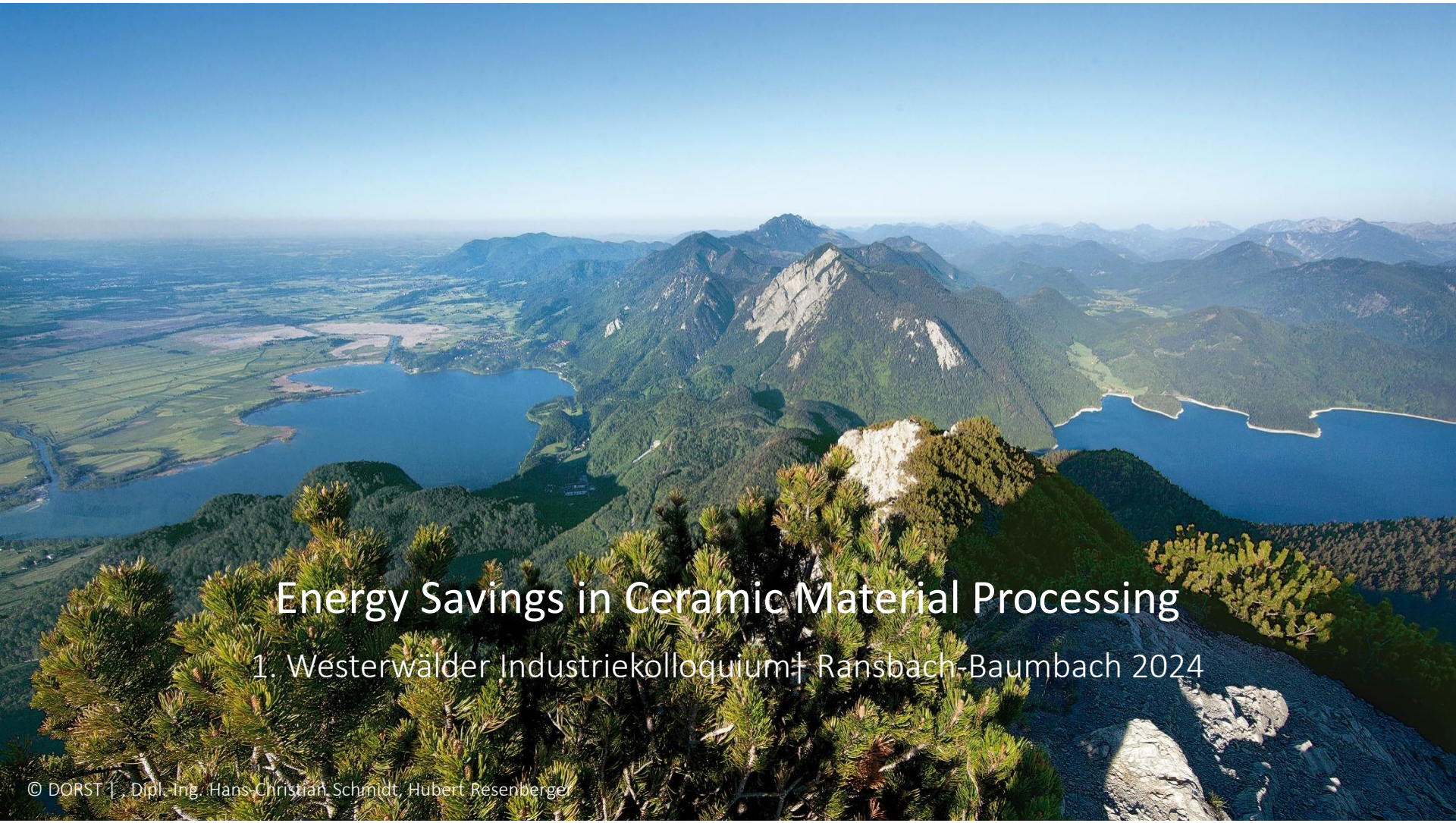

Energy Savings in Ceramic Material Processing

1. Westerwälder Industriekolloquium | Ransbach-Baumbach 2024

A HIDDEN CHAMPION IN POWDER SHAPING TECHNOLOGIES & PROCESSES

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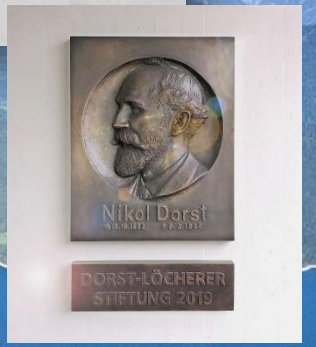


- UNI-AXIAL PRESSING
- ISOSTATIC PRESSING
- PRESSURE CASTING
- VACUUM EXTRUSION
- MAGNETIC FIELD PRESSING
- AUTOMATION
- SPRAY DRYING
- TOOLS & MOLDS
- ENGINEERING
- TECHNOLOGY CENTRE

