



Lodz University of Technology
Faculty of Process and Environmental Engineering

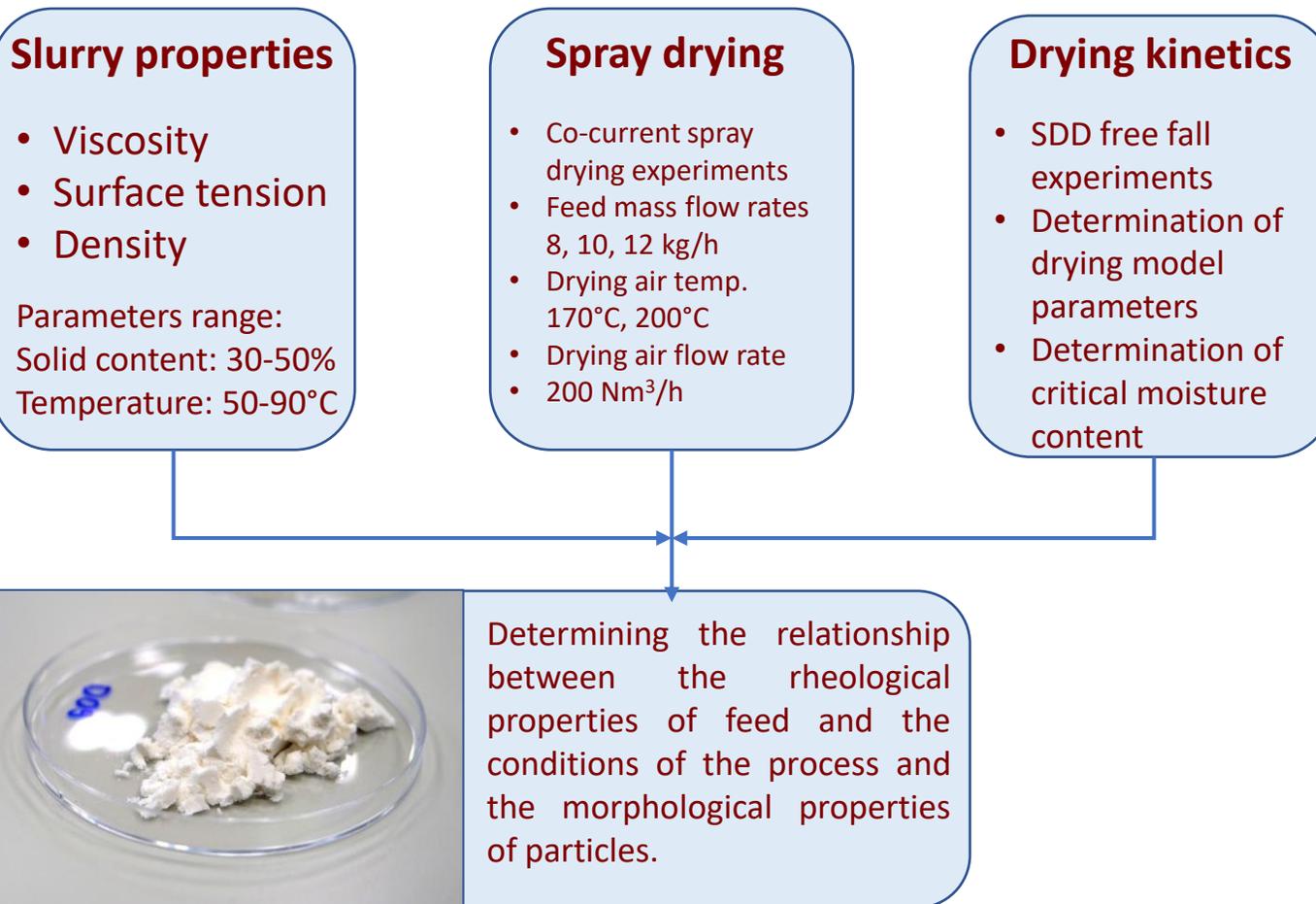


EFFECT OF FEED PROPERTIES AND LOCAL DRYING KINETIC ON PARTICLE MORPHOLOGY IN SPRAY DRYING

Maciej JASKULSKI, Weronika BAŁDYS, Marcin PIĄTKOWSKI

Artur LEWANDOWSKI, Michał KREMPSKI-SMEJDA

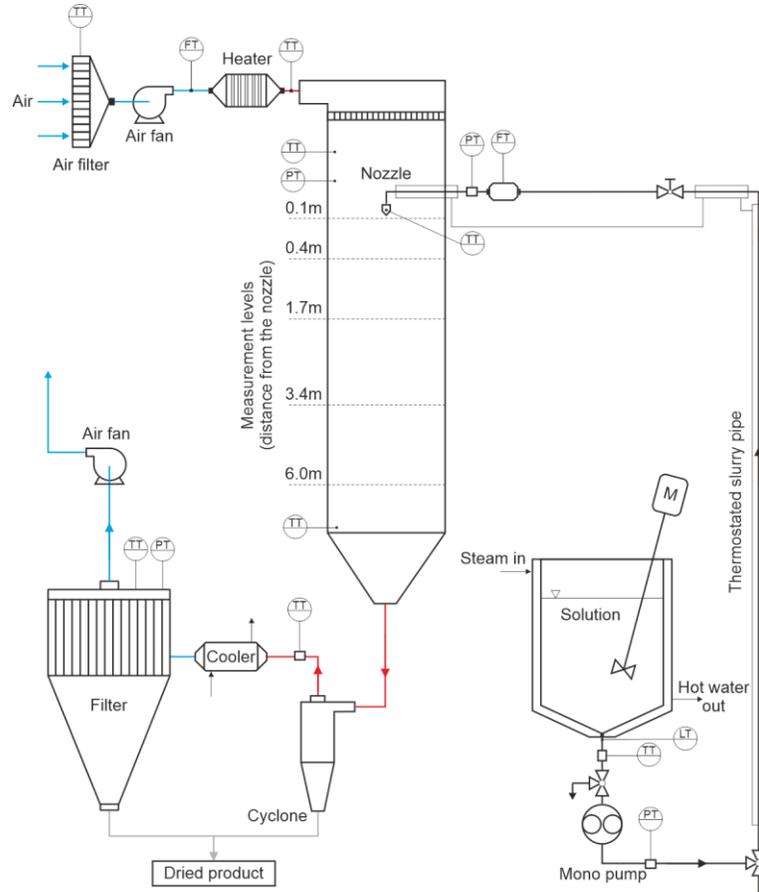
Aim of the project



Presentation plan

- **Aim of the project**
- Spray drying experiments
