PRO AGRO LECTORIUM

Production of mineral fertilizers

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Illustrated by Dmitry Dorofeyev using Kandinsky 2.1 neural network

Mineral fertilizers

PRO AGRO LECTORIUM

The main types of fertilizers

- Organic
- Mineral
  - With macronutrients
    - Nitrogen
    - Phosphoric
    - Potash
    - Sulfur-containing
    - Double
    - Triple
  - With trace elements
    - Boron
    - Zinc
    - Manganese
    - Copper
    - Molybdenum
    - Iron
    - Nickel
  - Water soluble
- Organomineral

	N	P_2O_5	K_2O	S
Ammonia	82	0	0	0
Urea	45-46	0	0	0
Ammonium sulfate	21	0	0	24
Ammonium nitrate	33.0-34.5	0	0	0
CAS	20.4-27.0	0	0	0
Urea-ammonium nitrate	28-32	0	0	0
Monoammonium phosphate	11	52	0	0
Diammonium phosphate	18	46	0	0
NPK fertilizer	Various	Various	Various	Various
Potassium nitrate	13	0	44	0
Crushed ore	0	20-40	0	0
Simple superphosphate	0	16-20	0	12
Double superphosphate	0	46	0	0
Potassium chloride	0	0	60	0
Potassium sulfate	0	0	50	18
Polyphosphates	10-11	34-37		

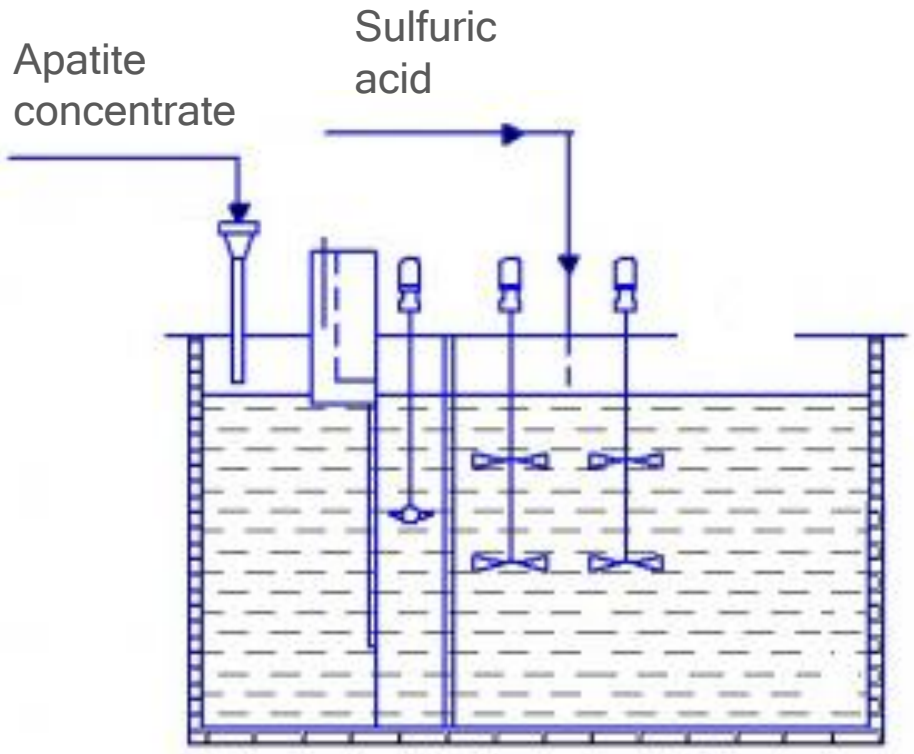
Source :International Fertilizer Association, World Farmers' Organisation\\Nutrient Management Handbook

Fertilizer production

3 core facilities:

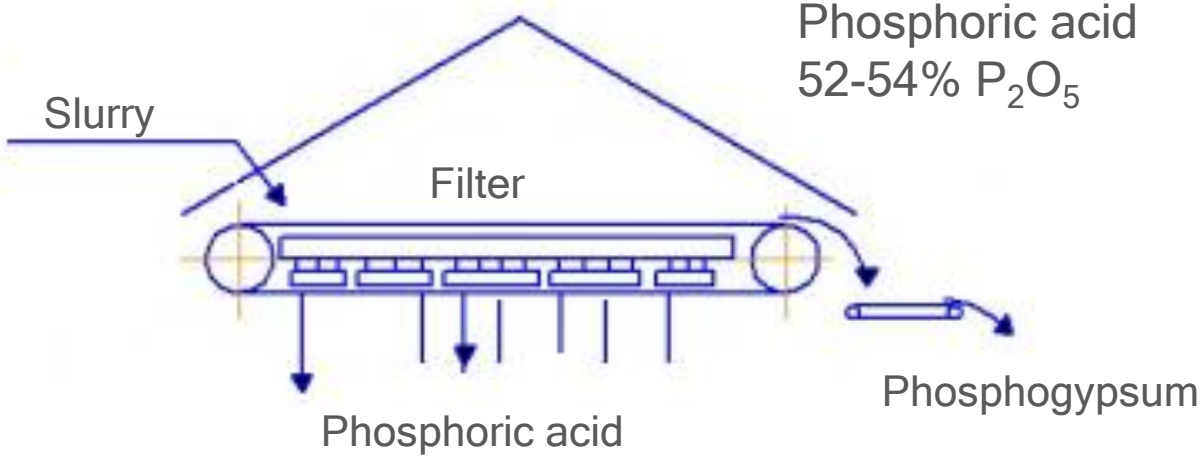
- JSC Apatit
- Balakovo branch of JSC Apatit
- Volkhov branch of JSC Apatit