Technical Ceramics
Magnetic Materials

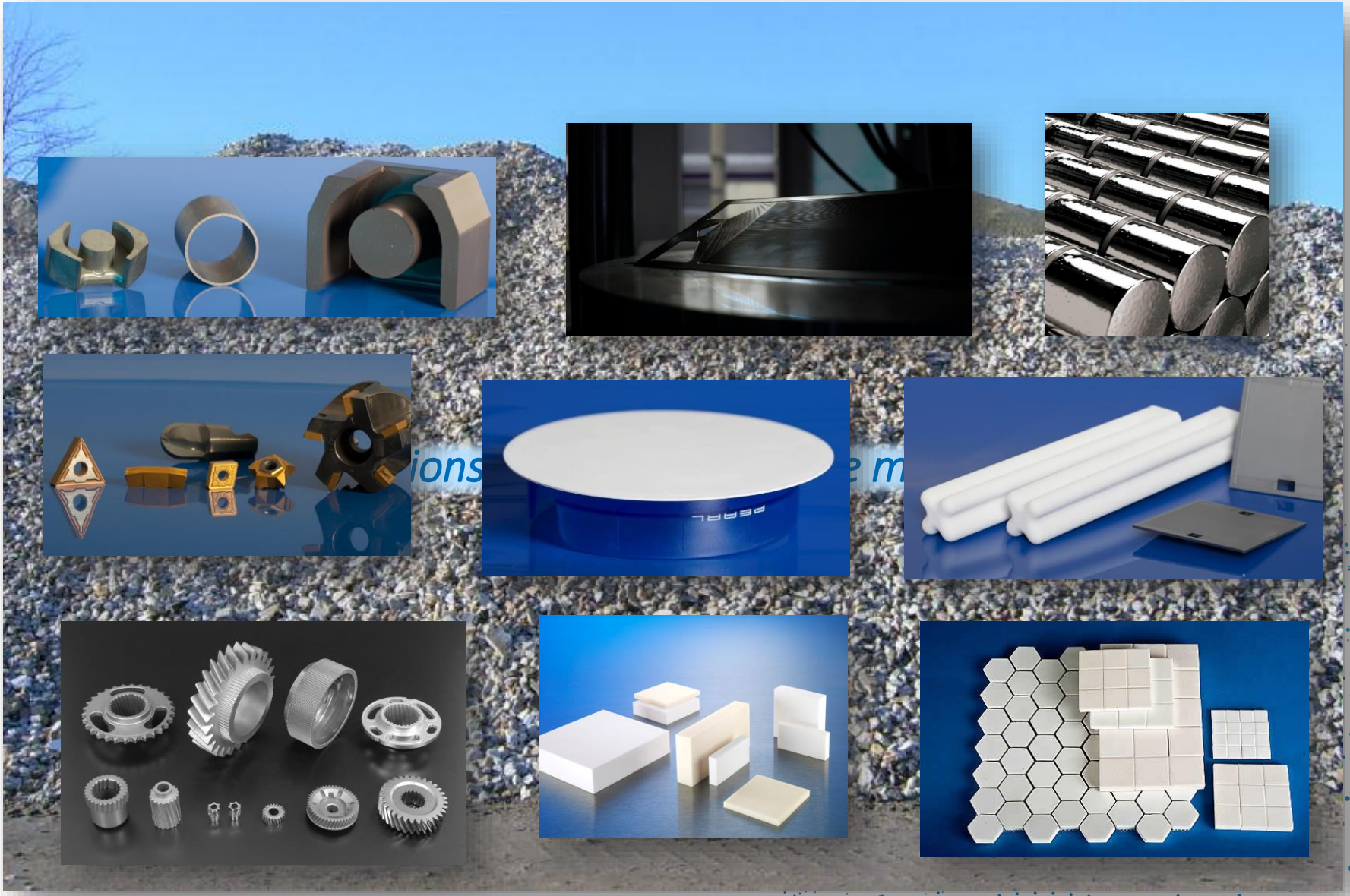
Hardmetals
Special Materials

Metal Powders

Ceramics

DIVERSIFICATION IN VARIOUS MARKETS

NETSHAPE PRESSING OF FUNCTIONAL & STRUCTURAL COMPACTS



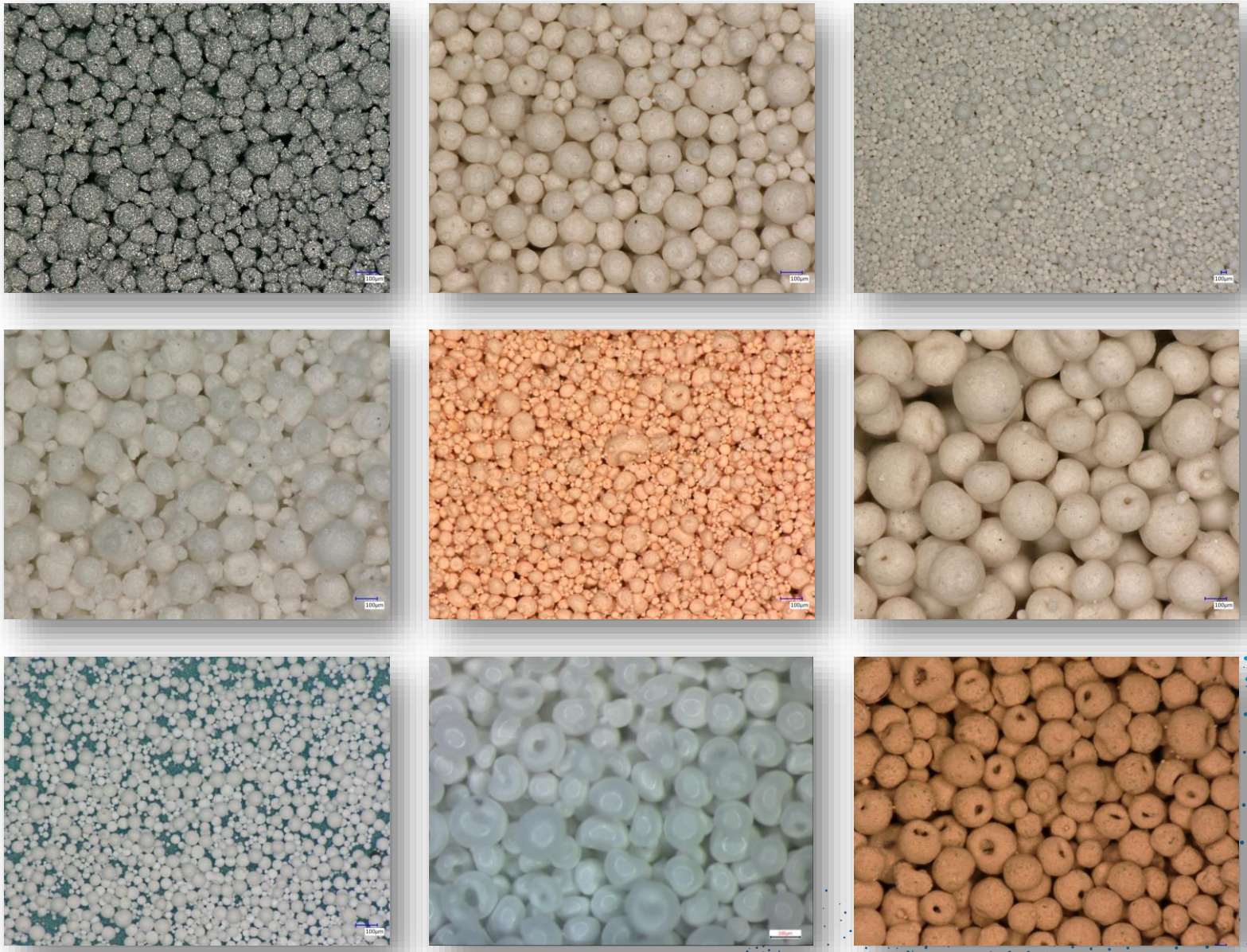
Reference: TU-BAF Freiberg


DORST
TECHNOLOGIES
SPRAY DRYING SOLUTIONS
efficient | reliable | digital
Ceramics
Technical Ceramics
Hardmetals & Cermets
Glass & Minerals
Polymers
Carbons & Graphites
Organic Materials
SMART Lab Atomizer Plug & Spray
Compact Dryer Systems
Customized Spray Drying Plants
Gas- or Electric Heating
Energy Saving Upgrades
Kiln Heat Recovery

