

LEADING PARTNER IN THE WORLD OF METALS



PRODUCTION OF HIGH-GRADE ALUMINIUM POWDER FOR ADDITIVE MANUFACTURING

SMS group GmbH, Aluminium 2022 in Düsseldorf, 29th Sep 2022

SMS @ group

February 27, 2023

LEADING PARTNER IN THE WORLD OF METALS

SINCE 1871 LEADING IN THE WORLD OF METALS

13,300 EMPLOYEES 2021

2.8 BN EURs SALES 2020

95 GLOBAL LOCATIONS

SMS group stands for pioneering technology with 150 years of experience in plant construction and mechanical engineering for the metals industry.

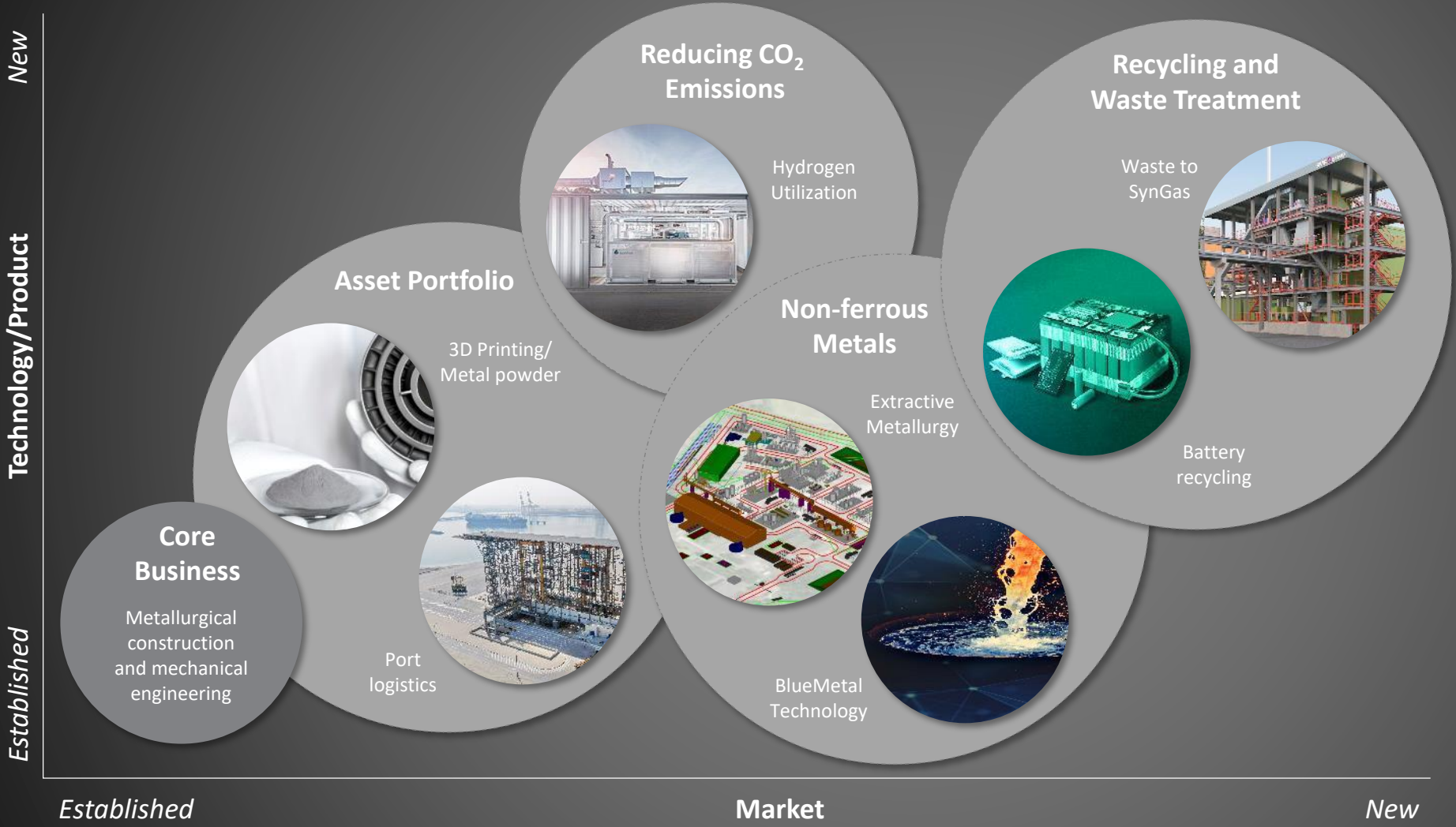
As an innovation-driven system supplier, we provide state-of-the-art plants, innovative business models and a complete lifecycle of integrated services to minimize costs, increase profitability and conserve resources.