Production of phosphoric acid

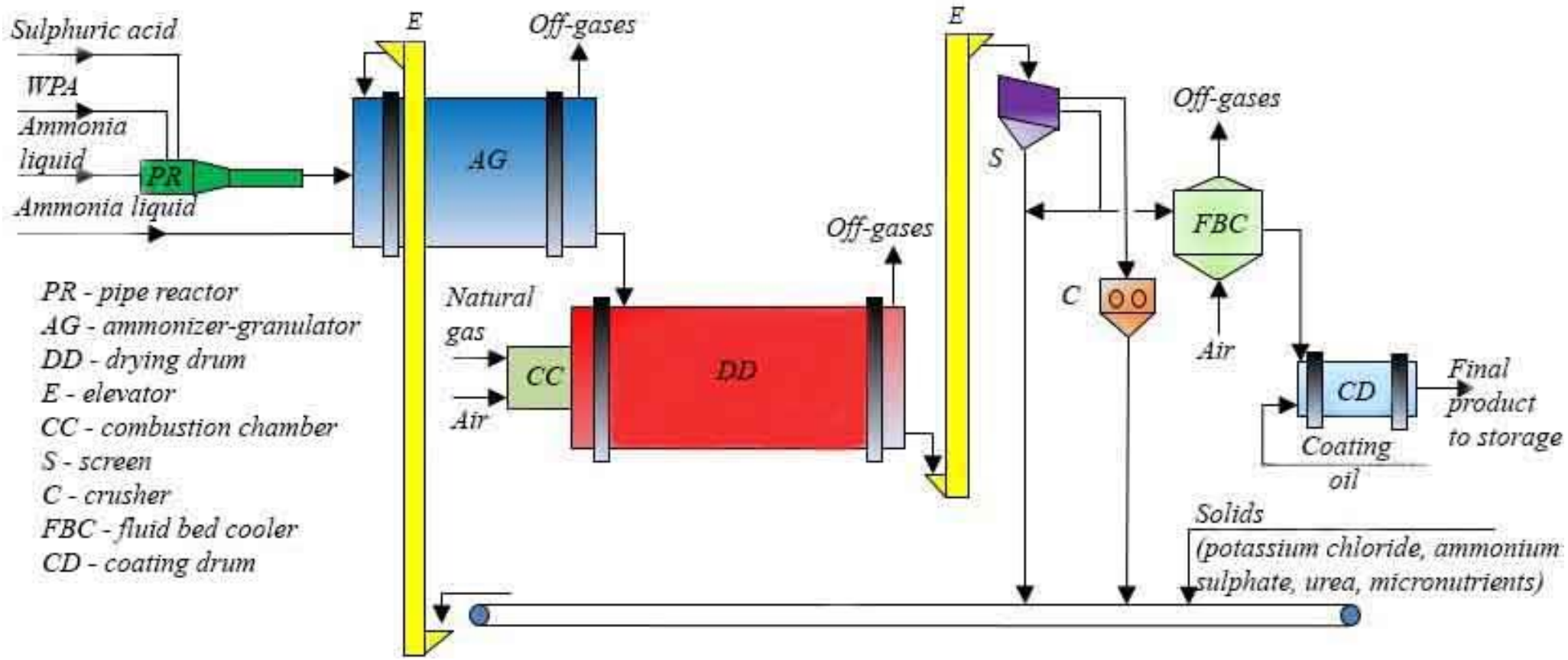


Extractor

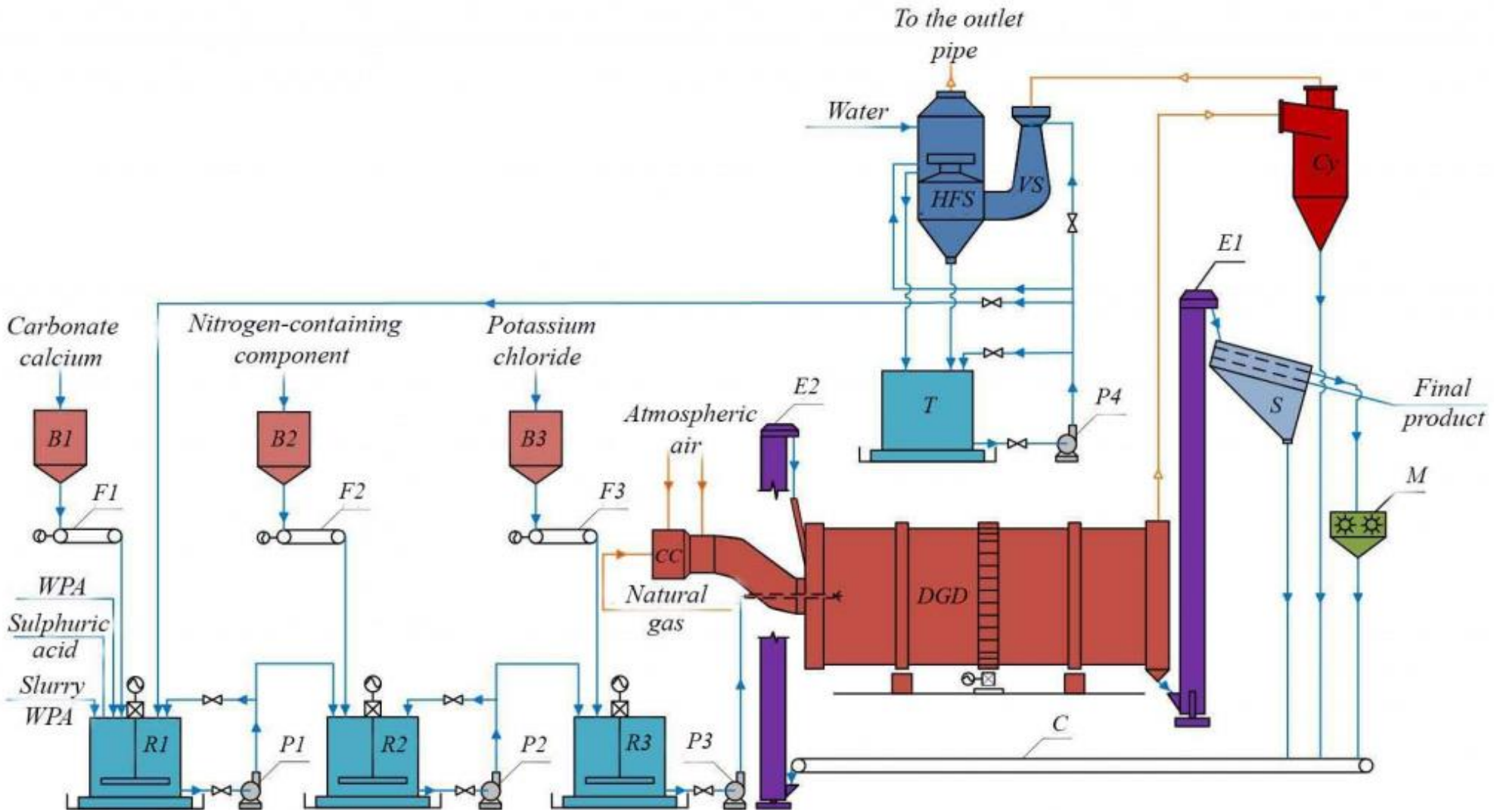
