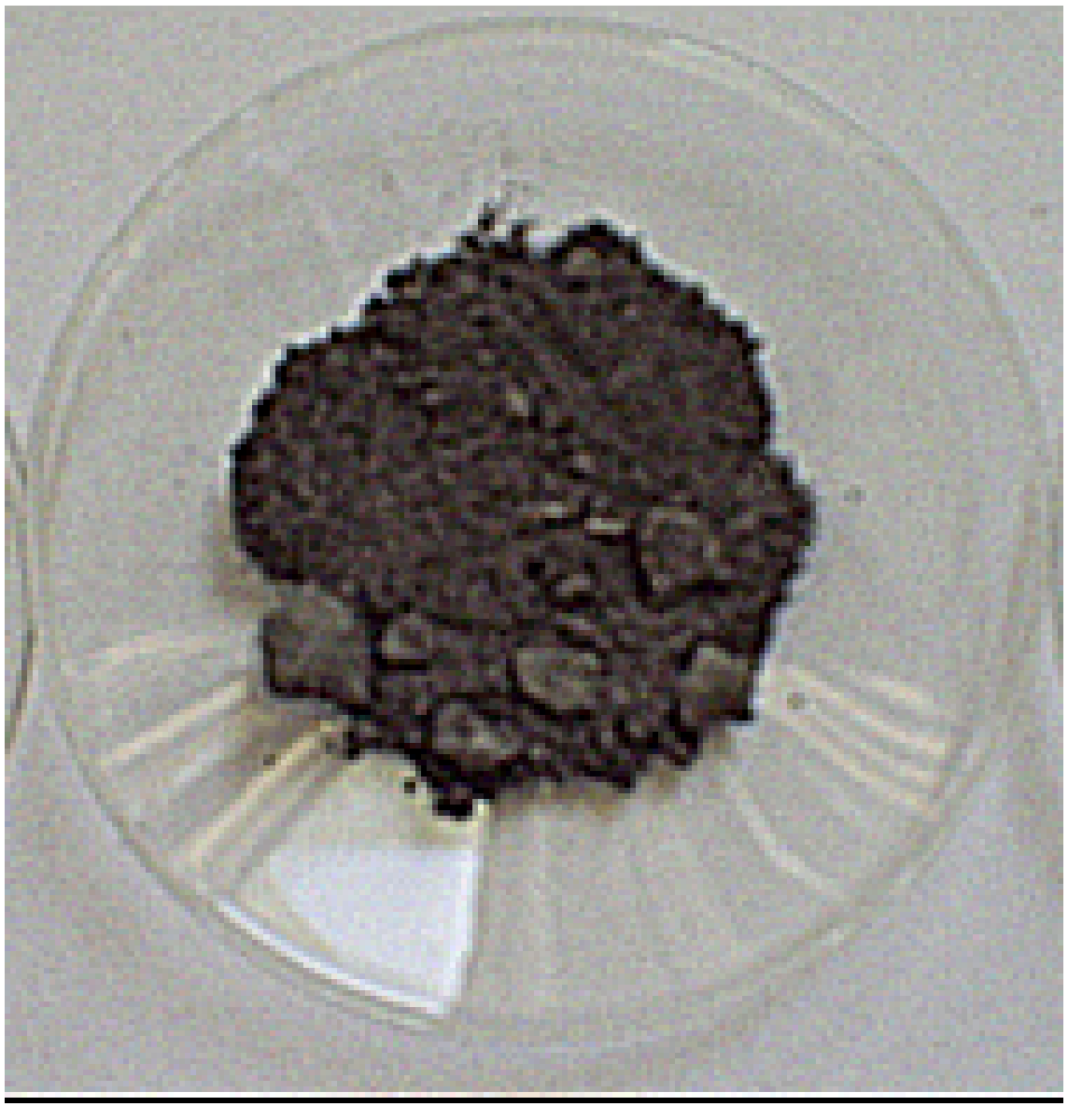
- PFC1 - Fertiliser
  - (A) Organic
    - (I) Solid
    - (II) Liquid
  - (B) Organo-mineral
    - (I) Solid
    - (II) Liquid
  - (C) Inorganic
    - (I) Macronutrient
    - (II) Micronutrient
- PFC2 – Liming material
- PFC3 – Soil Improver
  - (A) Organic
  - (B) Inorganic
- PFC4 – Growing medium
- PFC5 – Agronomic additive
- PFC6 – Plant Biostimulant
  - (A) Microbial
  - (B) Non-Microbial
- PFC7 – Fertilising product blend

Figure 1. Structure of the proposal for the revised Regulation.