AGENDA

- Introduction: SMS activities
- Aluminium powder market
- Aluminium powder for AM
- Gas Atomization Process
- SMS plant for aluminium powder
- Business model: Equipment as a service

NEW HORIZON: APPLYING OUR KNOW-HOW IN NEW MARKETS AND TECHNOLOGIES



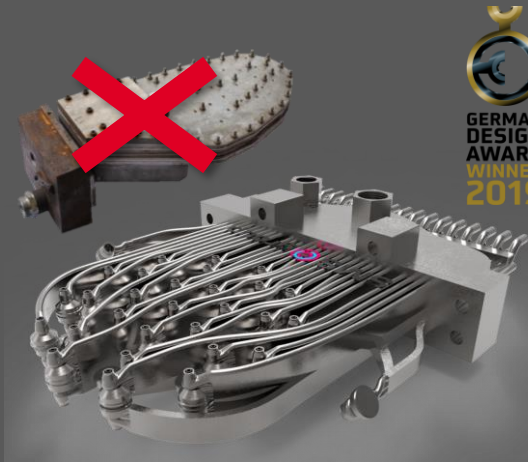
COVERING THE COMPLETE VALUE CHAIN IN THE FIELD OF ADDITIVE MANUFACTURING

Powder



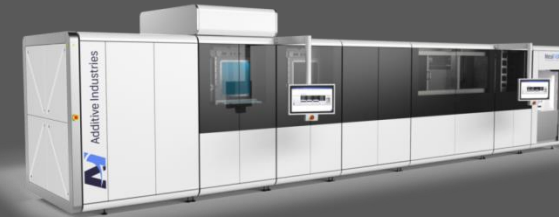
High quality powder,
new material concepts

Design



Function and cost optimized
design

3D Printing



Manufacturing and
development

Service

SMS 3D Test Center

ALUMINIUM POWDER MARKET



Technologies

- Chemical industry
- Explosives, pyrotechnics
- Rocket fuel
- Thermit welding
- Paints
- Powder Metallurgy
- Additive Manufacturing



Market

- 629,000 Tons in 2021
- Air atomization holds majority of market share
- AM Powders with strong growth



Production

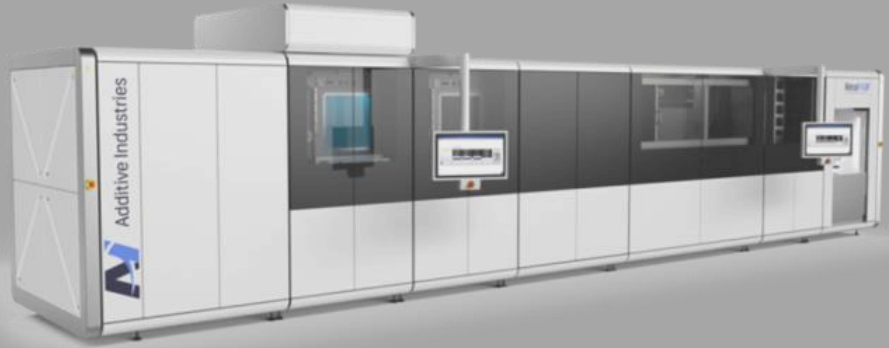
- Air atomization
- Gas atomization
- Mechanical milling
- Others

Source: www.imarcgroup.com

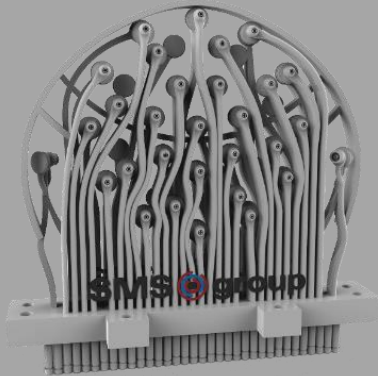
REQUIREMENTS FOR POWDERS FROM AM PROCESS