Phosphoric acid
52-54% P_2O_5



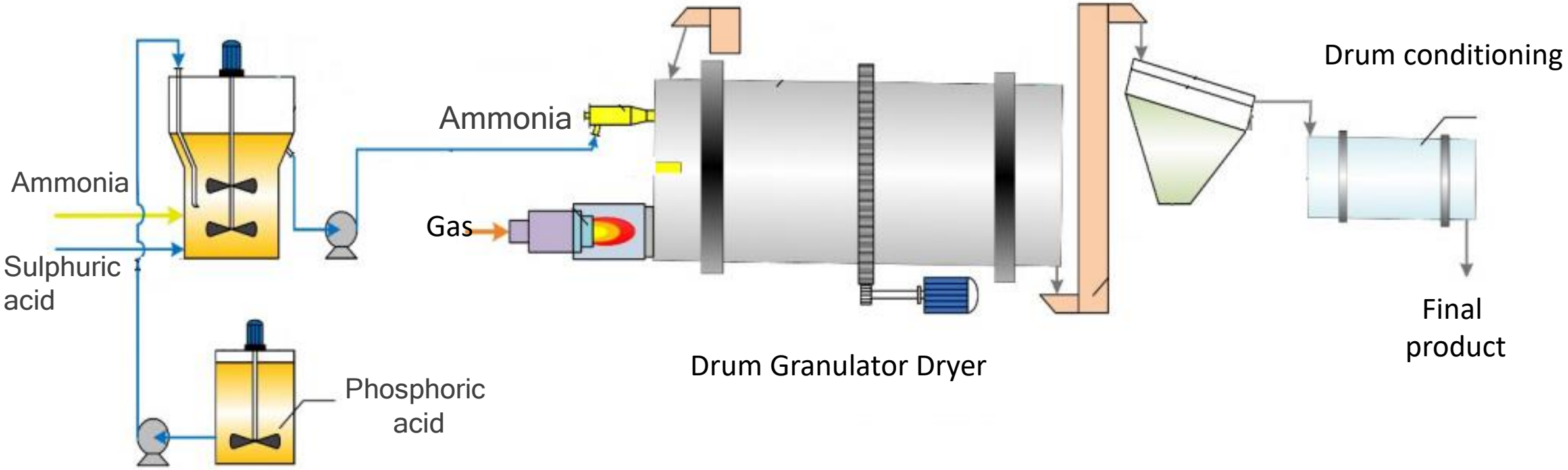
NPK production by Ammonizer-Granulator - Cherepovets



