

CHALLENGES IN GRANULATION TECHNOLOGY

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CCUV4 - Green Deal strategies for V4 countries:

The needs and challenges to reach low-carbon industry.

The CCUV4 Working Meeting No.2 – 30.01.2023, Miskolc

The project is supported by The International Visegrad Fund, project ID22120032.



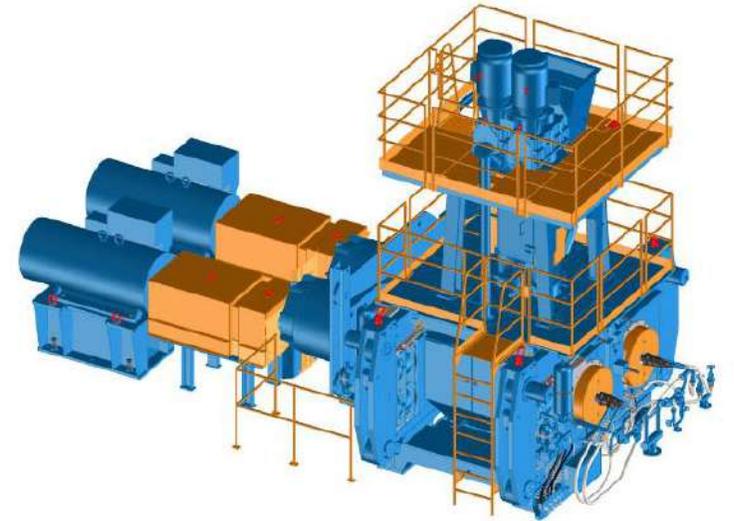
Particulate Materials Processes

- primary particulate material processes
 - agglomeration
 - disintegration
 - homogenization
- Secondary particulate material processes
 - storage
 - manipulation
 - transportation