Gas atomized metal powder



Powder bed based additive manufacturing



Printed part

REQUIREMENTS FOR POWDERS FROM AM PROCESS



Chemistry

- Within specification
- No contamination



Flowability

- Machine and powder bed



Particle Size Distribution

- Defined range 15-45 μm

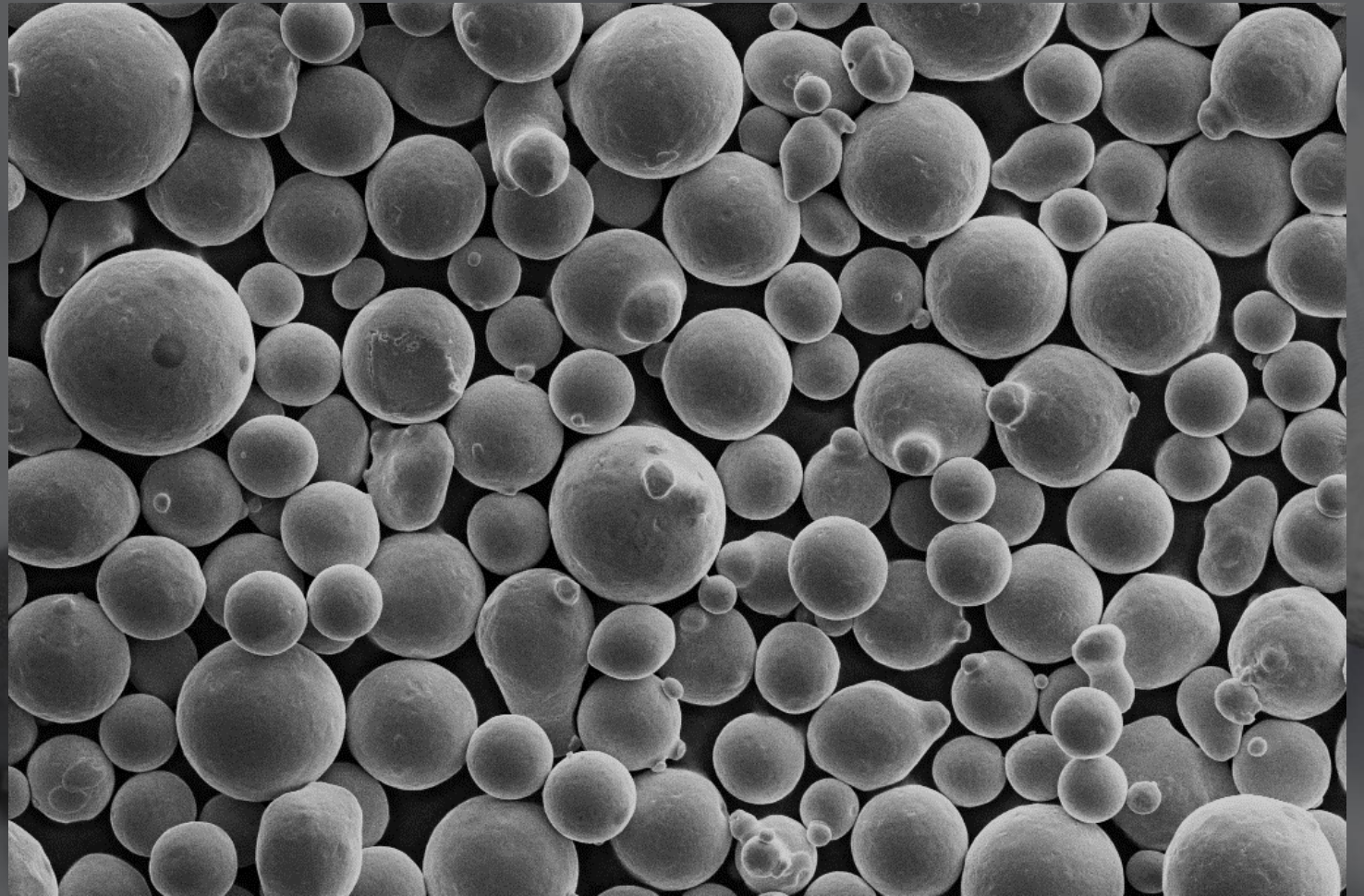


Bulk density
Tap density



Morphology

- High Sphericity



SMS powder with particles of high sphericity (316l)

AVAILABLE METAL POWDERS FOR ADDITIVE MANUFACTURING

Ni-Alloys

- Hastelloy X
- IN625
- IN718
- IN738LC
- IN939
- MAR-M-247
- René 80
- René142

Al-Alloys

- AlSi9Cu3, AlSi12
- AlSi7Mg, AlSi10Mg
- AlMgSc (Scalmalloy®)
- Alloy A205
- 2139, 2024, 2219
- 3003
- 5083
- 6061
- 7050, 7075