Spray drying plants

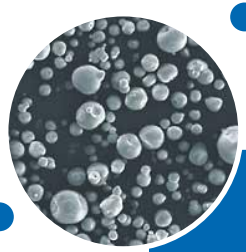
Equipment for material development

WATER BASED SPRAY DRYING GRANULATES



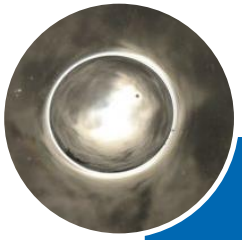
TWO OPERATIONS IN ONE PROCESS

Suspension



Granulation

Mechanical energy



Drying

Thermal energy

Powder

PROPERTIES OF SINGLE GRAIN *vs*. MASS BULK

Grain

Residual moisture

Grain hardness

Morphology

Chemical formula

Bulk

Grain size distribution

Flowability

Bulk cone

Bulk density

Bulk weight

Filling | Pressing | Sintering

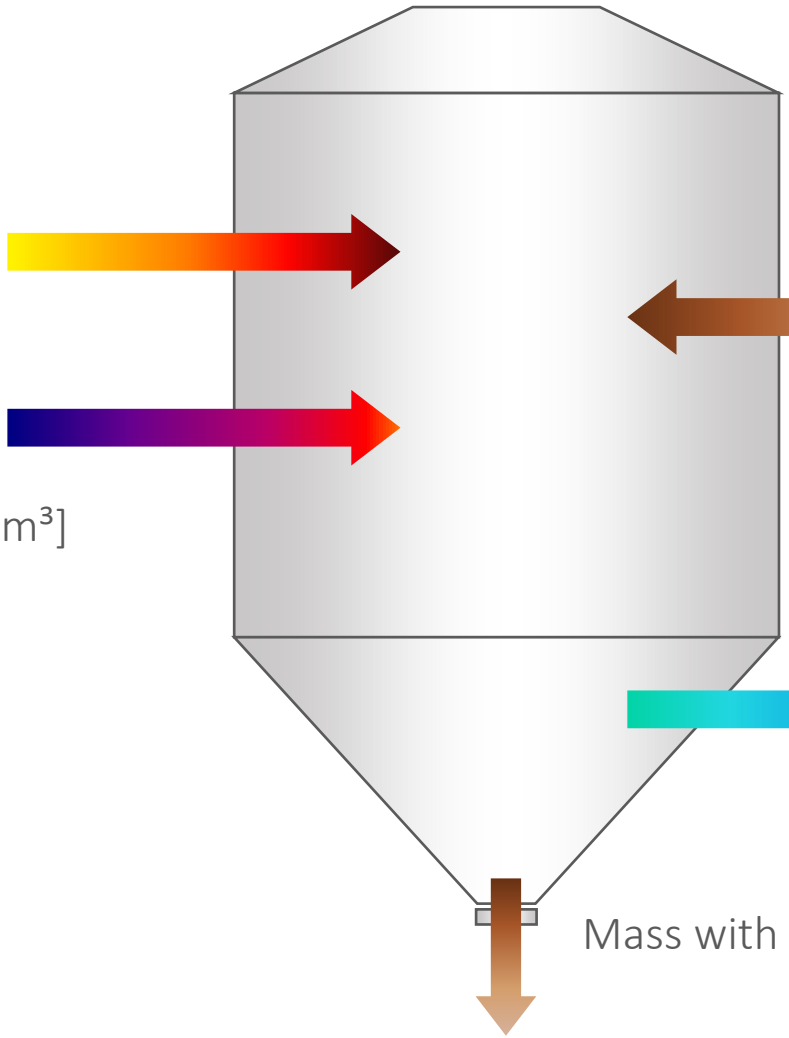
Properties

MASS AND ENERGY BALANCE

Heat quantity [kJ]

$Q = c_p \, m \, \Delta T$

Process air quantity [m³]



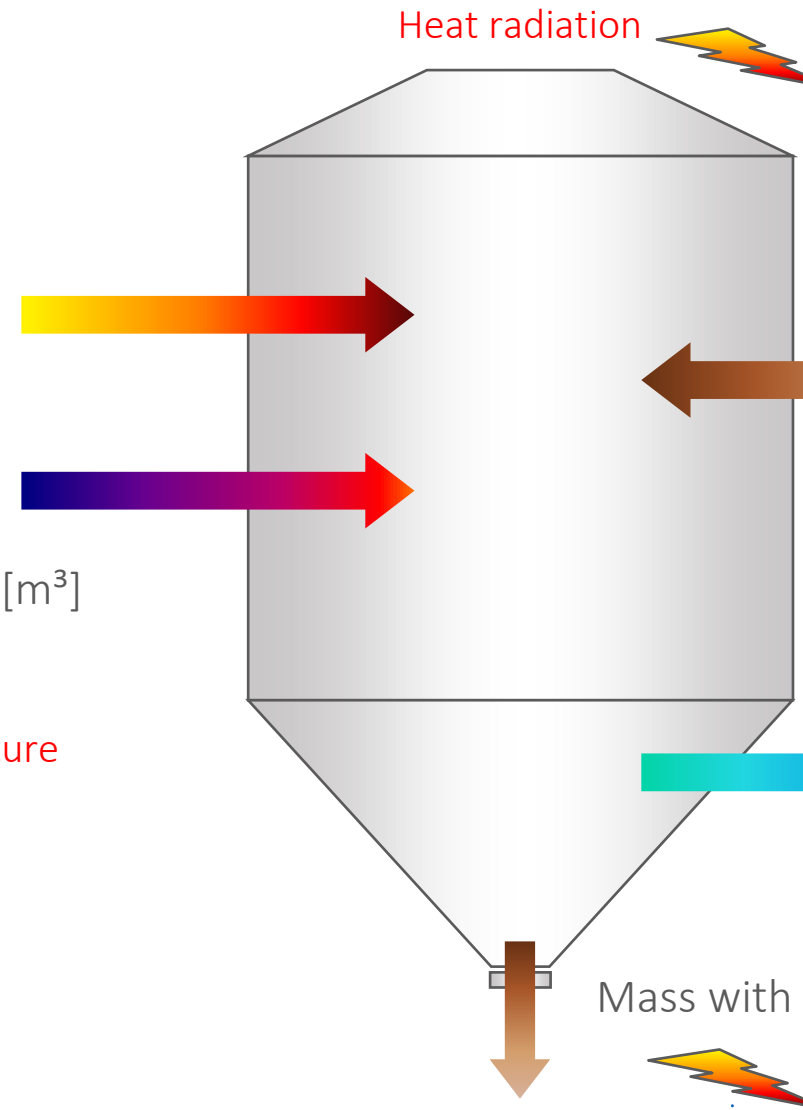
Suspension mass [kg]