STRUBIAS materials



material used for laboratory and semi-technical tests fertilizer production



Sample of meat and bone meal ash (MBMA):

- **dark gray color**
- **dusty form with visible hard particles**
- **slightly perceptible odor, typical for ash.**

materials used for laboratory and semi-technical test
ertilizer production

Table 1. Main components of MBMA

Total wt %	P_2O_5	$P_2O_{5\ (ws+c)}$	$P_2O_{5\ (ws)}$	K_2O	MgO	CaO	SO_4	Fe_2O_3	Al_2O_3	Na_2O	H_2O
MBMA	27.60	2.93	0.12	2.80	0.89	45.14	0.86	1.44	0.50	3.91	1.44

e 2. Heavy metal content in MBMA (by ICP-OES and CV-AAS)

Total mg/kg	As	Cd	Pb	Hg
MBMA	**0.70**	**0.11**	**0.12**	**0.003**
Limit*	50	50	140	2

*Regulation UE 2003/2003

The chemical composition of the MBMA is similar to the composition of hydroxyapatite, i.e. it contains difficult available phosphorus for plants. In order to process the insoluble form of phosphate contained in the ash, to the forms that are easy absorbed by plants (mono- and dicalcium phosphates), it is necessary to conduct the reaction of ash with sulfuric acid, in the same manner as in the production of single superphosphate, according to the equation:

$$2Ca_5OH(PO_4)_3 + 7H_2SO_4 \rightarrow 3Ca(H_2PO_4)_2 + 7CaSO_4 + 2H_2O$$

Based on the steichiometry of the reaction, it was assumed that the weight ratio of ash to sulfuric acid in the decomposition process will be **1:0.7**, and the product will have chemical composition similar to the single superphosphate.