Co-Alloys

- CoCr(F75)
- CoCrMP1
- CoCrSP2
- MAR-M-509

Fe-Alloys

- 1.2083
- 1.2343
- 1.2344
- 1.2709
- 1.4404
- 1.4540
- 1.4542

Ti-Alloys

- Ti6Al4V
- Titanium Grade 2

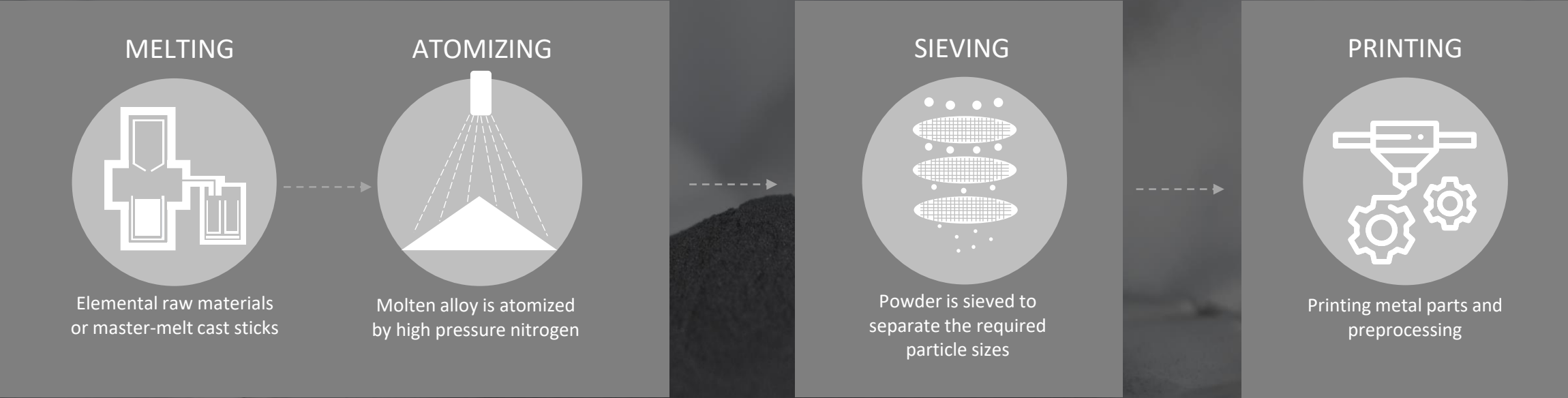
Cu-Alloys

- CuCrZr (K150)
- CuNiSi (K220)
- CuNiCo (K265)

Others

- 16MnCr5
- Hard metal
- Al-CNT
- Invar
- Pure metals (Au, Ag, Cu...)
- ...