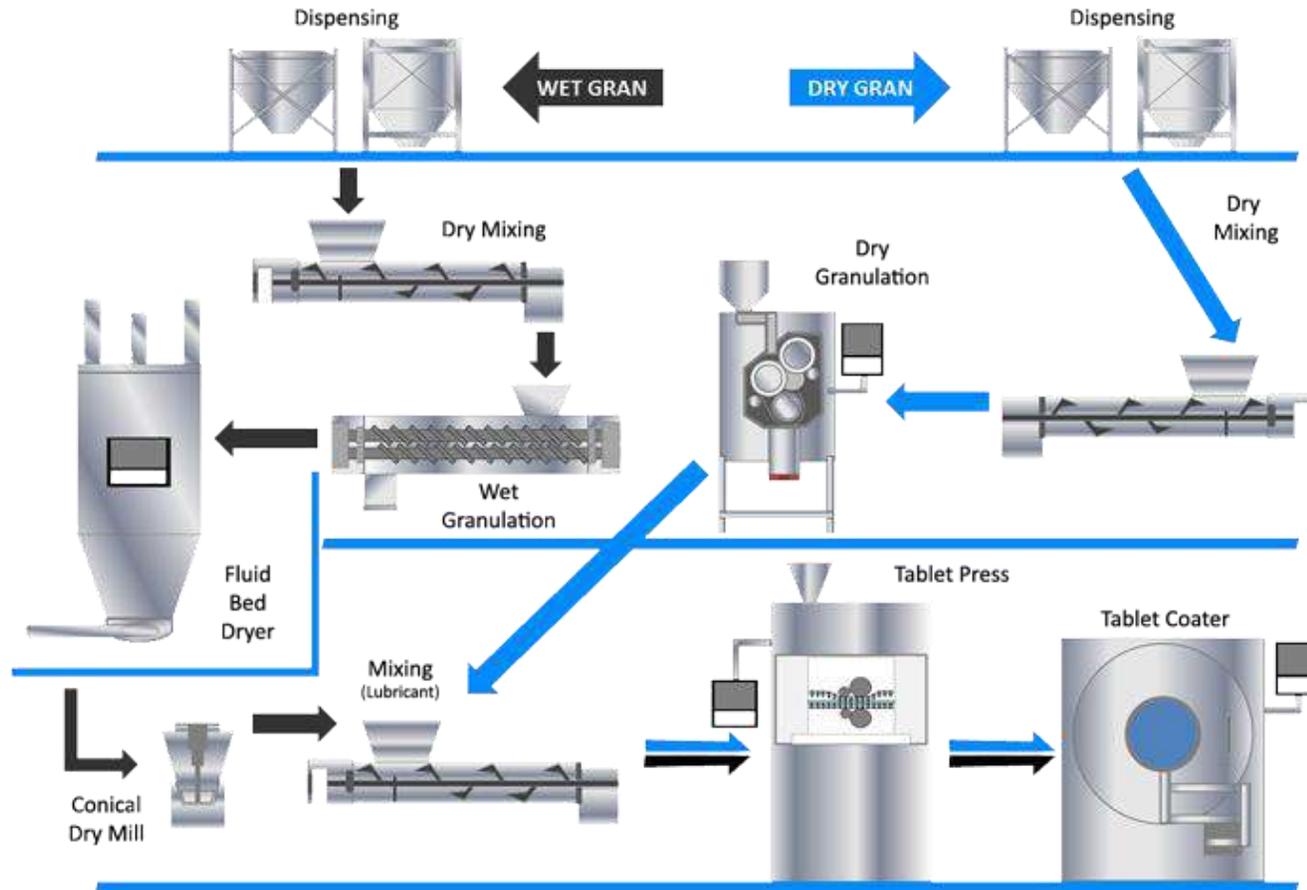


Agglomeration of Particulate Materials

- processing of dry powder materials
 - **tableting**
 - **compaction**
 - **granulation**
- processing of wet powder materials and pastes
 - extrusion
 - granulation



Tablet Manufacturing Process



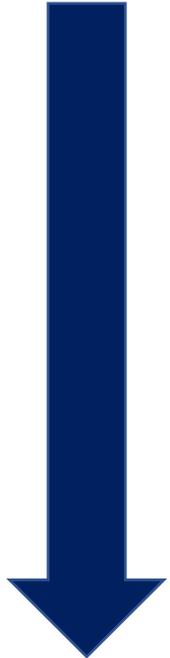
<http://www.pharmatips.in/Articles/Pharmaceutics/Tablet/Introduction-Of-Tablet-Manufacturing-Process.aspx>

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Granulation Technology

- **raw material**



- series of subsequent processes
- selection of key processes
- theoretical knowledge of key processes
- experimental measurements
- process calculation, equipment design, basic design, detail design
- economic and ecological sustainability (CO₂ reduction)
- application in industry

- **product**



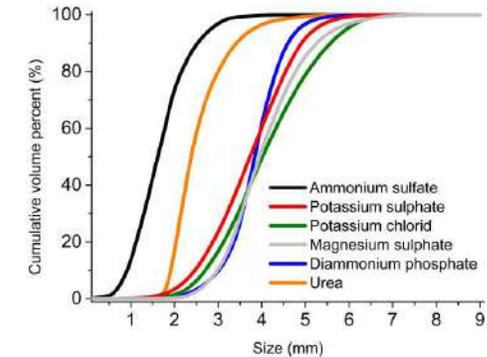
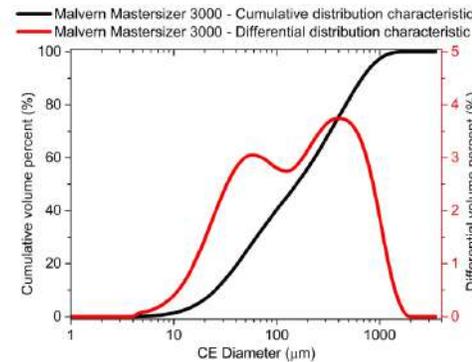
Technological Line for Processing Multicomponent Fertilizers

- raw material

- particulate materials (ammonium sulfate, potassium sulfate, potassium chlorid, magnesium sulfate, diammonium phosphate, urea, ...)