- Samples and results
- Thermostated chamber test
- IR camera selection
- Summary

Spray drying test installation



New heaters



Overview



Bottom



Cyclones



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Spray drying test installation- control and data acquisition system



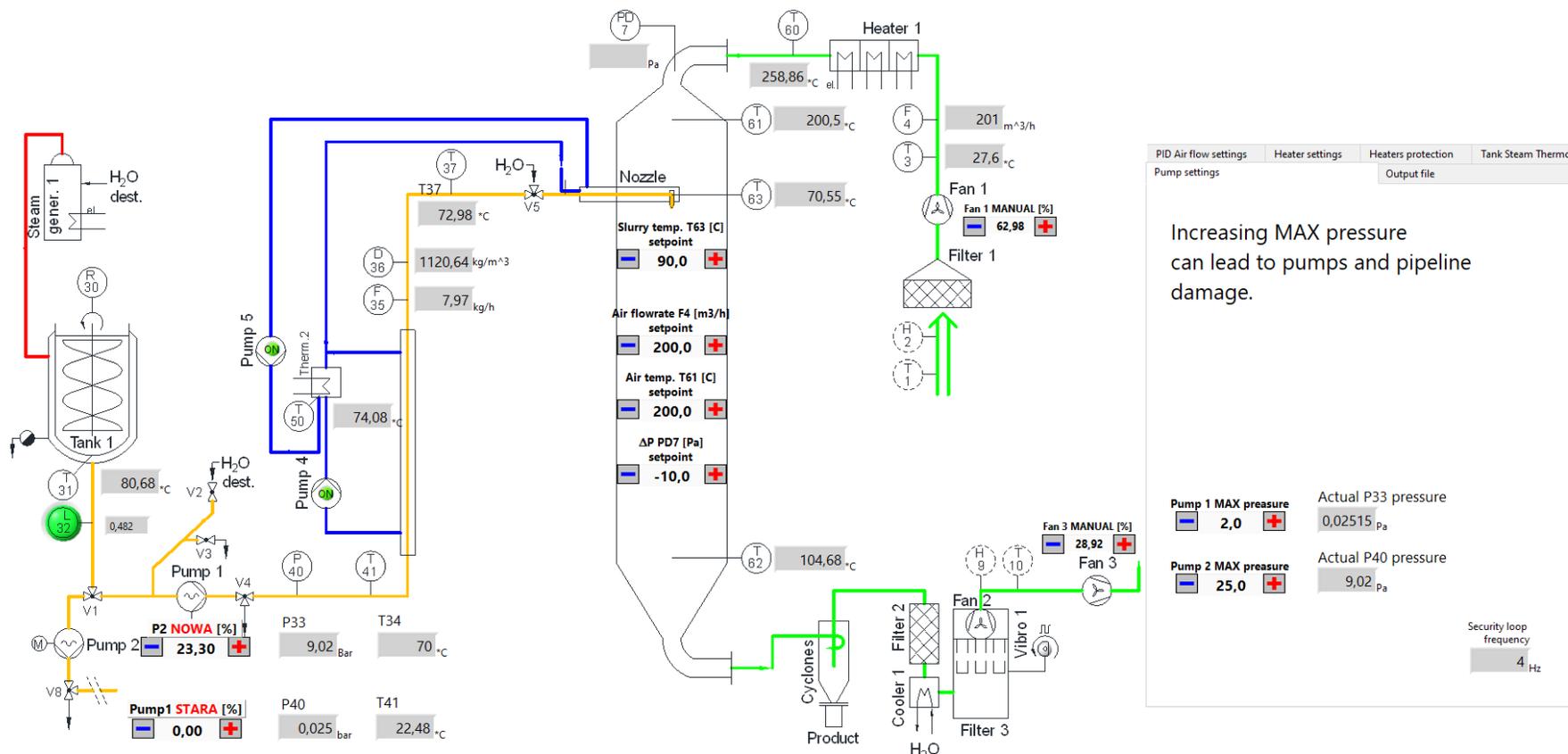
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Spray drying test installation- control and data acquisition system