PROCESS CHAIN FROM POWDER PRODUCTION TO ADDITIVE MANUFACTURING

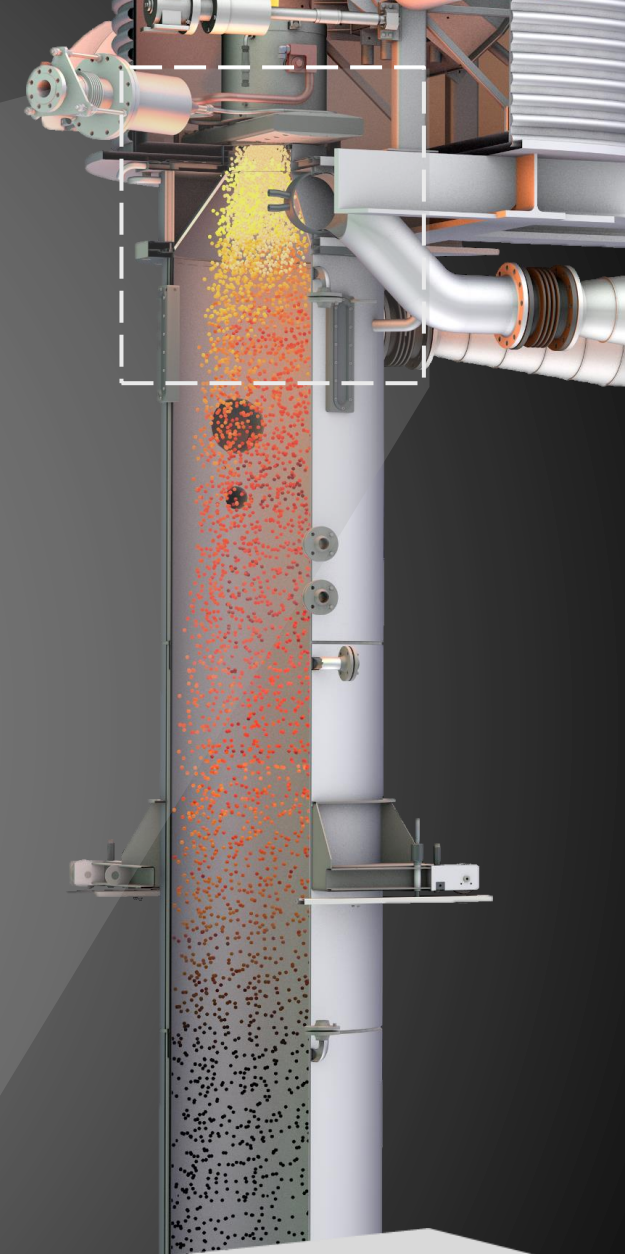
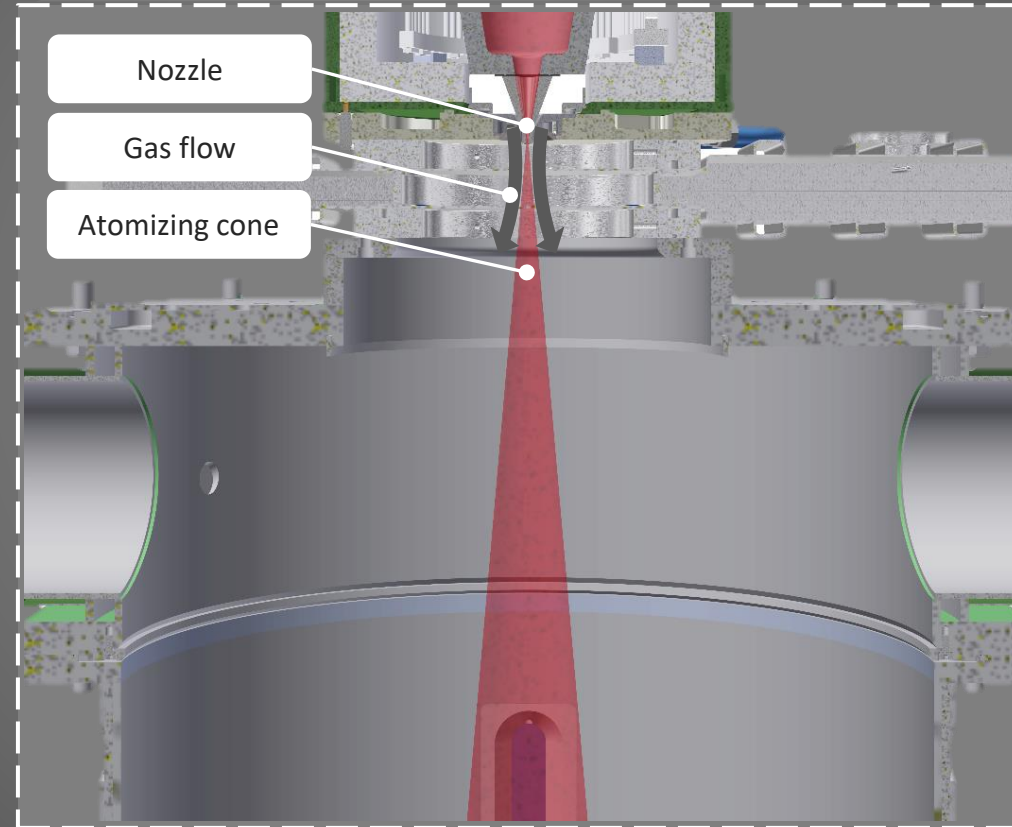