- milling



Peciar P. and col., Design of particulate material compactor rolls diameter, Acta Polytechnica, 2017. DOI:10.14311/AP.2017.57.0263.

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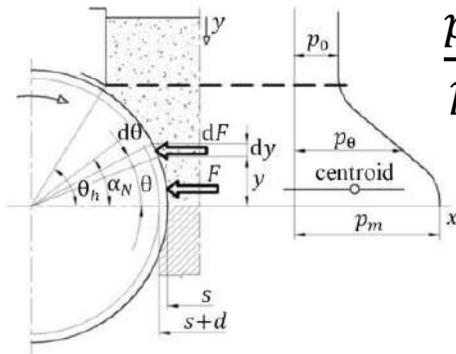
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Technological Line for Processing Multicomponent Fertilizers

- **compaction process**

- experimental measurements
- pressing force, pressing pressure, production performance
- calculations

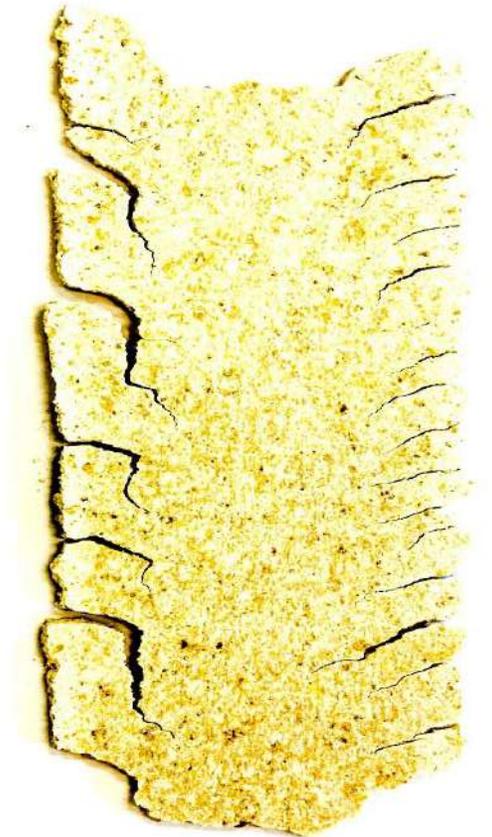


$$\frac{p_m}{p_0} = f(D)$$

$$D = \frac{(d + s) \left(\frac{p_m}{R_1 p_0} \frac{1 - \sin \delta}{1 + \sin \delta} \right)^{\frac{1}{K}} - d - s \cos \alpha_N}{(1 - \cos \alpha_N) \cos \alpha_N}$$

$$R_1 = e^{\left(\int_{\theta_h}^{\alpha_N} \frac{4 \left(\frac{\pi}{2} - \theta - \lambda \right) \tan \delta}{\left(1 + \frac{s}{D} - \cos \theta \right) \left(\cot \left(\frac{\pi}{2} + \theta + \lambda - \nu \right) - \cot \left(\frac{\pi}{2} + \theta + \lambda + \nu \right) \right)} \cos \theta \, d\theta \right)}$$

- energy aspect of the process



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Technological Line for Processing Multicomponent Fertilizers

- **granulation process**

- experimental measurements for different types of granulation
- proposal of a new method of granulation
- patenting in SK and WIPO
- energetic and ecological aspect of the process

- **sorting process**

- experimental measurements
- device design
- energetic and ecological aspect of the process