Heat quantity [kJ],

Waste air quantity [m³]

Mass with residual moisture [%]

MASS AND ENERGY BALANCE



Heat radiation

Slurry temperature

Compressed air (2-fluid nozzle)

Suspension mass [kg]

Heat quantity [kJ]

$Q = c_p \, m \, \Delta T$

Process air quantity [m³]

Environment temperature

Heat quantity [kJ]

Waste air quantity [m³]

Mass with residual moisture [%]

Material temperature

Plant scheme of water based, open system for spray drying of anorganic materials

1. Slurry pump
2. Slurry filter
3. Combustion chamber / heating cartridge
4. Drying reactor
5. Cyclone
6. Dry baghouse filter
7. Main fan
8. Fines recycling
9. Granulate tower fraction

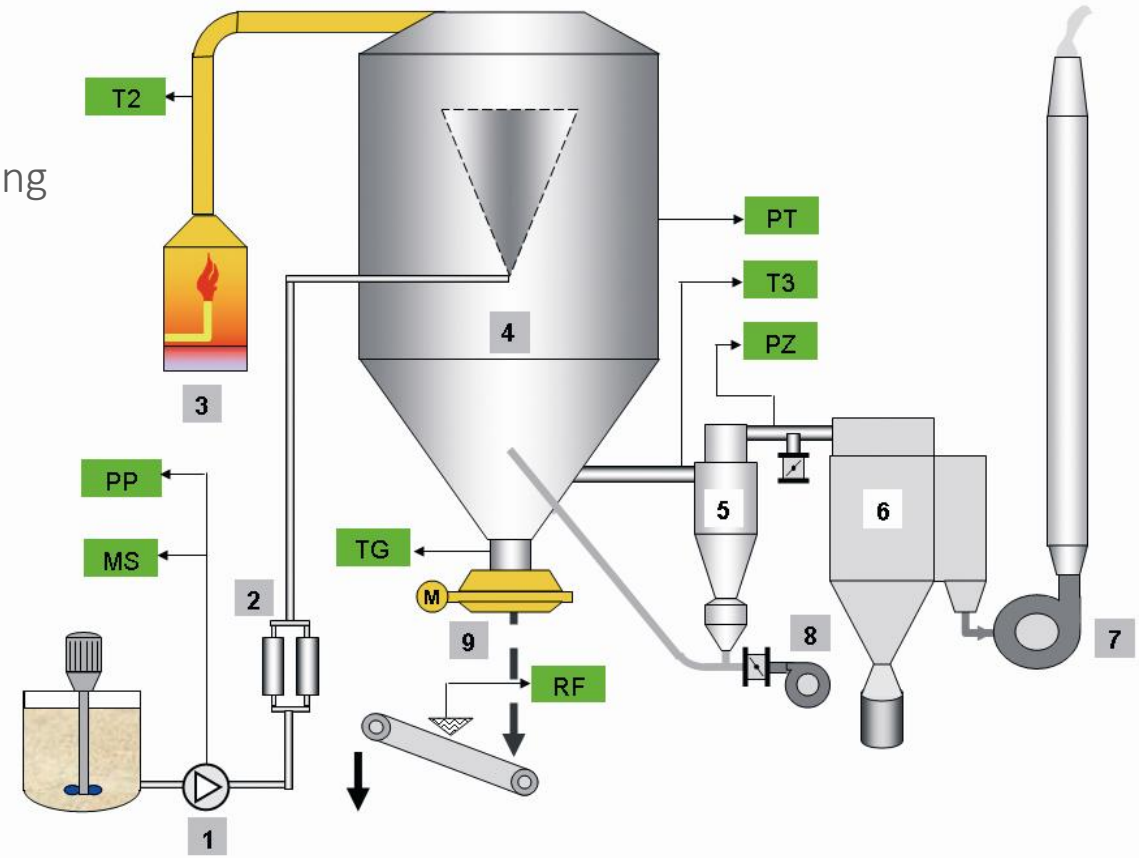


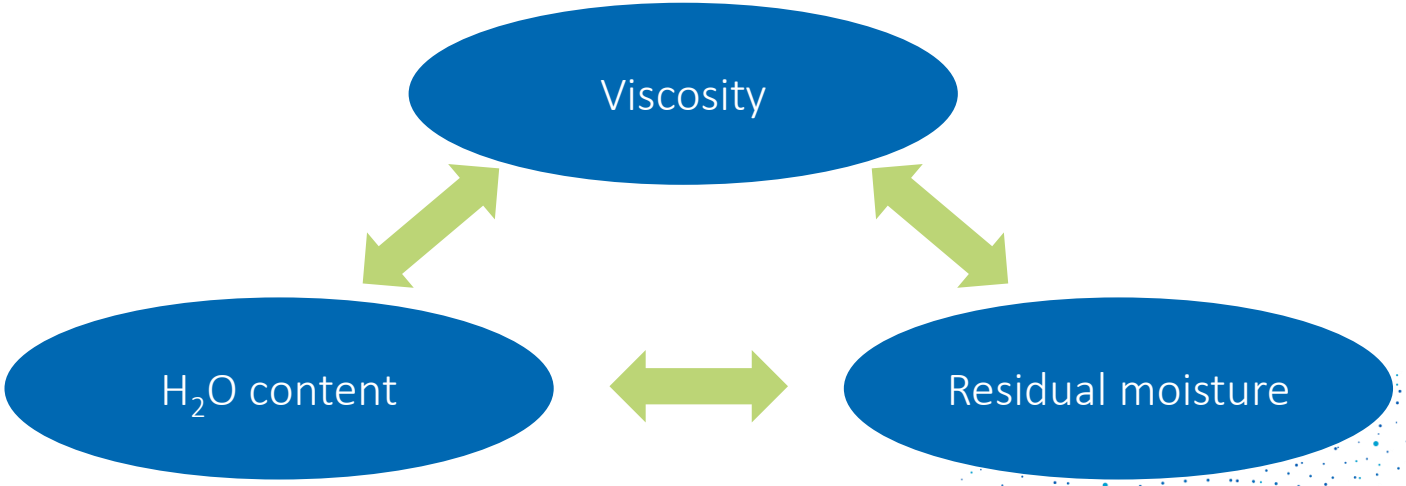
Photo Pixabay

Photo Pixabay

Additives

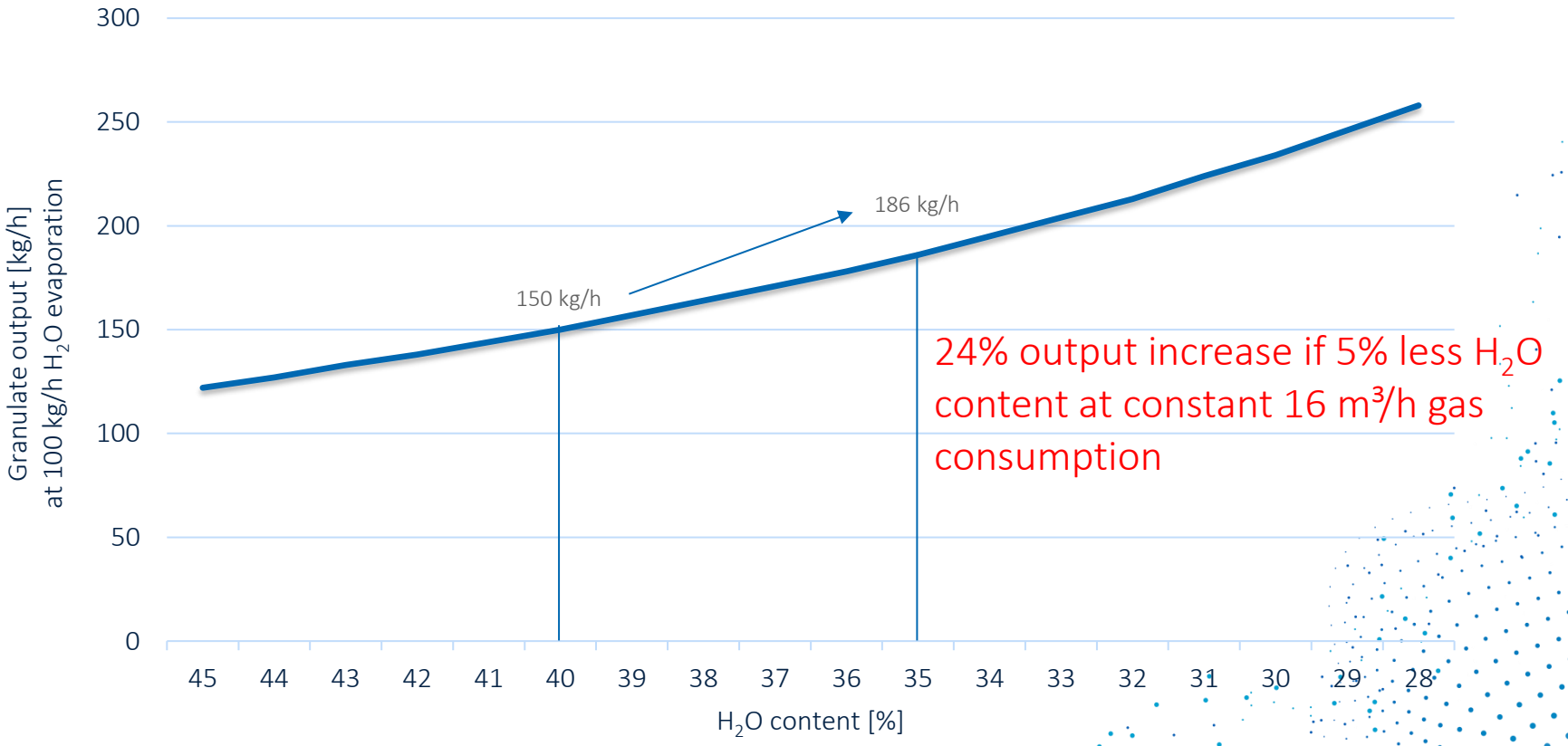
Liquefiers

$$\textit{Energy requirement } for\ H_2O\ evaporation\ = f(H_2O\ content)$$