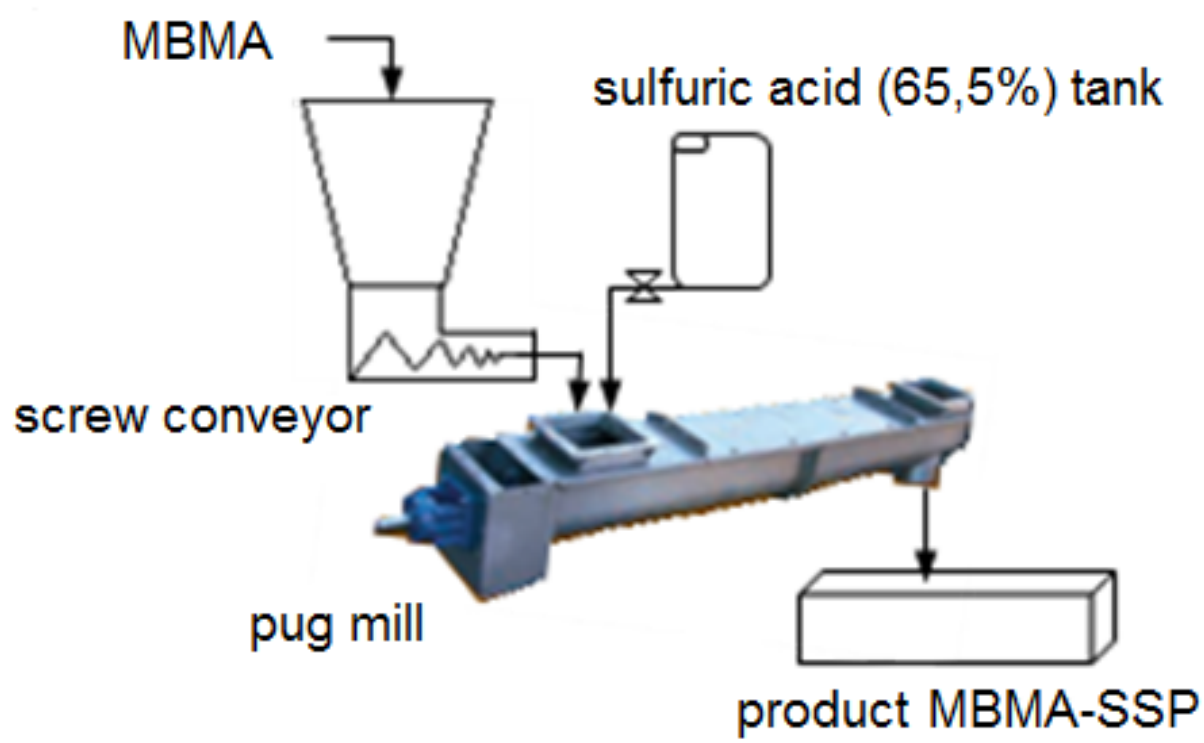


Table 3. Analysis of different forms of phosphorous in the final product – MBMA-SSP

Total wt%	P_2O_5	$P_2O_{5\ (ws+c)}$	$P_2O_{5\ (ws)}$	H_2O	pH
MBMA-SSP (batch system)	**18.60**	**15.21**	**12.20**	**7.90**	**3.10**
MBMA-SSP (continuous system)	**17.21**	**14.20**	**11.82**	**9.62**	**2.64**

Raw materials used for laboratory and semi-technical tests of fertilizers

- **ash from the burning of the meat and bone meal,**
- **dried phosphate sludge from the production of food phosphates *(45.0 wt% $P_2O_{5\ (ws+c)}$, 44.7 wt% $P_2O_{5\ (ws+c)}$, 5.0 wt% $P_2O_{5\ (ws)}$),***
- **sulfuric acid *(95.0%)*,**
- **ammonium sulfate *(21.0 wt% N, 24 %wt S),***
- **potassium sulfate *(50.3 wt% K_2O),***
- **potassium salt *(60.0 wt% K_2O)*,**
- **dolomite *(45.0 wt% CaO+MgO),* ,**
- **magnesium sludge from the production of magnesium sulfate *(19.3 wt% MgO, 4.3 %wt CaO),***
- **bentonite *(as a granualtion binder).***

The aim of this part of the research was to determine the effective method for production of multi-component fertilizers, type: PK (10-20) and NPK (4-9-20), based on the aforementioned raw materials.

List of tests:

1. PK 10-20
- MBMA-SSP – 61.5 wt%
- Potassium salt – 33.5 wt%
- Bentonite – 5.0 wt%

2. PK 10-20
- MBMA-SSP – 60.0 wt%
- Potassium salt – 32.5 wt%
- Bentonite – 7.5 wt%

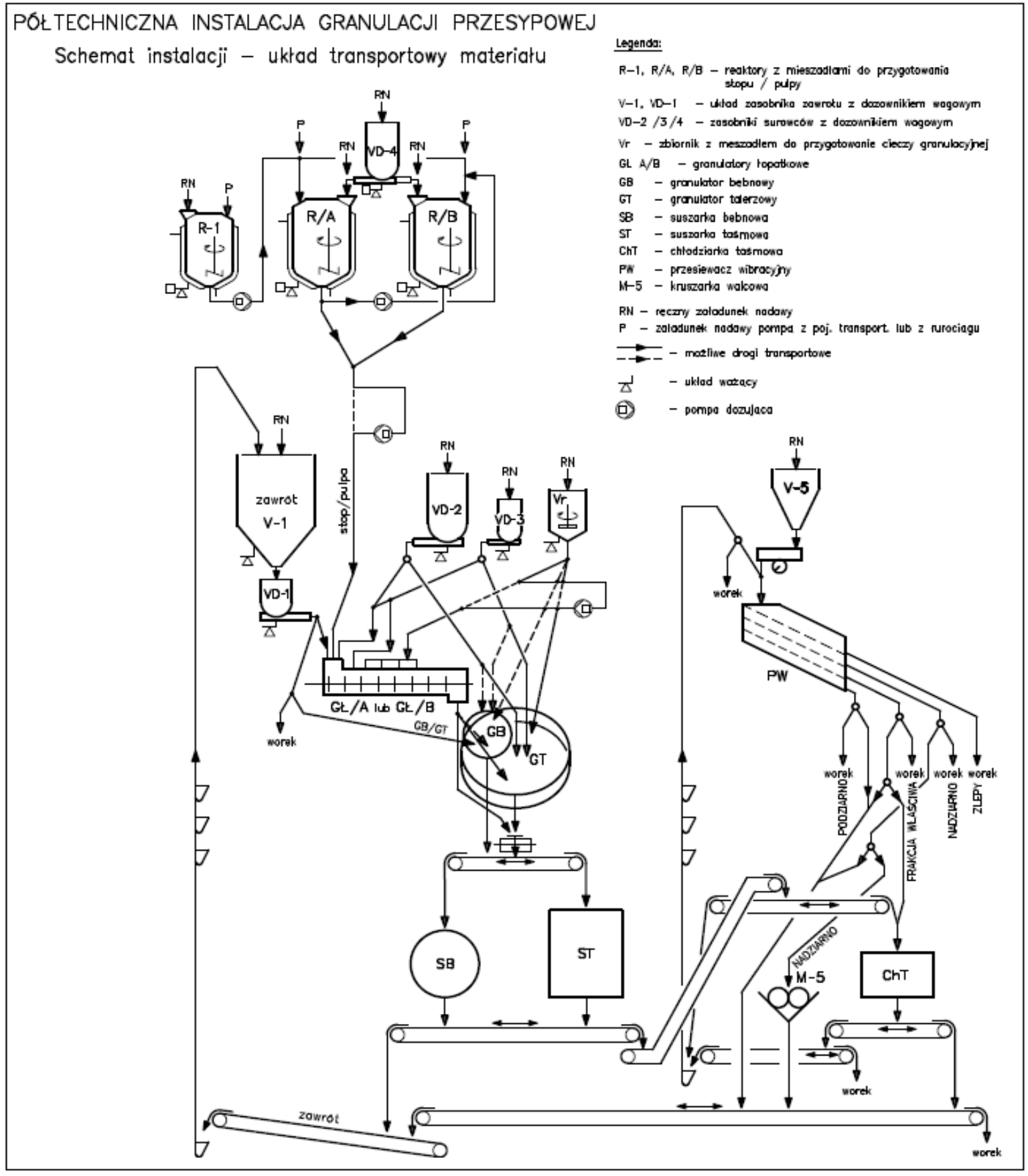
3. PK 10-20
- MBMA-SSP – 55.0 wt%
- Potassium sulfate – 37.5 wt %
- Bentonite – 7.5 wt%