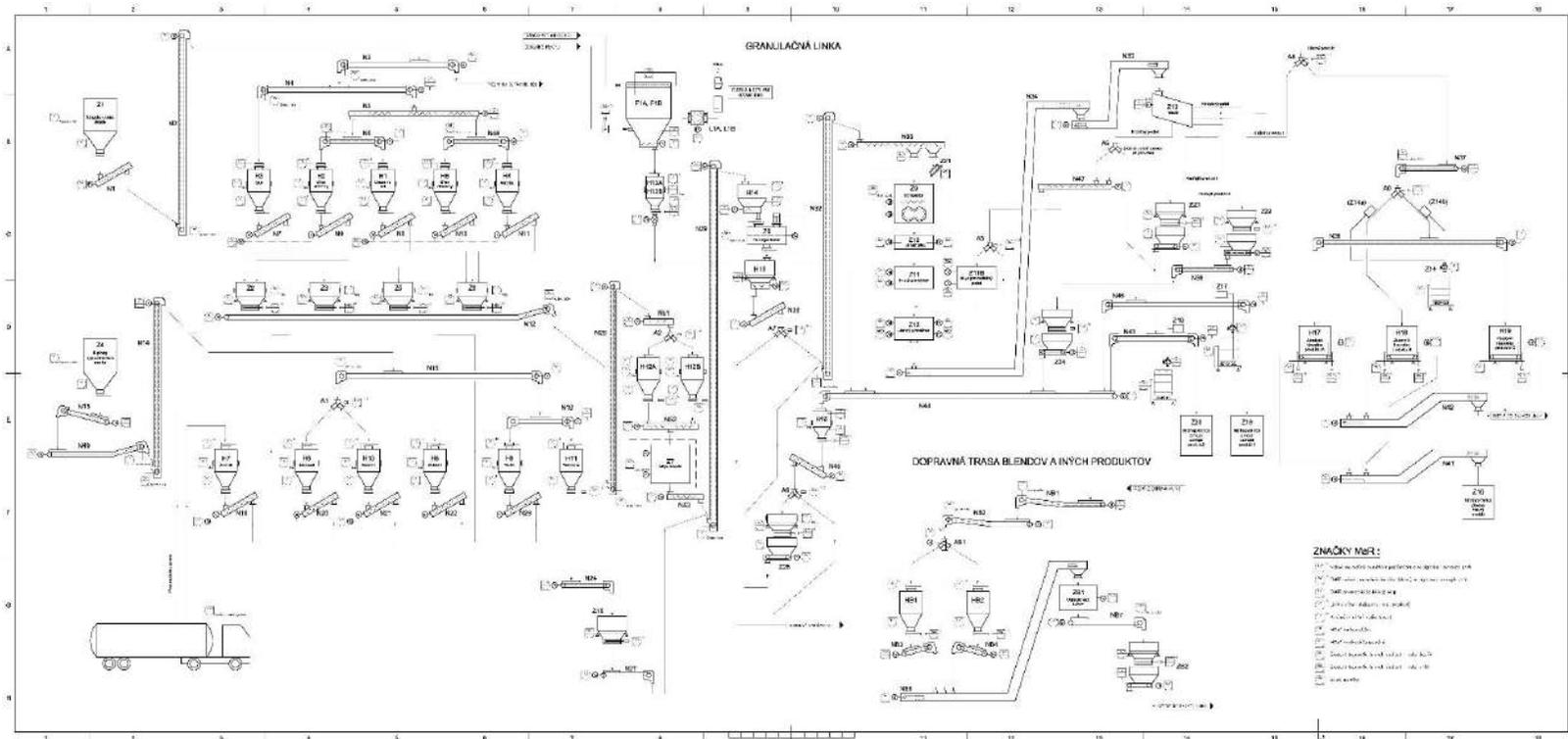
Technological Line for Processing Multicomponent Fertilizers

- **product**
 - granulate with precise fractional composition
 - verification of mechanical-physical properties
 - sample application in industry