Influence H_2O content rate

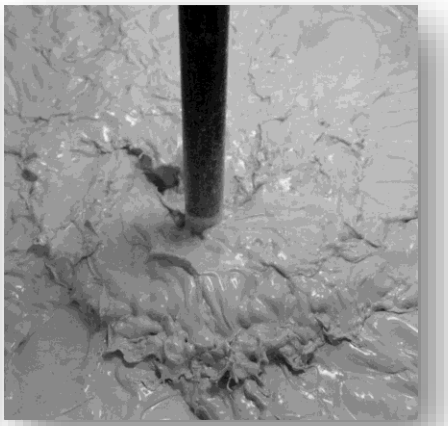
D100 | 40% H_2O| Al_2O_3
Spray dryer gas consumption: 16 m³/h
Residual moisture: 0,5 %



DISPERSING, MIXING, STIRRING, STORAGE

Dispersing, mixing & stirring designed for purpose and efficiency

- Reduction of process times by high-efficiency devices
- Quantity and process optimized operation – split of dispersing & mixing



Suspension storage container with insulation | pre-tempered with recover heat

Selection of sustainable and cost-efficient energy sources & system combinations

- Natural Gas
- H_2 Hydrogen
- Biogas
- Electrical Heating
- Cogeneration Heating
- Recovery Heat

Design of spray drying plant and place of installation aspects

Selection of appropriate plant size | purpose- oriented plant size | definition of optimal point of operation

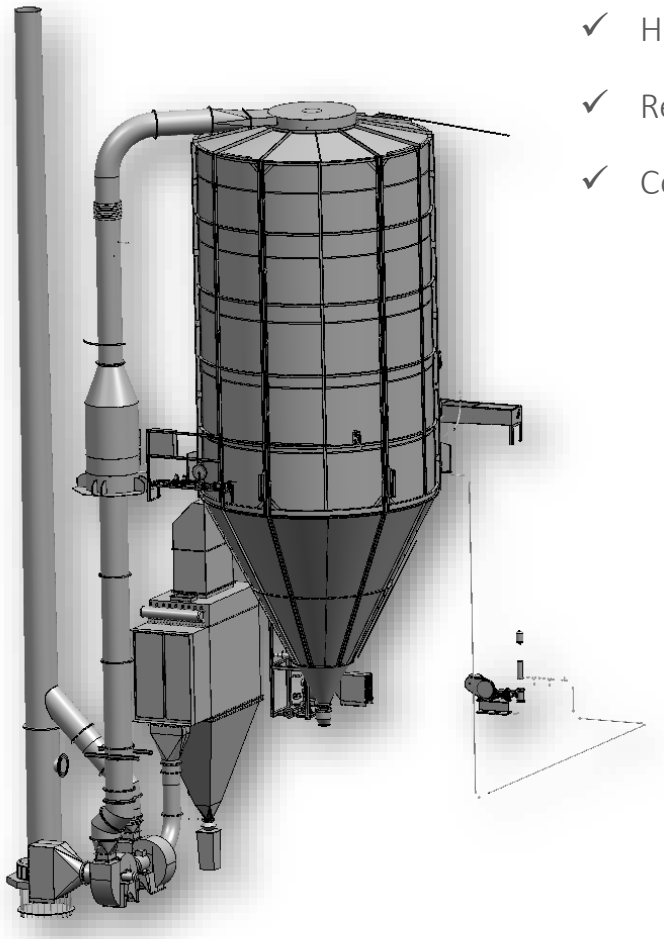
Design of spray drying plant and place of installation aspects