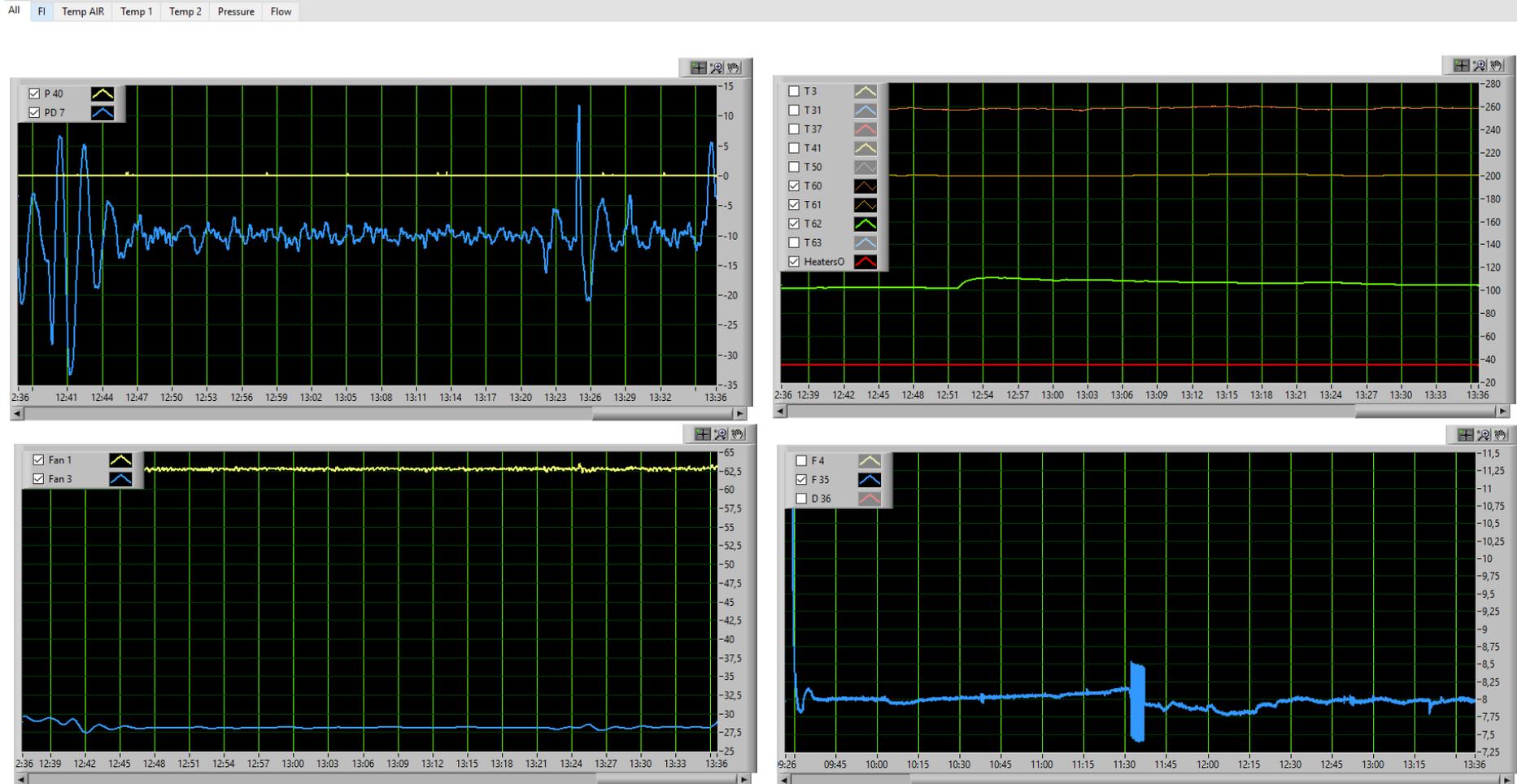
Main panel Figures Plant Parameters



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Spray drying test installation- control and data acquisition system