4. NPK 4-9-12
- MBMA-SSP – 50.0 wt%
- Potassium sulfate – 23.5 wt%
- Amonium sulfate – 19.0 wt%
- Bentonite – 7.5 wt%

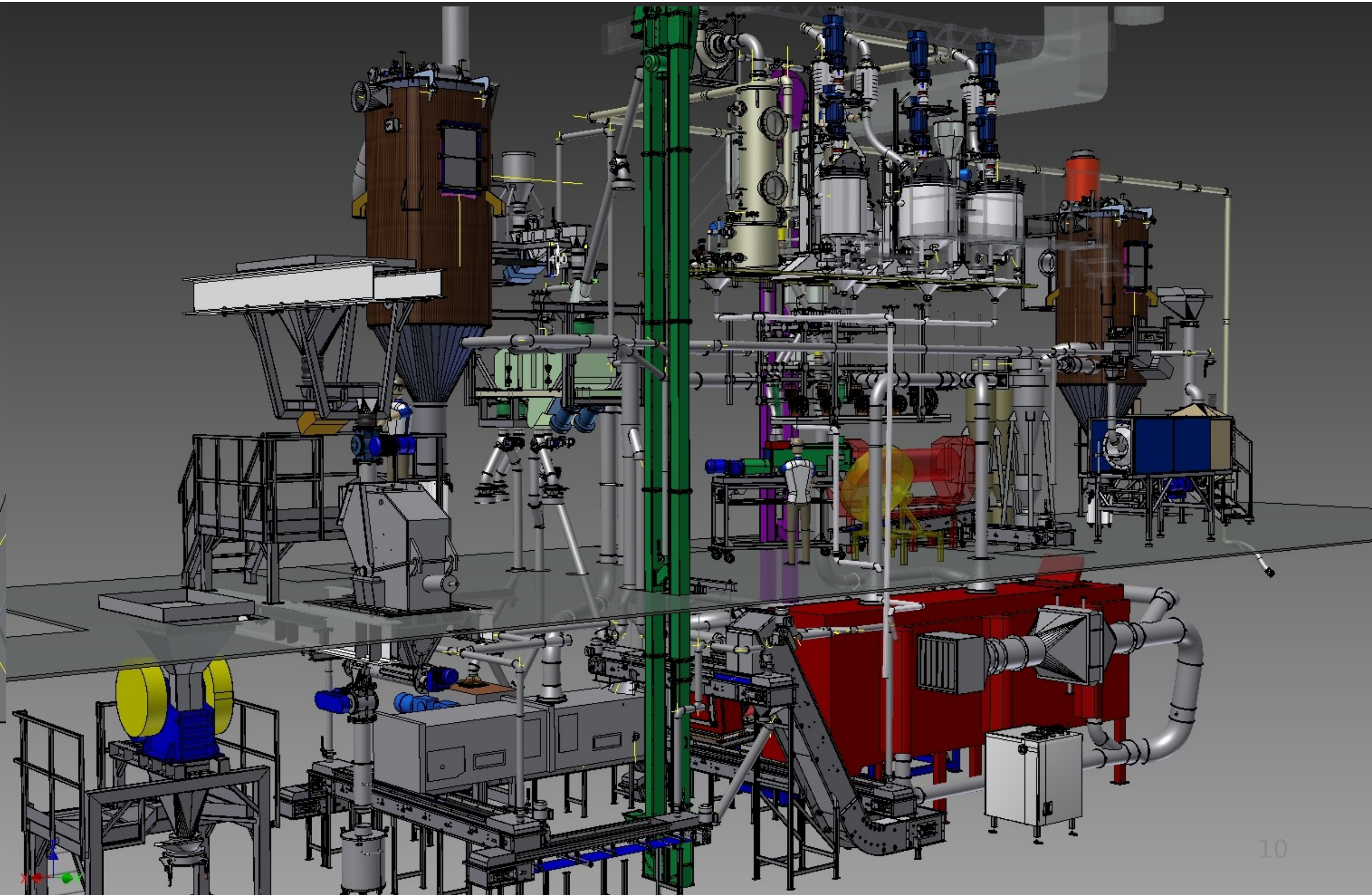
5. PK(Mg) 10-20(8)
- MBMA – 18.9 wt%
- Potassium sulfate – 35.8 wt%
- Dolomite – 13.7 wt%
- Magnessium sludge – 10.5 wt%

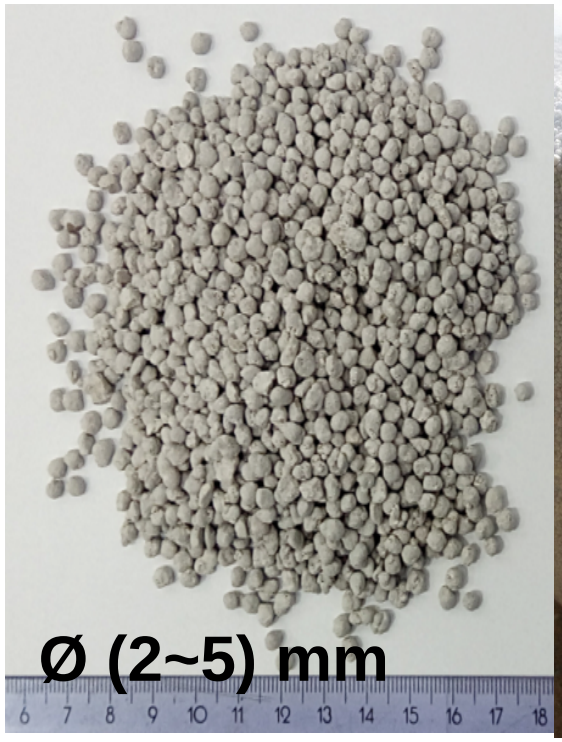
Pulp (30 wt% H_2O):
- Phosphate sludge – 11.8 wt%
- Sulfuric acid – 9.2%

Plant diagram



Equipment used for investigation of granulation processes





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PRODUCT AND PROCESS

Assessment methods of fertilizer quality applied in the research

- chemical analysis,
- screen analysis,
- granule abrasibility,
- granule compressive strength,
- caking susceptibility,
- hygroscopicity.