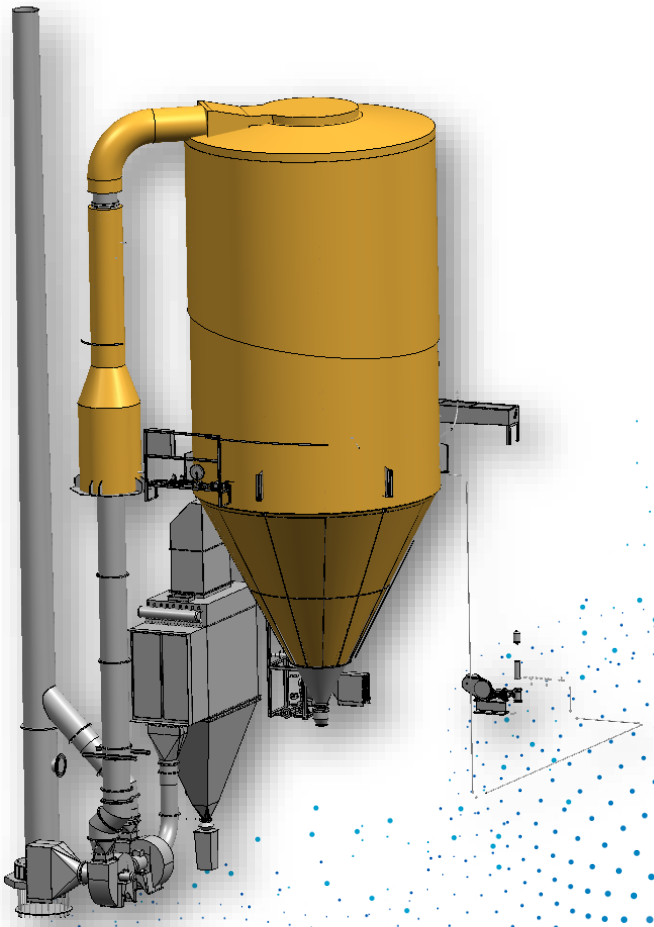
Building architecture | environment conditions

Installation inside building *vs.* above roof

System insulation – dry | robust |effective insulation material | full plant

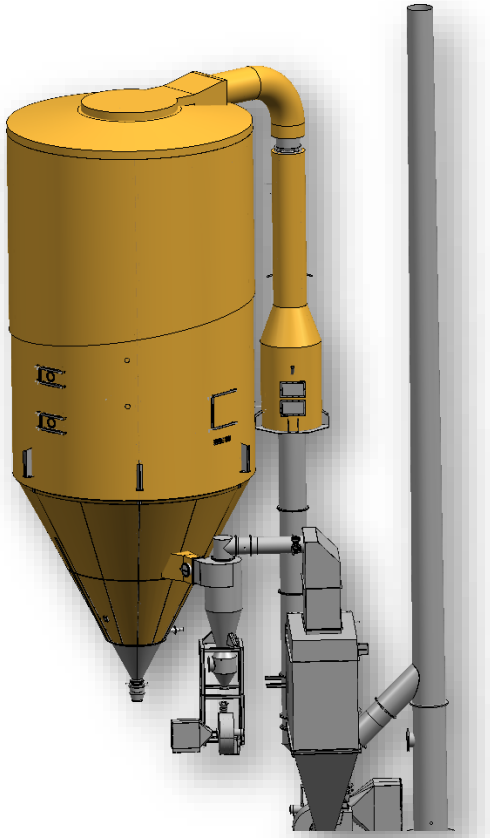
- ✓ Combustion chamber
- ✓ Hot air duct
- ✓ Reactor
- ✓ Conus