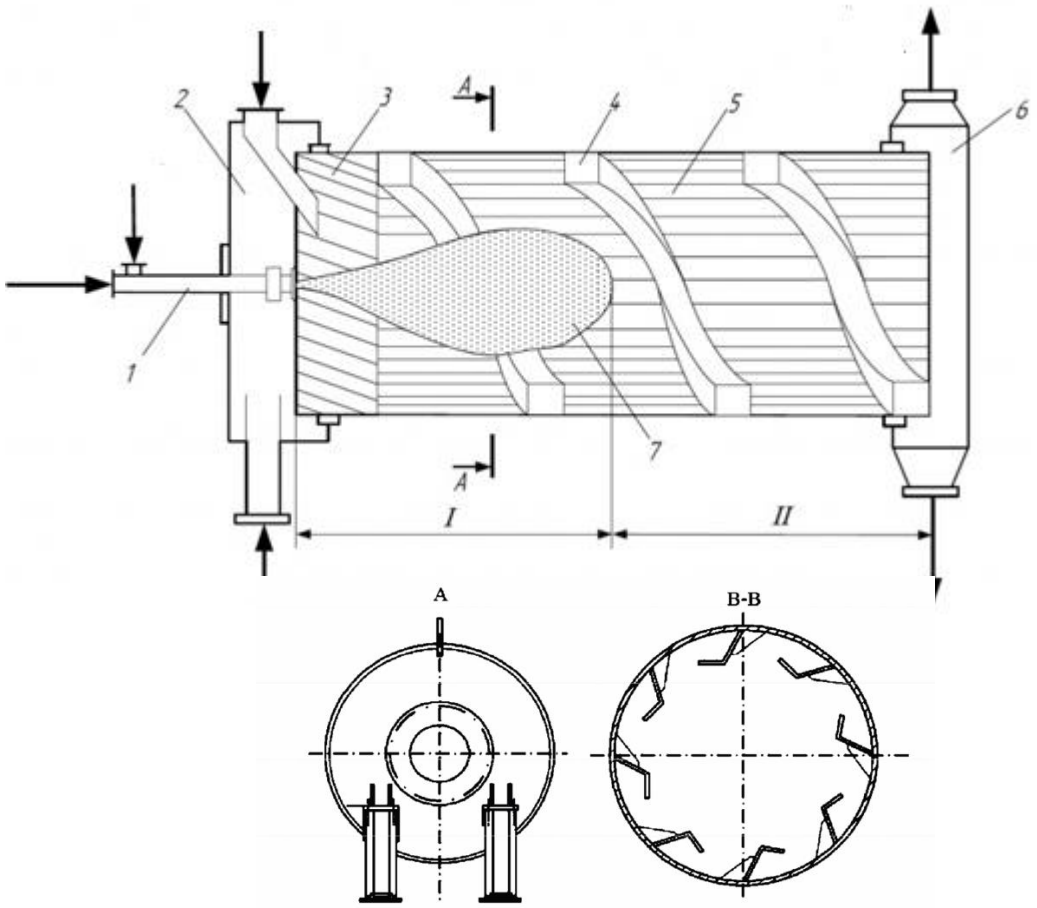
PK, NPK fertilizer production - Volkhov



Obtaining MAP / DAP fertilizers with one drum



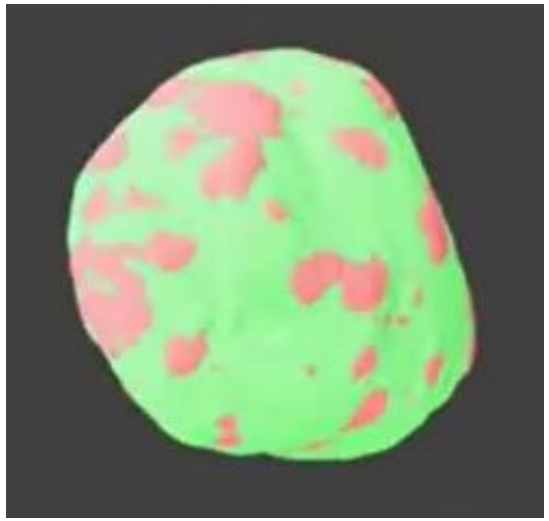
Fertilizer granulation

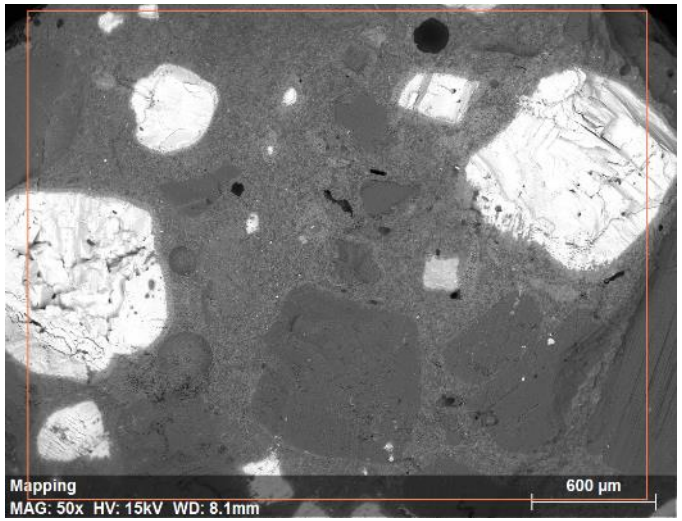


Drum Granulator Dryer