Table 4. Results of physico-chemical analysis of PK and NPK type fertilizers obtained during the pilot scale tests

No.	Description	N	P_2O_5	P_2O_5 (ws+c)	P_2O_5 (ws)	K_2O	MgO	H_2O	pH	d_z	granule compressive strength	abrasibility
		wt%								mm	N/gran.	%
1	PK 10-20	-	10,88	9,93	7,00	25,73	-	3,07	3,28	2,71	60,65	98,2
2	PK 10-20	-	11,33	9,38	6,40	22,80	-	4,94	3,73	2,70	35,20	98,3
3	PK 10-20	-	9,45	8,24	6,04	19,73	-	5,00	4,01	3,74	21,75	98,5
4	NPK 4-9-12	3,89	8,95	7,91	5,40	13,21	-	6,15	3,18	3,33	27,45	97,9
5	PK(Mg) 10-20(8)	-	12,76	9,33	3,79	22,07	8,05	3,15	5,43	2,85	28,70	98,4

Conclusions

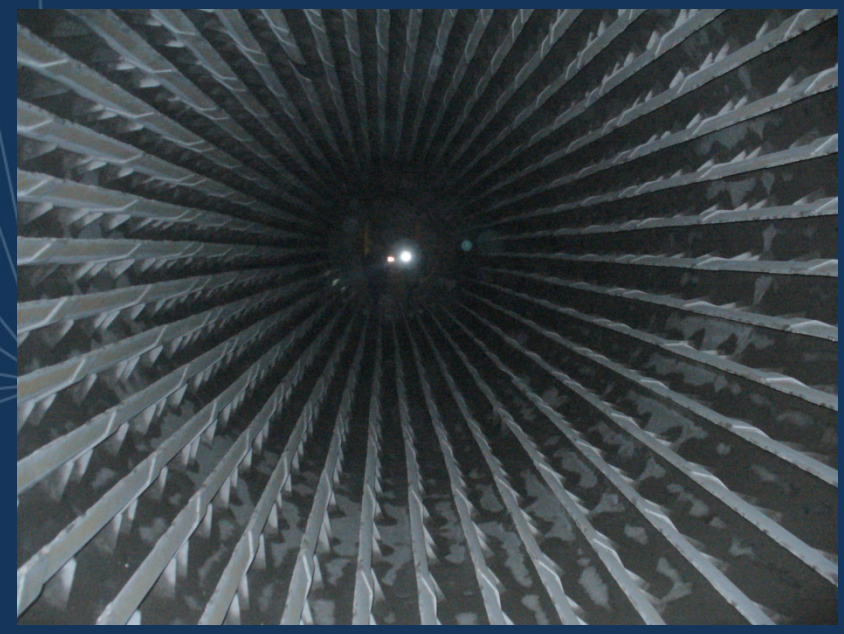
The conducted research confirmed the possibility of producing multi-component fertilizers with assumed compositions using ashes.

The obtained fertilizer is compliant with the requirements for compound mineral fertilizers.

In the proposed production process of compound fertilizers, in order to increase the degree of phosphorus absorption in the product, acidulation of ash with sulfuric acid was performed. The absorption with chemical reaction is needed in this process.

Conclusions

- **The content of moisture should be in the range of 12-14% in the material in pan granulator and the temperature should be kept at a level 50-60°C, then the granulation process runs efficiently. Exceeding these parameters even to a small extent causes large disturbances in the granulation process.**
- **Ash, as well as MBMA-SSP, has no granulating properties and requires additional binders to the granulation process.**
- **In the future, the aforesaid wastes may become a valuable phosphorous resource for fertilizers production. Additionally, in the new draft of Fertilizers Regulation, animal by-product wastes can be used as a phosphorous resource.**



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