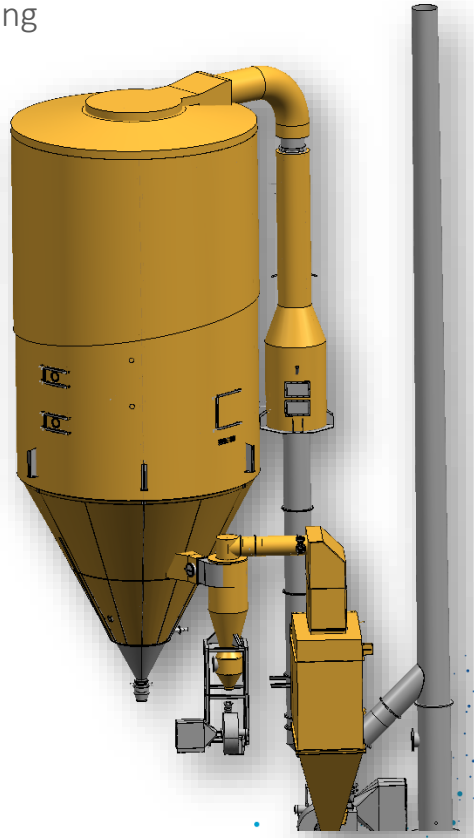




System insulation – dry | robust |effective insulation material | full plant

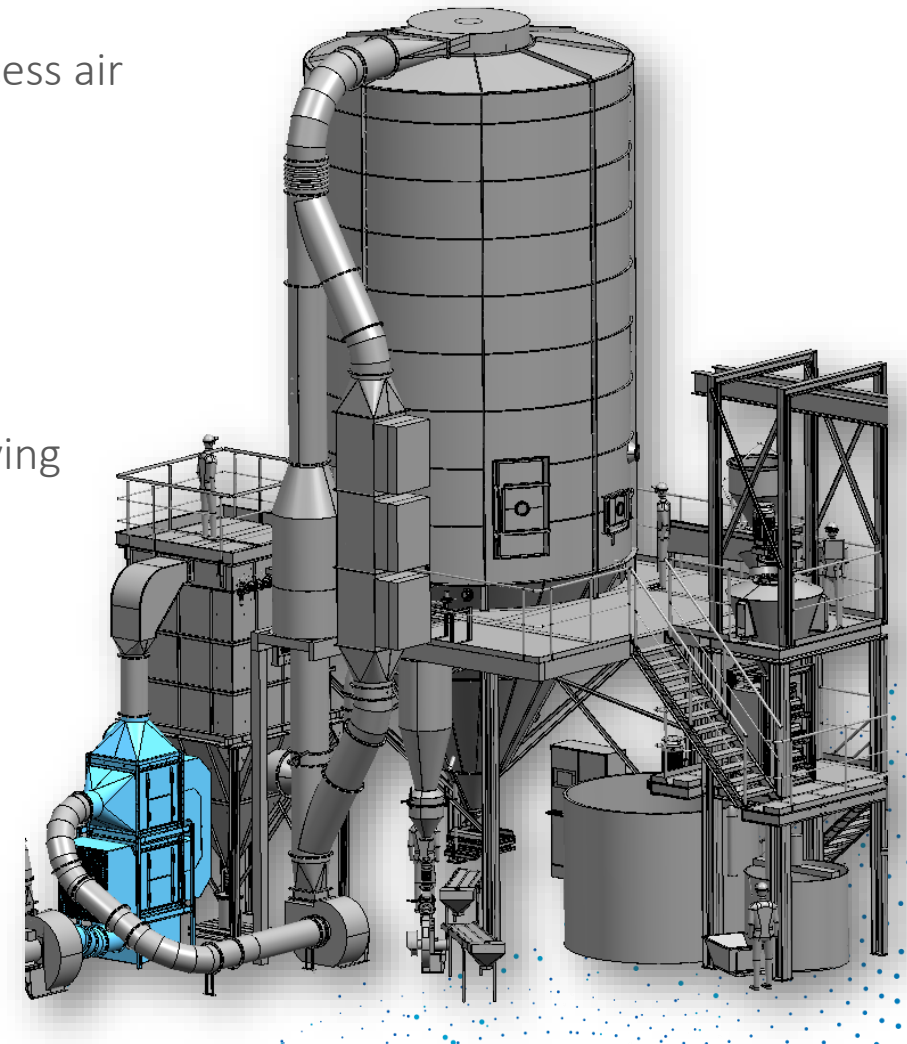
- ✓ Waste air duct
- ✓ Cyclone de-dusting
- ✓ Baghouse filter



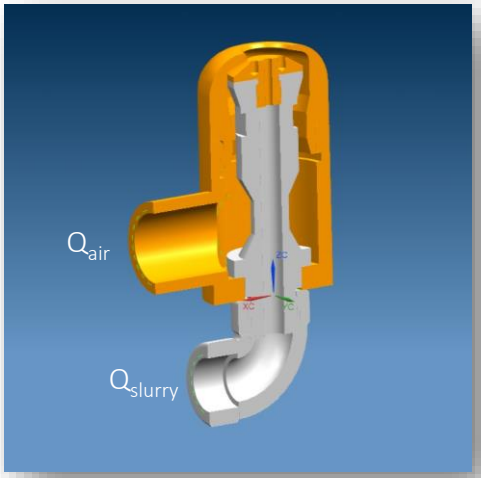


Heat exchanging systems

- ✓ Heat exchanger for pre-heating process air
- ✓ Recovery heat usage for pre-heating material suspension
- ✓ Recovery heat for slurry container warming
- ✓ 2-staged drying process by spray drying and post drying with recovery heat



Comparison of nozzle spraying systems



Scenario:
D100

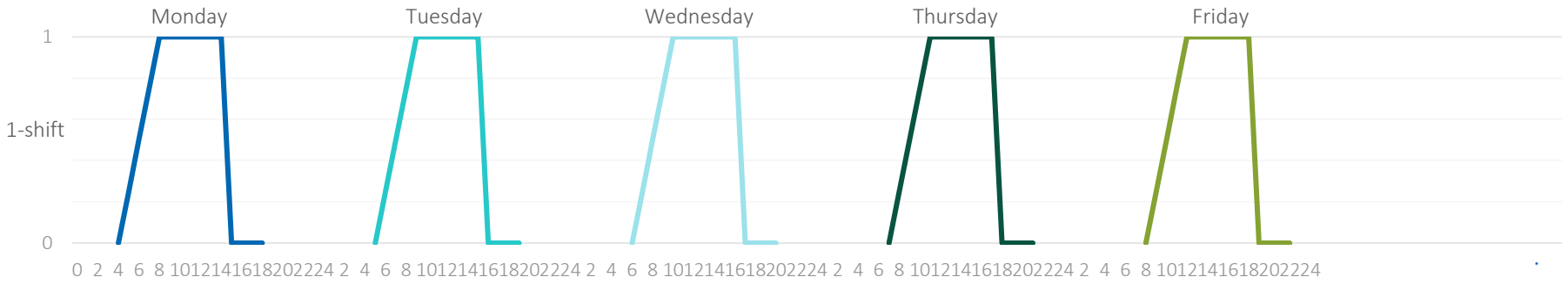
Feed pump	[kW]	Pressure pump	[kW]
Compressed air	[m³]		

2-Fluid nozzle: 150 m³/h compressed air
3,90 € /h electrical energy costs for compressed air generation

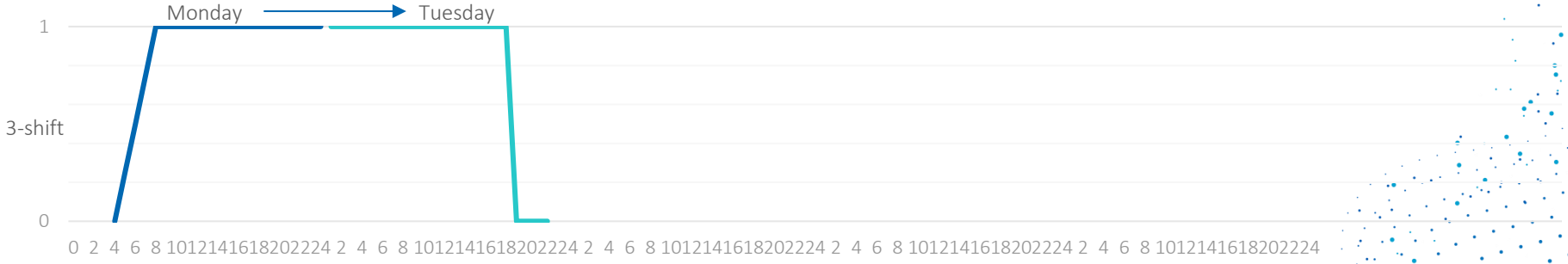
Pressure nozzle: 1,5 kWh pump power
0,31 € /h electrical energy costs for pressure pump

Comparison of operation

D400 | 40% H_2O| Al_2O_3
Spray dryer gas consumption: 67 m³/h
Total net production hours: 35 h