VIDEO FILE

Granule structure of NPK compound fertilizers

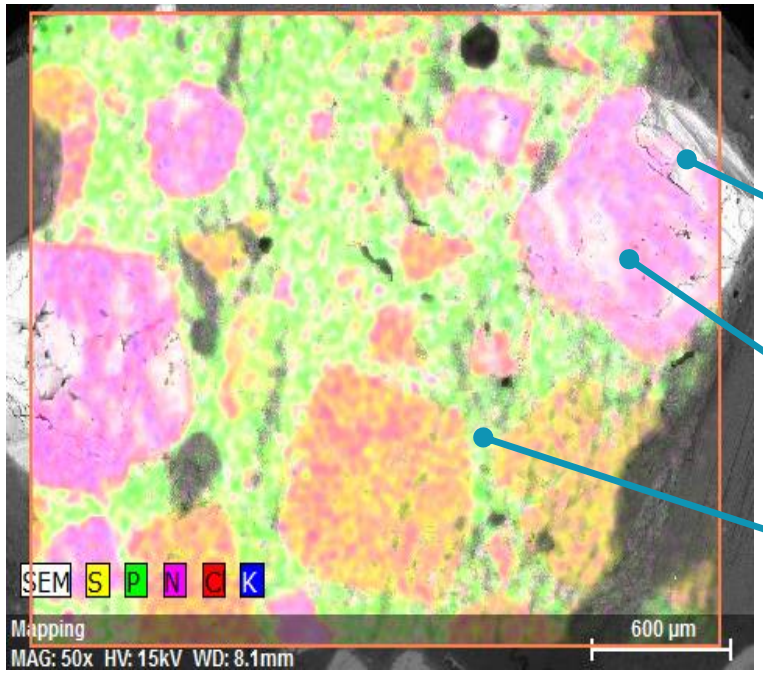




potassium chloride

ammonium phosphates

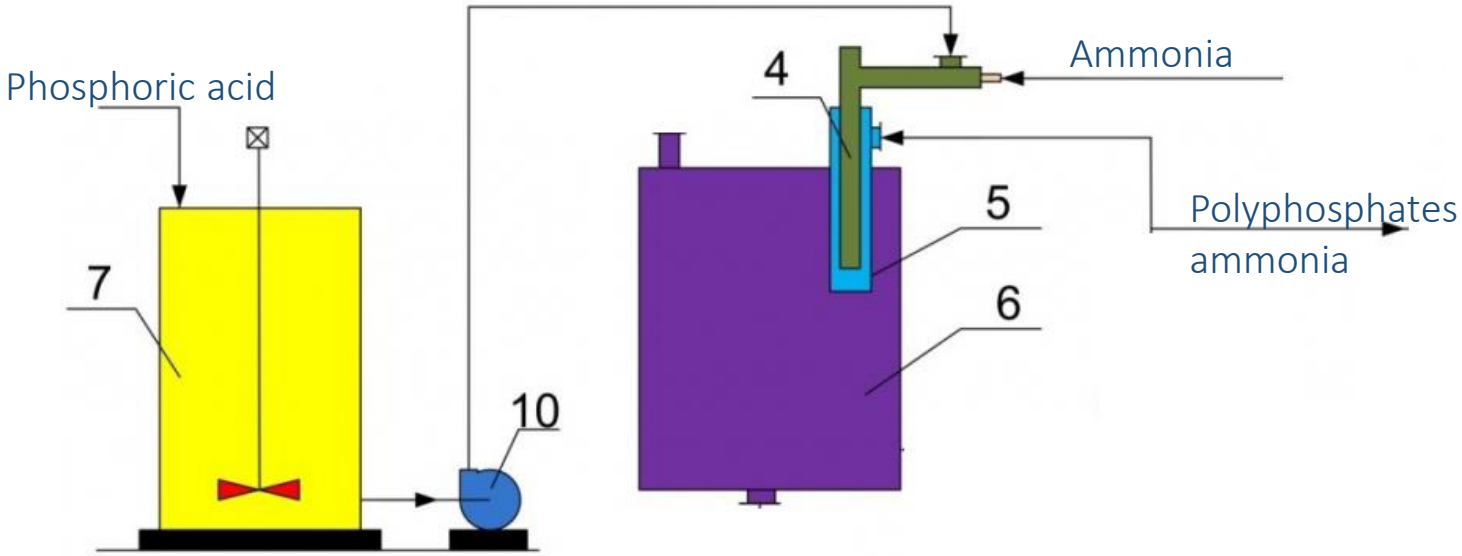
pores



Distribution of nutrients in a granule. Slice of NPK(S) 15-15-15(10)