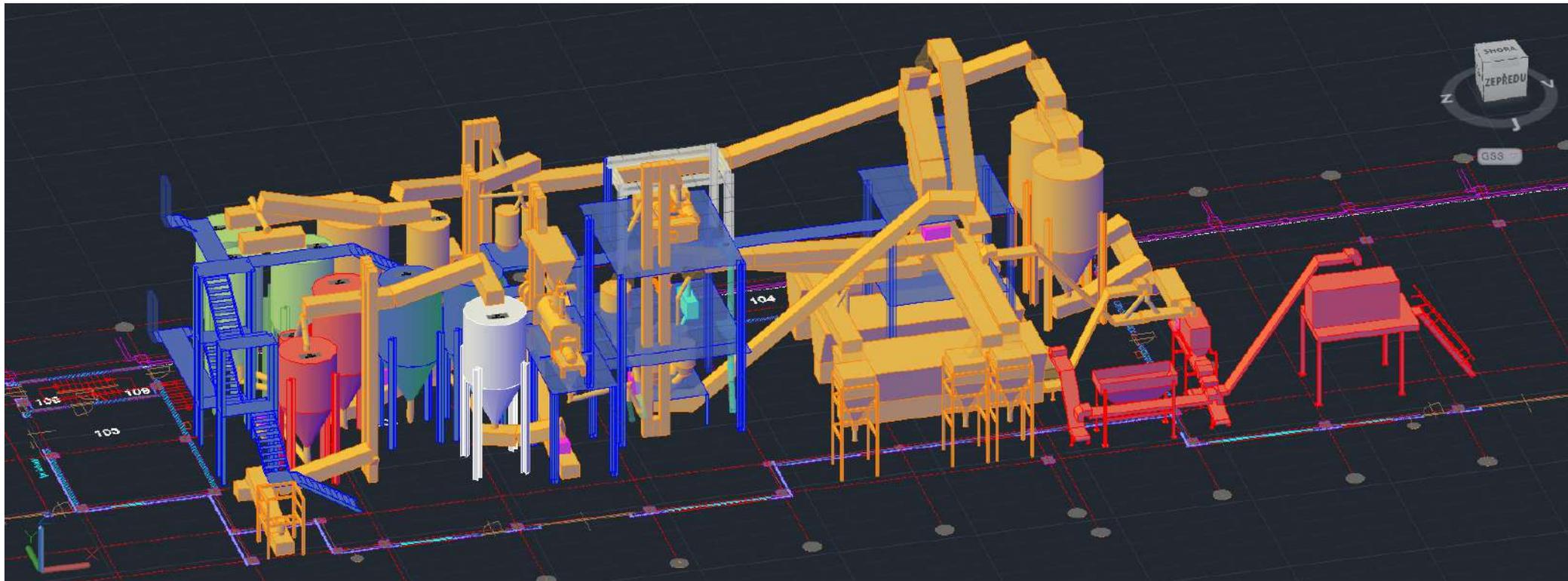
Technological Line for Processing Multicomponent Fertilizers

- process calculations, equipment design, basic design, detail design



Technological Line for Processing Multicomponent Fertilizers

- innovative approaches /3D modeling, virtual reality/



Technological Line for Processing Multicomponent Fertilizers

- **construction implementation process**

- 2016: the beginning of scientific research works
- 2016 – 2018: experimental and scientific research activities
- 2018 – 2020: design and construction of granulation line
- 2020: start-up, trial run
- 2020 – 2022: process optimization for selected recipes
- 2022: commercial production of fertilizers



Technological Line for Processing Multicomponent Fertilizers

- **important information**

- total investment over 7 million EUR
- realized unique technology in industrial practice
- economic aspect (saving at least 40 % of electricity compared to competing technologies)
- patented device - granulator with a flat matrix (product yield 40-50 %, other technologies on the market 10-13 %)
- ecological aspect, waste-free technology
- significant reduction of CO₂ production