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Spray drying tests- experiments plan

Air side:

- Air flow rate 200 Nm³/h
- Air temperature 170°C and 200°C
- Initial humidity ≈ 8 g/kg

Feed side:

- Initial solid concentration: 30, 34, 40, 45 and 50%
- Initial feed temperature: 30, 50, 70 and 90°C
- Feed flow rate 8, 10 and 12 kg/h
- Nozzle type: one fluid pressure nozzle, hollow con, type fine with 1mm outflow diameter

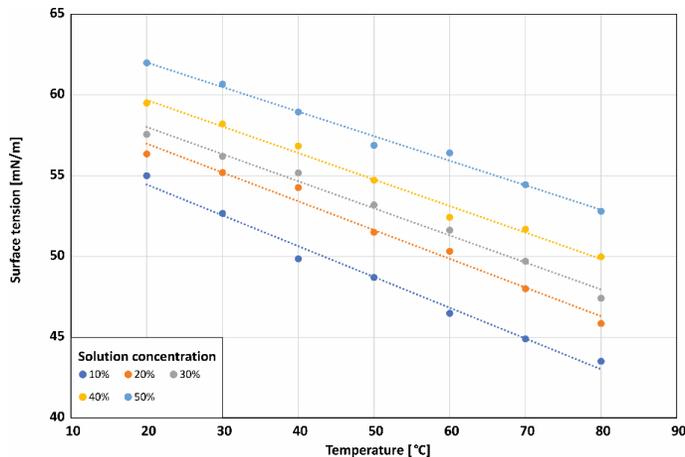
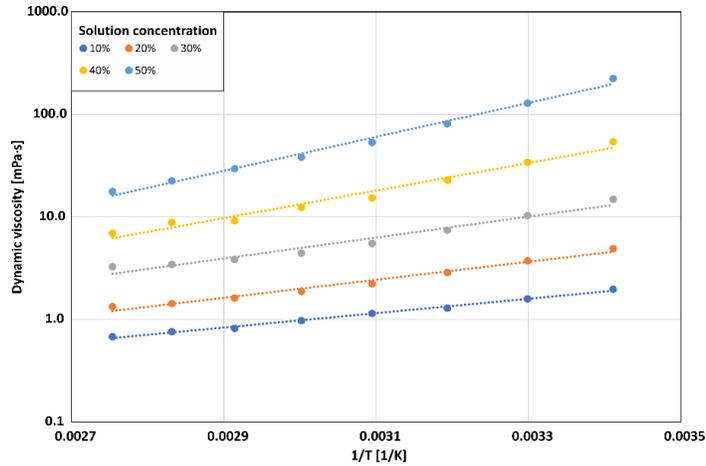
Additional experiments:

- Air flow rate 200 Nm³/h
- Air temperature 200°C
- Initial solid concentration: 50%
- Feed flow rate 14 and 16 kg/h

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Wrong atomization



Nozzle operation change : 50% initial concentration of MDX
flow rate 12 kg/h, pressure ~ 21bar, temperature difference 10°

Causes of poor spraying:

- Too low pressure at the nozzle.
- Too high viscosity.