Gross operation hours 42,5
Total gas consumption 2´847 m³



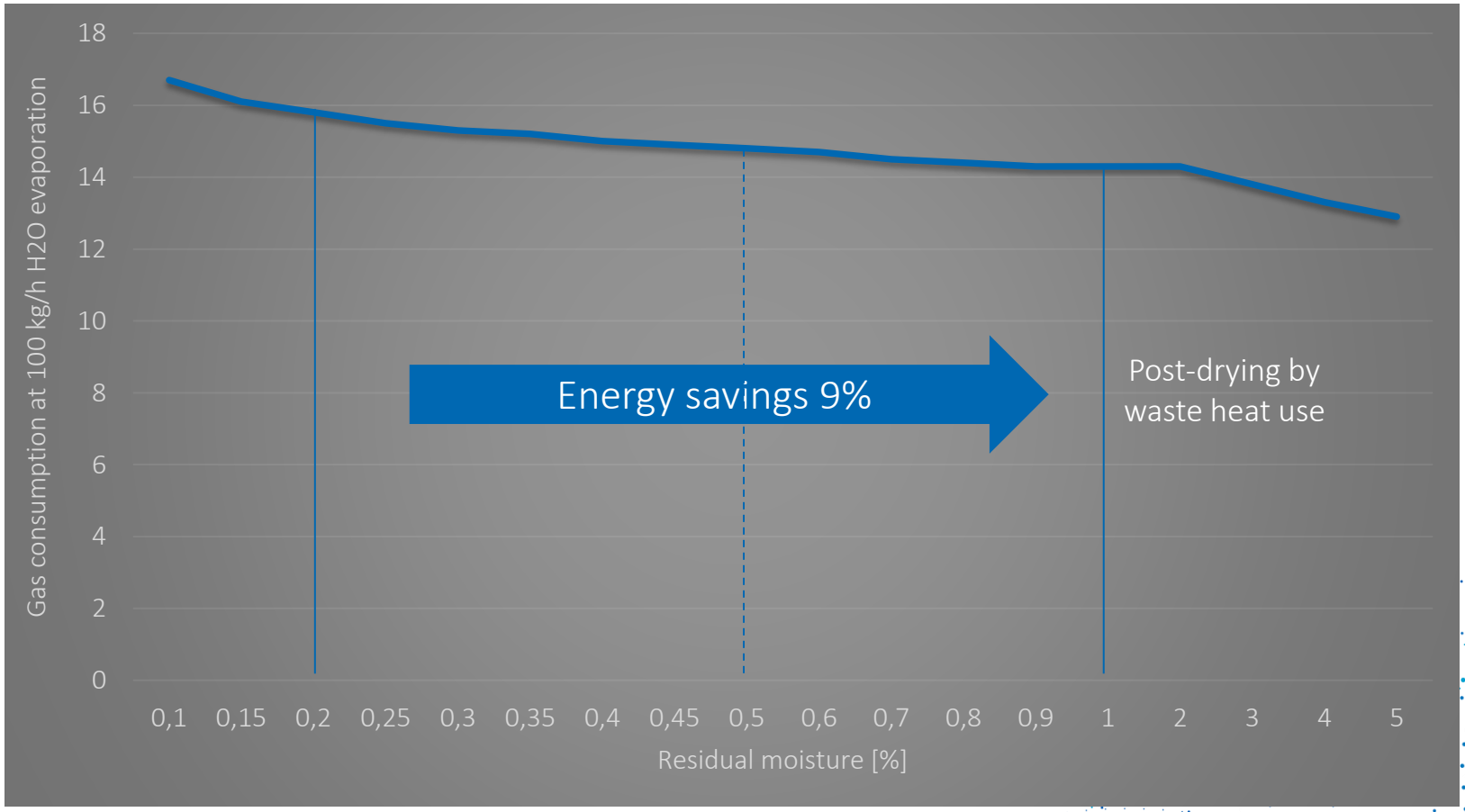
Gross operation hours 36,5 h
Total gas consumption 2´445 m³

Net energy savings ≈ 14%

Net energy cost savings 402 m³ = **311,6 €** (7,75 ct/m³)

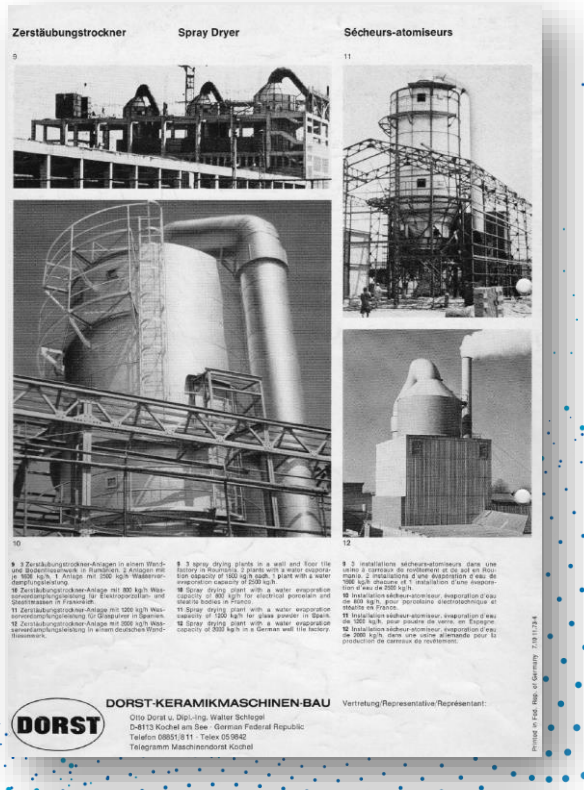
Influence residual moisture rate

D100 | 40% H_2O| Al_2O_3
Spray dryer gas consumption: ca. 16 m³/h
Residual moisture: 0,5 %



Plant refurbishment

- ✓ Retrofitting of insulation
- ✓ Repair of leaking and cracks of reactor vessel, combustion chamber, air ducts
- ✓ Replacement of burner systems with energy efficient heating systems
- ✓ Decommissioning of air flap for air balance control
- ✓ Upgrade of motors with frequency converted drives
- ✓ Modern PLC and HMI with process control features
- ✓ Adjustment of bag house cleaning interval
- ✓ Retrofitting with baghouse filter systems
- ✓ Consequent maintenance and cleaning



Energy Saving Strategies for Powder Preparation by Spray Drying

- Active measures
- Passive measures
- Selection of energy source
- Storage | dispersing | mixing | stirring
- Slurry composition

Observation → Doubts → Analysis → Economics → Actions → Monitoring

Reduction of operational costs and improvement of carbon footprint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