GAS ATOMIZATION PLANT

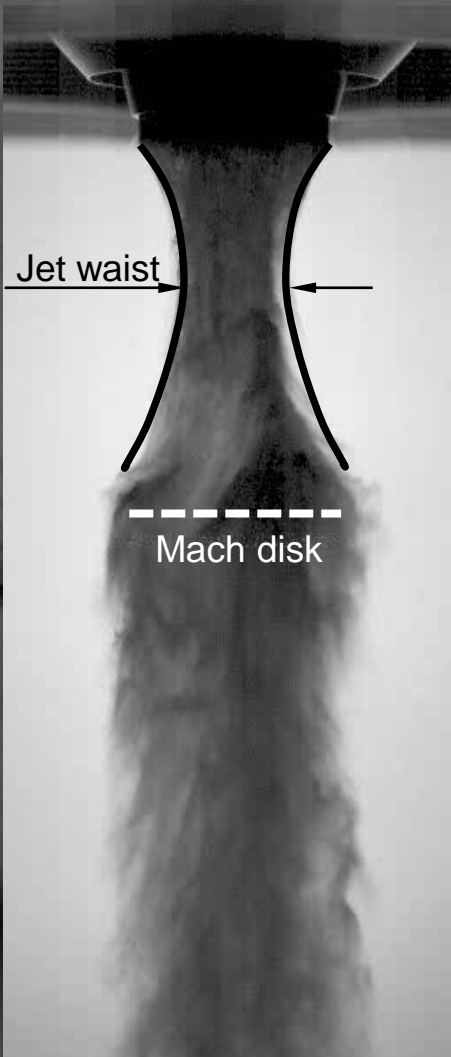
METAL POWDER PRODUCTION OF ALUMINIUM POWDER

Gas atomization process

- Molten metal is disintegrated into small droplets
- Melt flows through nozzle
- Impact of high-energy jets of gas
- Rapid solidification before coming into contact with each other or with the chamber

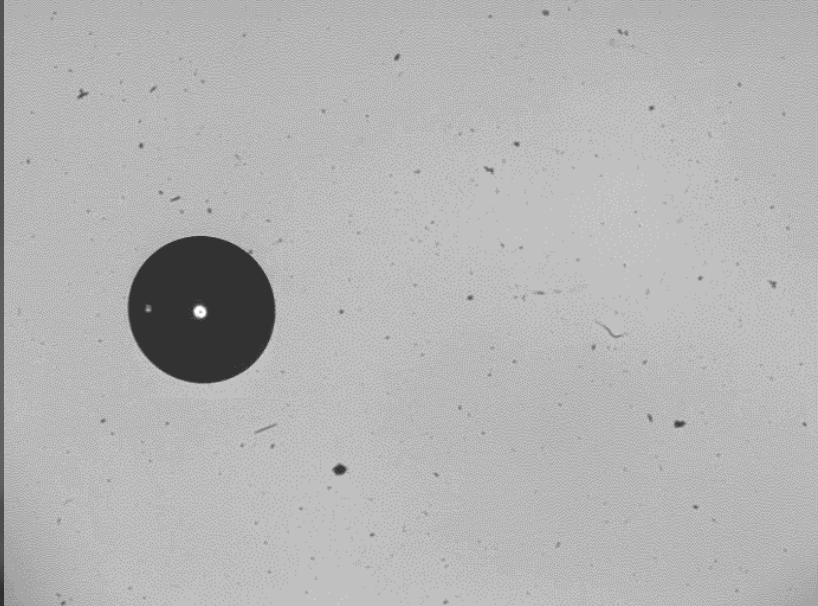
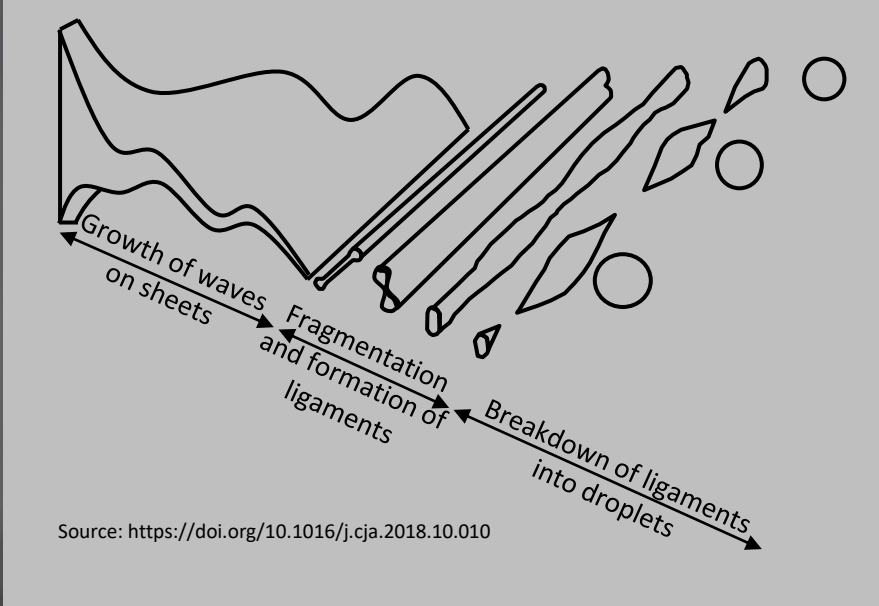