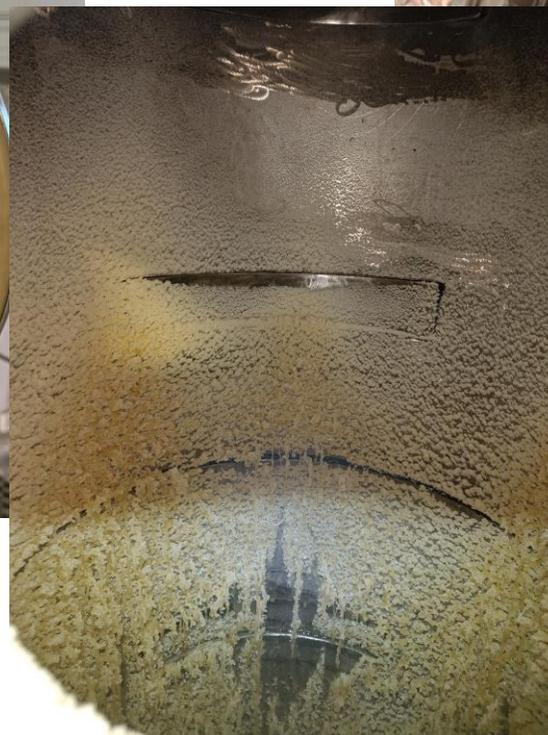
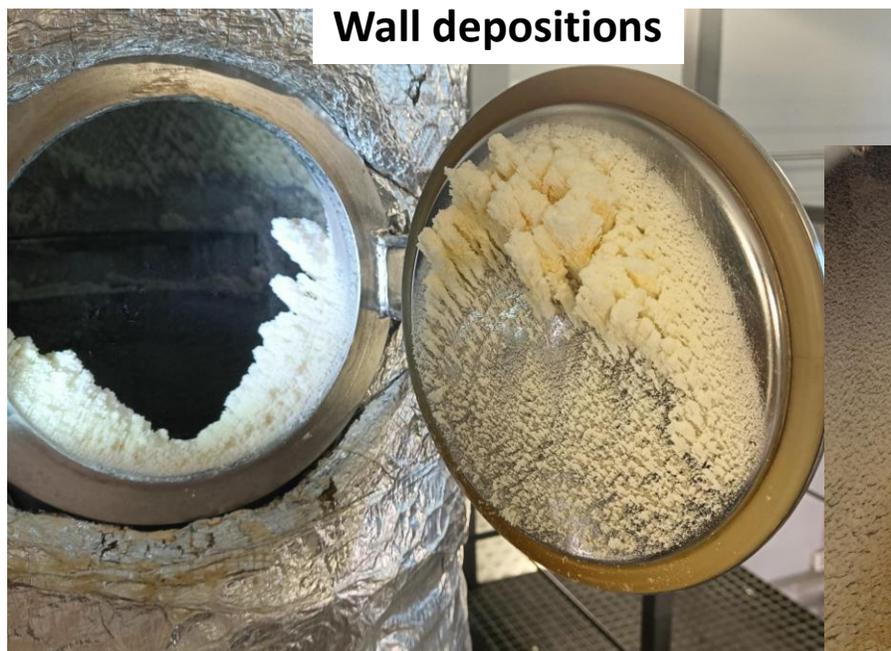
Other causes of poor column operation:

- Too low temperature at the dryer outlet - Powder concentration in the outlet channels.

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The result of a failed experiment



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Experimental plan completed

Feed rate 8 kg/h Inlet air temp. 170°C		Feed temperature, °C			
		30	50	70	90
Feed concentration wt. %	30				
	35				
	40				
	45				
	50				

Feed rate 10 kg/h Inlet air temp. 170°C		Feed temperature, °C			
		30	50	70	90
Feed concentration wt. %	30				
	35				
	40				
	45				
	50				

Feed rate 12 kg/h Inlet air temp. 170°C		Feed temperature, °C			
		30	50	70	90
Feed concentration wt. %	30				
	35				
	40				
	45				
	50				

Feed rate 8 kg/h Inlet air temp. 200°C		Feed temperature, °C			
		30	50	70	90
Feed concentration wt. %	30				
	35				
	40				
	45				
	50				

Feed rate 10 kg/h Inlet air temp. 200°C		Feed temperature, °C			
		30	50	70	90
Feed concentration wt. %	30				
	35				
	40				
	45				
	50				

Feed rate 12 kg/h Inlet air temp. 200°C		Feed temperature, °C			
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Collected samples for analysis



Collected from each experiment:

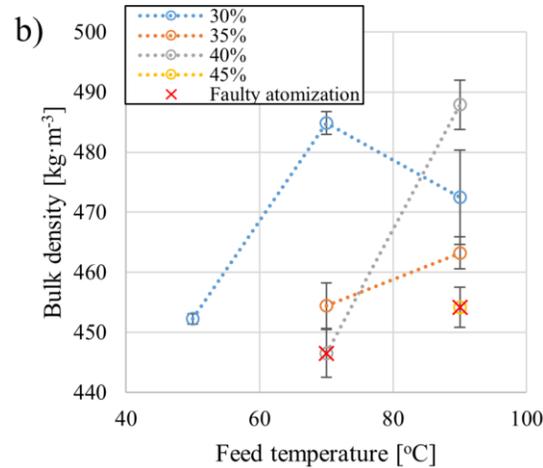
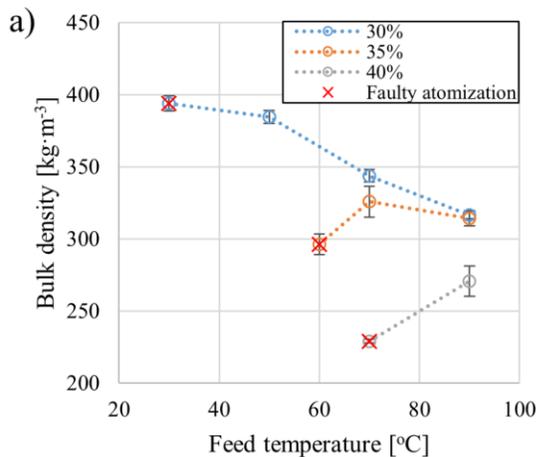
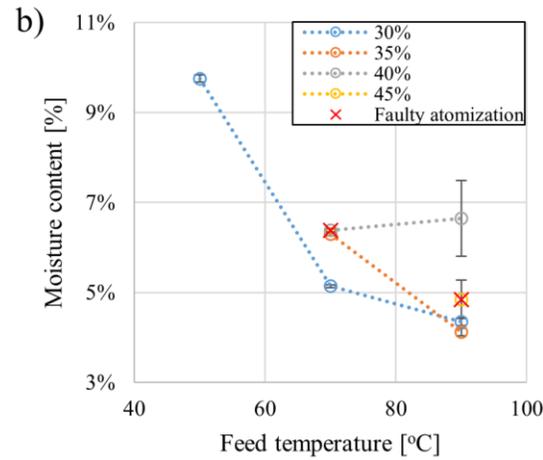
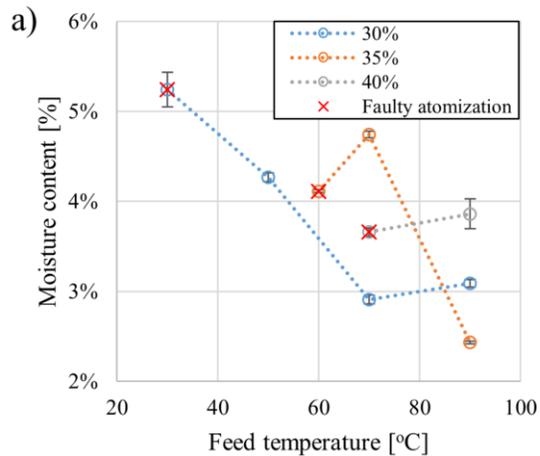
- three jars with a capacity of 3l - each jar was sealed and written on. Each sample has its own individual number corresponding to the process conditions

- two diabetes insipidus for microscopic analysis

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First results



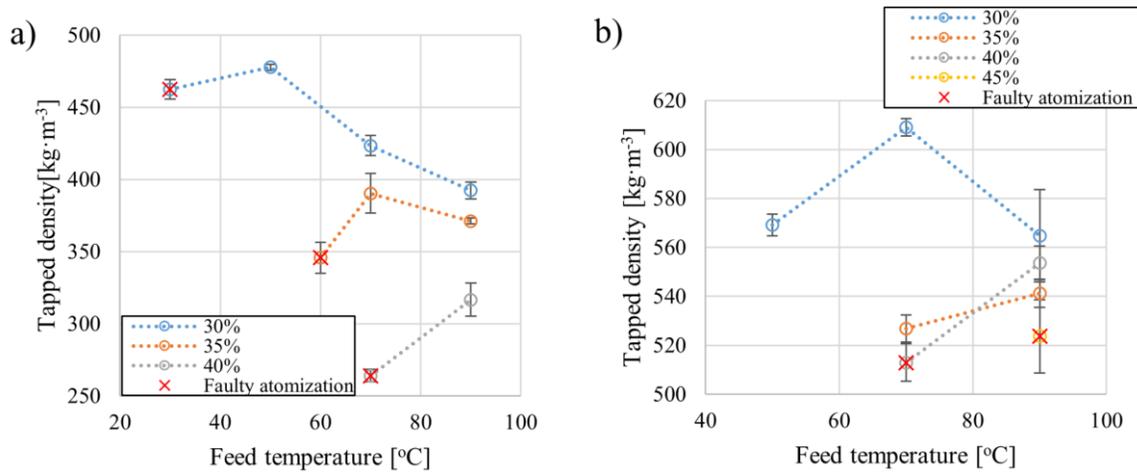
The **moisture content** of the samples was determined by the dryer weight method. The samples were dried at 105°C until their weight stabilised (about 3 h). Each measurement was repeated three times and then averaged.

The **bulk density** was determined by placing the powder in a 250 cm³ measuring cylinder and then weighing the contents of the cylinder. Each measurement was repeated three times and then averaged.

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First results



Tamped density was determined by placing the powder in a 250 cm³ measuring cylinder and then weighing the contents of the cylinder.

The contents of the cylinder were tamped by striking the cylinder 100 times on the ground from a height of about 15 mm and then measuring the volume occupied. Each measurement was repeated three times and then averaged.