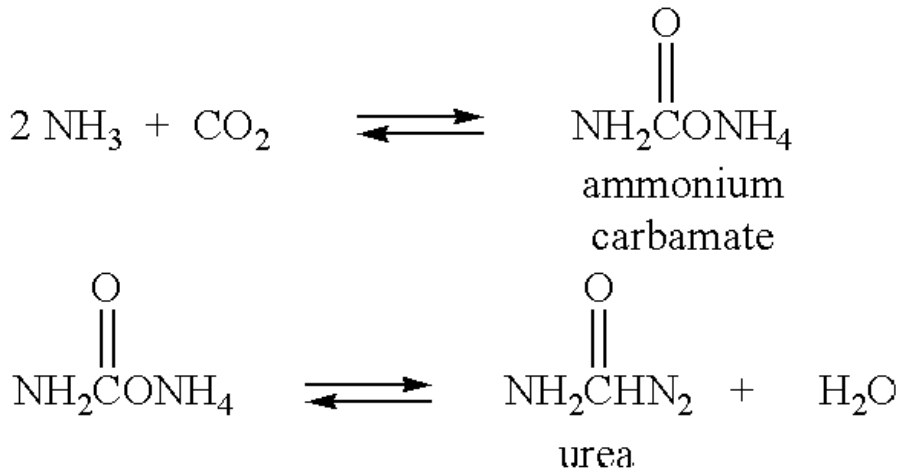
Source: NIUIF, photographs obtained by scanning electron microscopy with X-ray fluorescence microanalysis of the surface of granule chips, microscope HITACHI TM3030

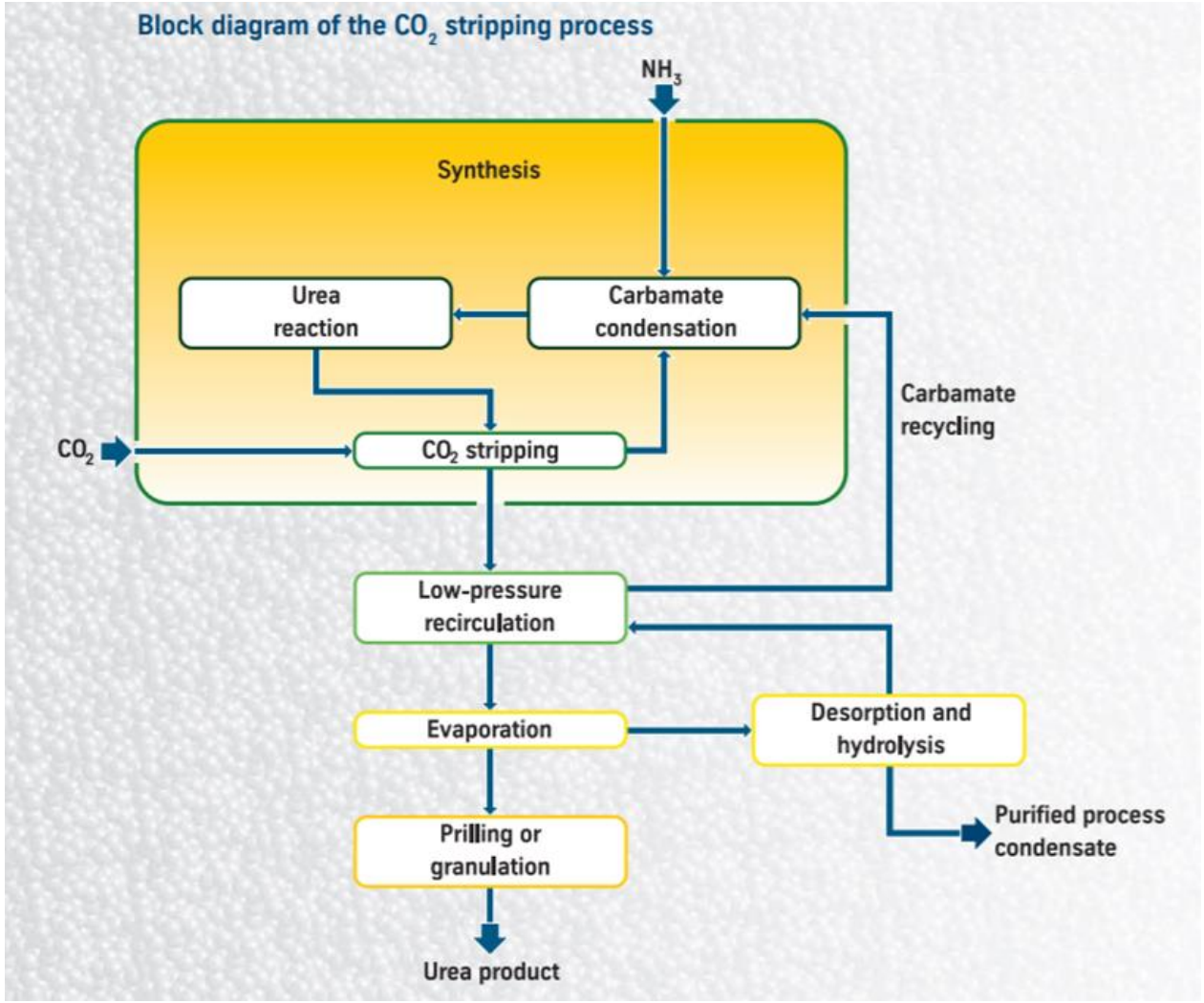
Liquid complex fertilizers



Urea

Urea is obtained by the reaction of ammonia with CO_2.
In this case, the first intermediate product is obtained - carbamate, which then decomposes into urea and water.
T 150-220 °C, P 20-30 MPa