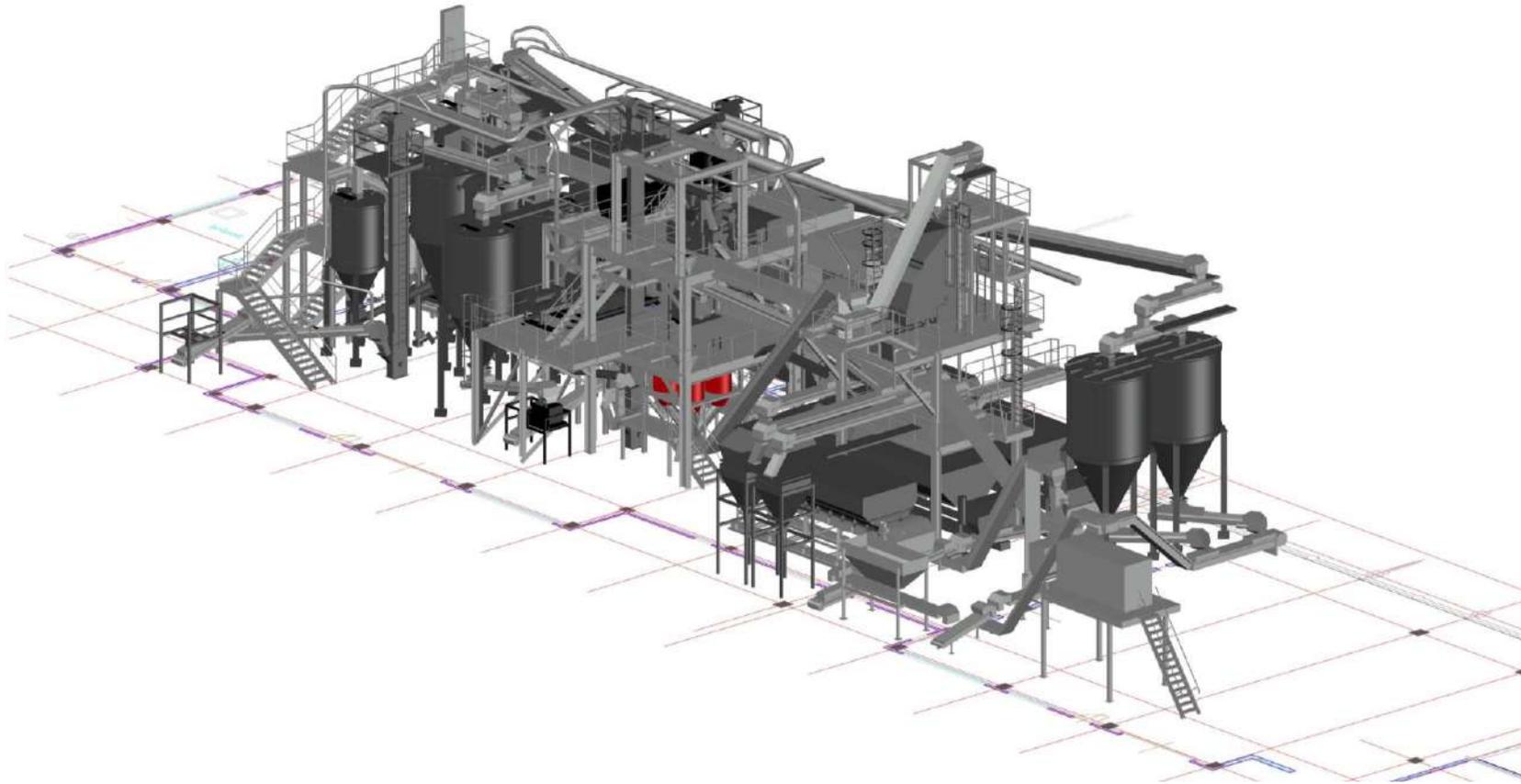
Technological Line for Processing Multicomponent Fertilizers

- **important information**

- awards associated with the technology developed: **Scientist of the year SR 2020, Scientist of the year STU 2020, Innovative act of the year 2020**
- **the first patent license sold at STU in history**



Technological Line for Processing Multicomponent Fertilizers



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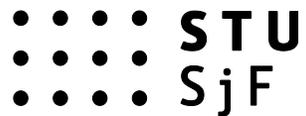




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Thank you for your attention



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