Analyzes made in the near future:

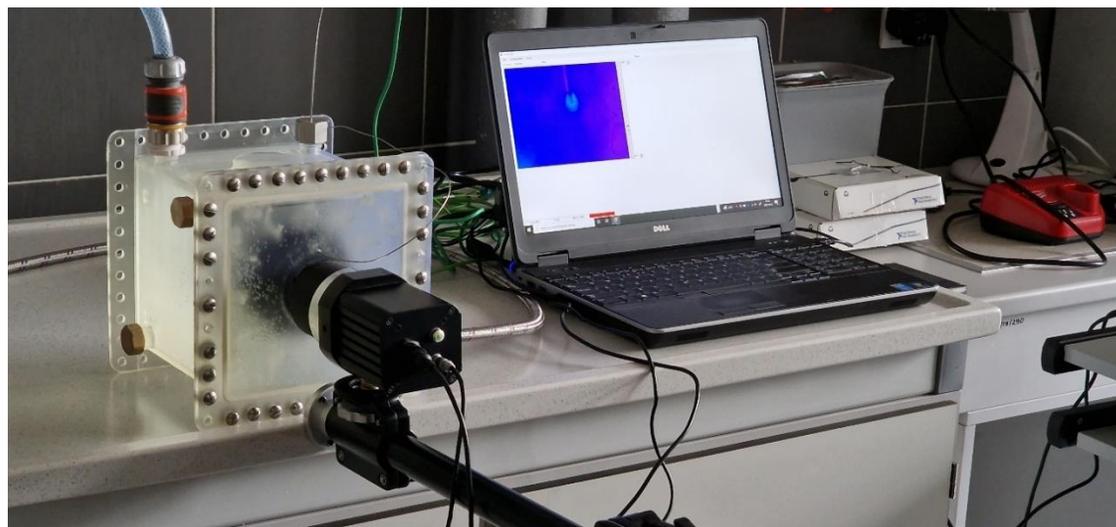
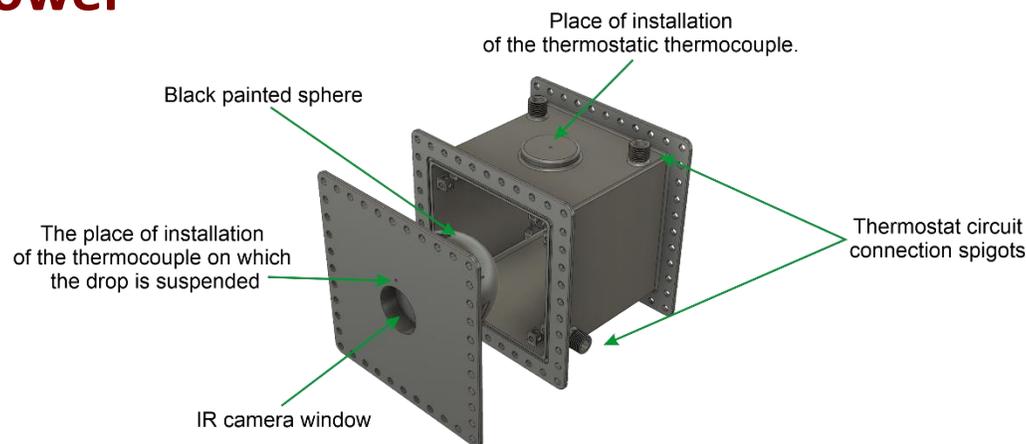
- Porosity of the bed and of a single particle,
- Diameter distributions and corresponding Rosin-Rammler distribution curves,
- Sorption isotherms,
- Images from an optical microscope,
- Images from an electron microscope (SEM),