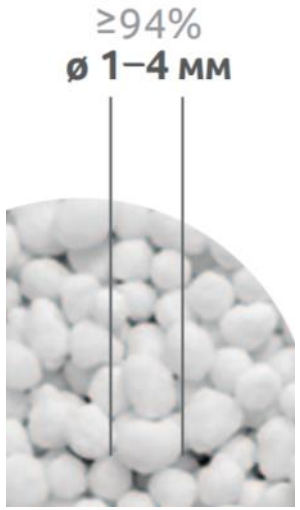


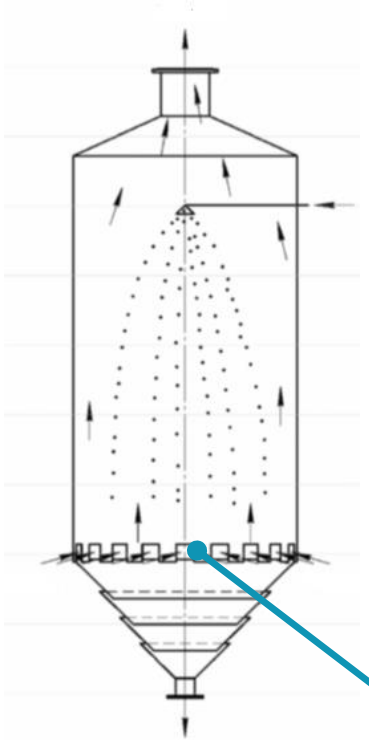


Source: Materials of ThyssenKrupp Industrial Solutions

The scheme for obtaining prilled urea from melt

Fluid bed of the tower

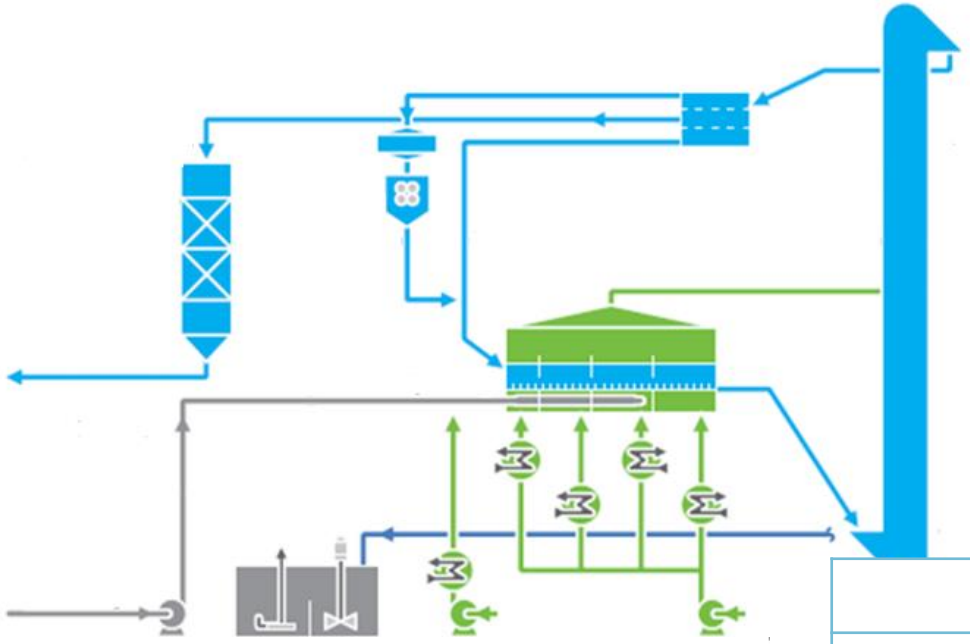


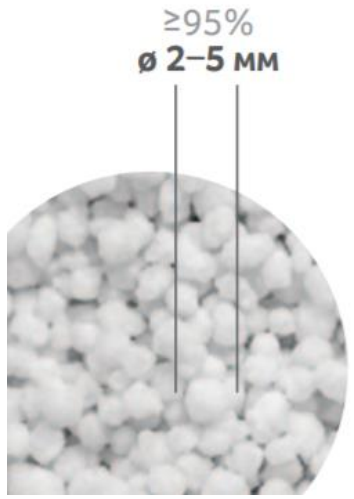


Installation of prilled urea,
Apatit JSC, Vologda Region

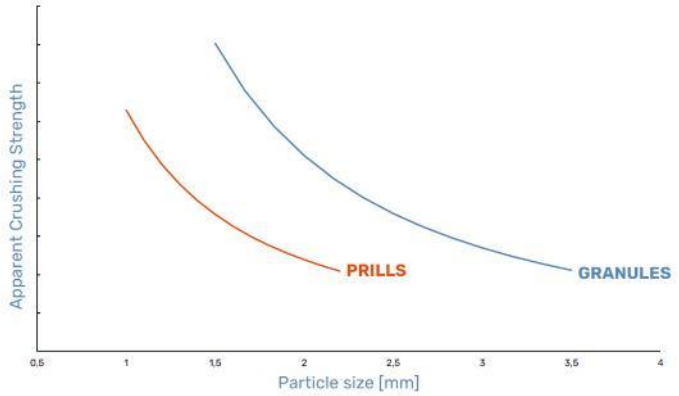
VIDEO FILE

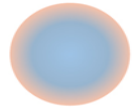
Granulated urea production - fluidized bed





Product info	
The total mass fraction of nitrogen in terms of dry matter, % - not less	46,0
Mass fraction of water by Fisher's method, %, no more	0.5
Static strength of granules, kg Force / granule, not less	2,5
Free flowing	
No harmful impurities	
Treated with anti-caking agent	



Prilla			Granule		
Stage 1	Formation of liquid droplets		Stage 1	A solid base has been formed	
Stage 2	Hardening shell prilla		Stage 2	The liquid melt layer is sprayed onto a solid base	
Stage 3	Hardened Prilla. A small cavity is formed in the center		Stage 3	Solid granule	

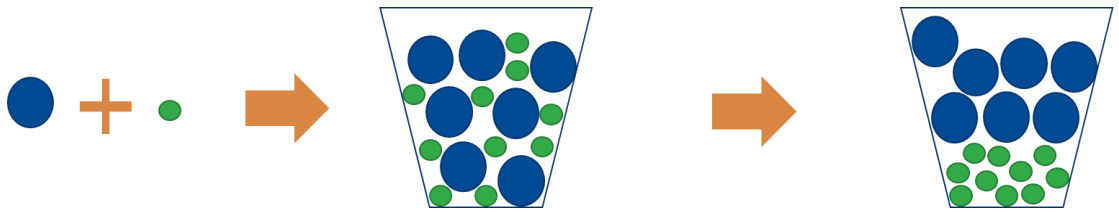
Source: Van 'T Land, C. M. *Industrial Crystallization of Melts*. Boca Raton : CRC Press, 2004.

Consumer characteristics of products and package

- Content of citrate soluble components
- Content of water soluble components
- Granule size
- Granule strength
- Caking
- Humidity
- Content of harmful impurities

Bulk Bigbag

Particle size distribution - granule segregation