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SDD free fall drying tower

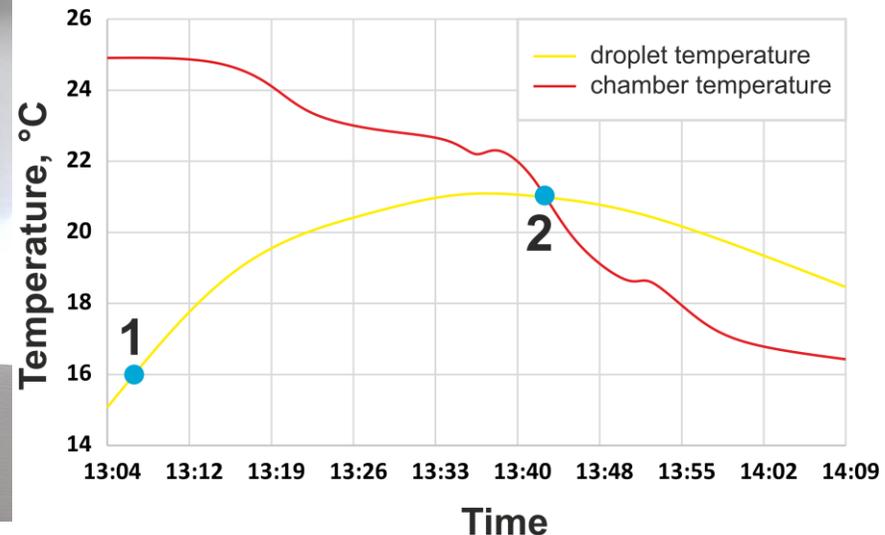
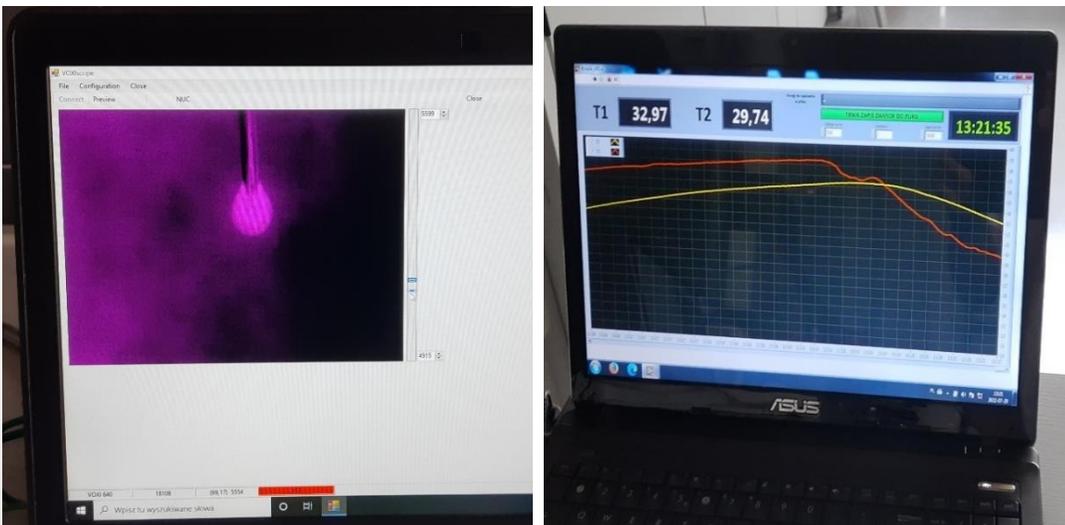
In search of a non-contact method to measure the temperature of a falling particle without knowledge of its emissivity.



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Thermostated chamber test



Measuring point No. 1:

- actual drop temperature = 16.00°C,
- drop temperature according to IR camera = 16.89°C
- Error = 5.5%

Measuring point No. 2:

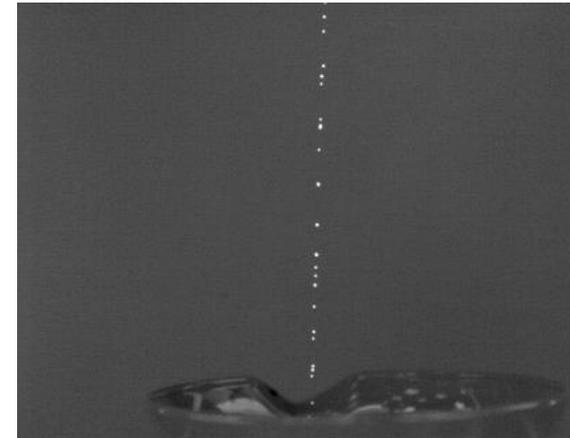
- actual drop temperature = 21.32°C,
- drop temperature according to IR camera = 21.36°C
- Error = 0.18%

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Thermostated chamber test

We tested two cameras: a FLIR A6753 SLS camera with a reading speed of 125 Hz at a resolution of 640x512 pixels, and a FLIR X6901sc SLS camera that was able to capture the object at 1004 Hz at the same resolution.



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Topic	Status
	1st year
1. Adaptation of the existing equipment to the project requirements.	Done
2. Selection of suitable experimental media and determination of quality criteria.	Done
3. Measurements of rheological properties of aqueous solutions of selected materials.	Done
4. Design of particle free fall SDD measurement system;	In progress- We check the technical possibilities and the availability of equipment
	2nd year
1. Carrying out experimental drying processes and analysis of powder morphology obtained from different slurries and process parameters:	Done
- Identification of the effect of feed properties, feed rate, air flow rate, drying temperature on powder morphology;	In progress- The analysis of the collected powders will take about 4-5 months
- Specification of mathematical relationships describing the drying and powder properties;	In progress- we need morphology data- moved to 3rd year
2. Experimental determination of critical moisture content of dried materials.	In progress- SDD tower is under construction
3. Construction and test of free fall drying kinetic determination system.	

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IFPRI
International Fine Particle Research Institute



Thank you for your attention