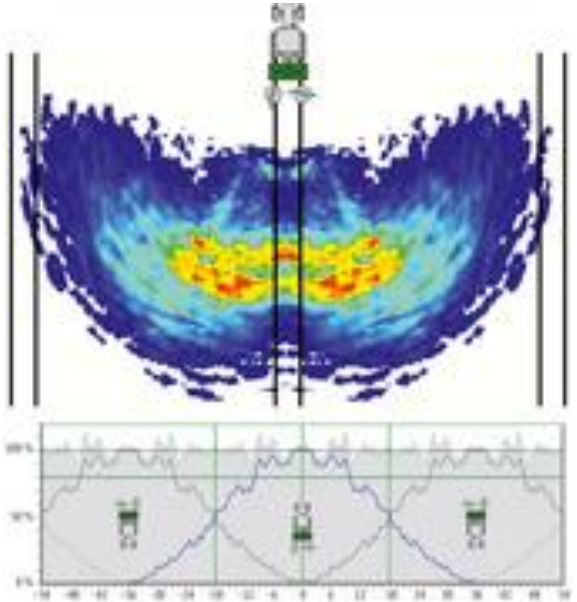


The size of fertilizer granules has the great importance in the preparation of fertilizer mixtures

Uniform distribution of granules

Uniform particle size distribution => uniform fertilization

Fertilizer distribution



Ballistic examination of fertilizers from AMAZONE

Granule strength. Caking

Static strength is the ultimate compressive strength of the granules.

Sources of decline in fertilizer quality:

- Lack of conditioning agent
- Improper shipping
- Transshipment
- Too long / improper storage
- Spreading discs

In case of improper storage, introduction of excessive moisture, the granules of the surface layer of the dump lose up to 50% of their strength, caked, lose color.

Useful links

Information on the properties and characteristics of PhosAgro products

Fertilizer production technologies (Scientific Research Institute for Fertilizers and Insectofungicides named after Professor Y. V. Samoilov)

Publications on types of fertilizers, yield management, development of an environmentally friendly food system (International Fertilizer Industry Association)

Notes on the use and properties of fertilizers (International Plant Nutrition Institute)

Conference proceedings InfoAG - the largest organizers of agricultural exhibitions in the USA

Battery removal calculator (International Plant Nutrition Institute)

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Thank you!