ATOMIZATION PROCESS WITH WATER IN LABORATORY TEST



Primary atomization

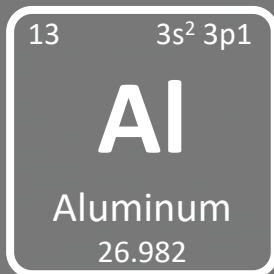
Secondary atomization



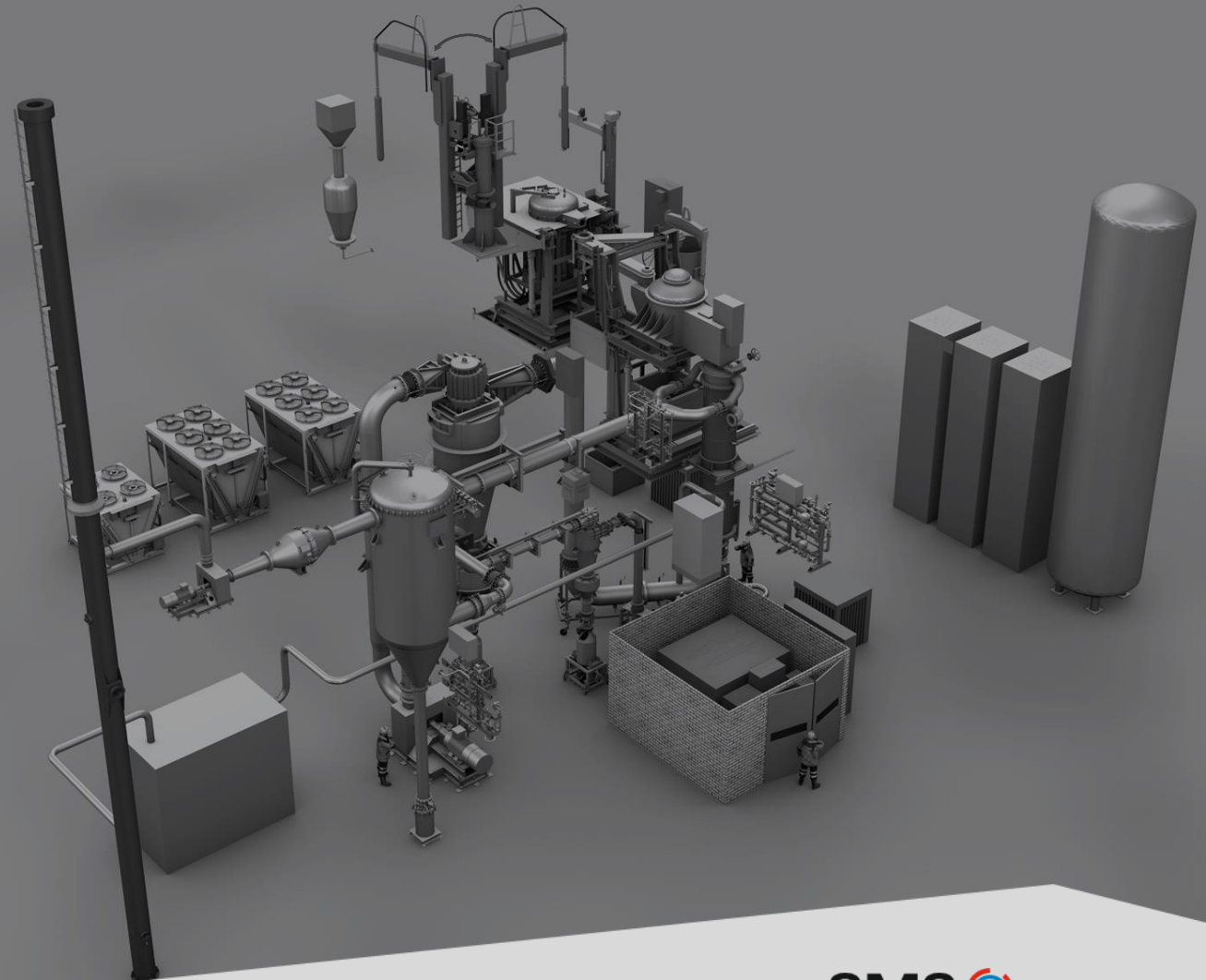
POWDER PRODUCTION: ALUMINUM INERTGAS ATOMIZATION

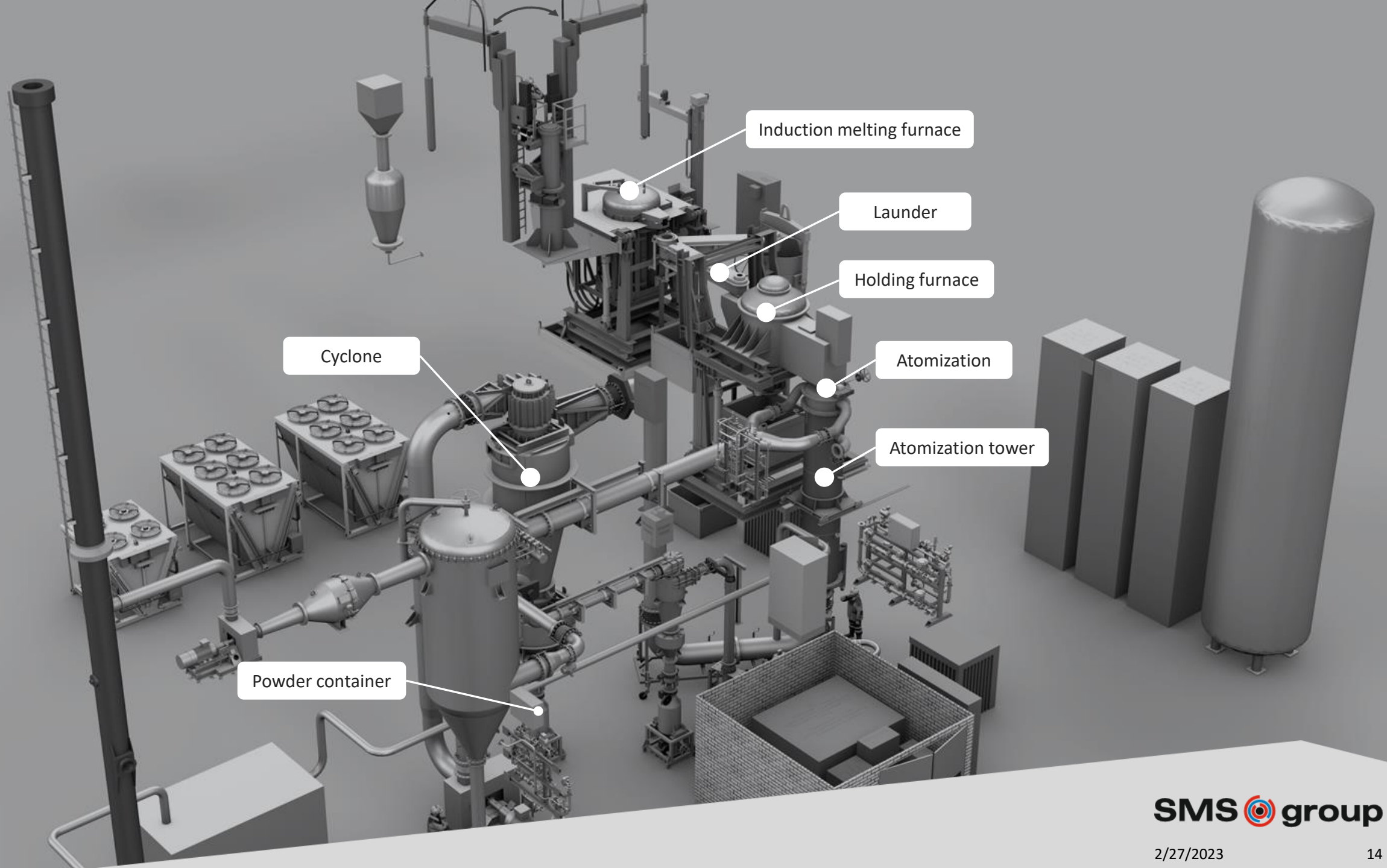
Characteristics:

- Highest powder quality
- Spherical particle shape
- Melting and atomizing under nitrogen (N₂)
- Induction melting furnace
- Holding furnace (for buffering)
- Design: Pressure resistant design (13 bar necessary), security flaps
- Melt refining station



13 bar
pressure
resistance





Induction melting furnace

Launder

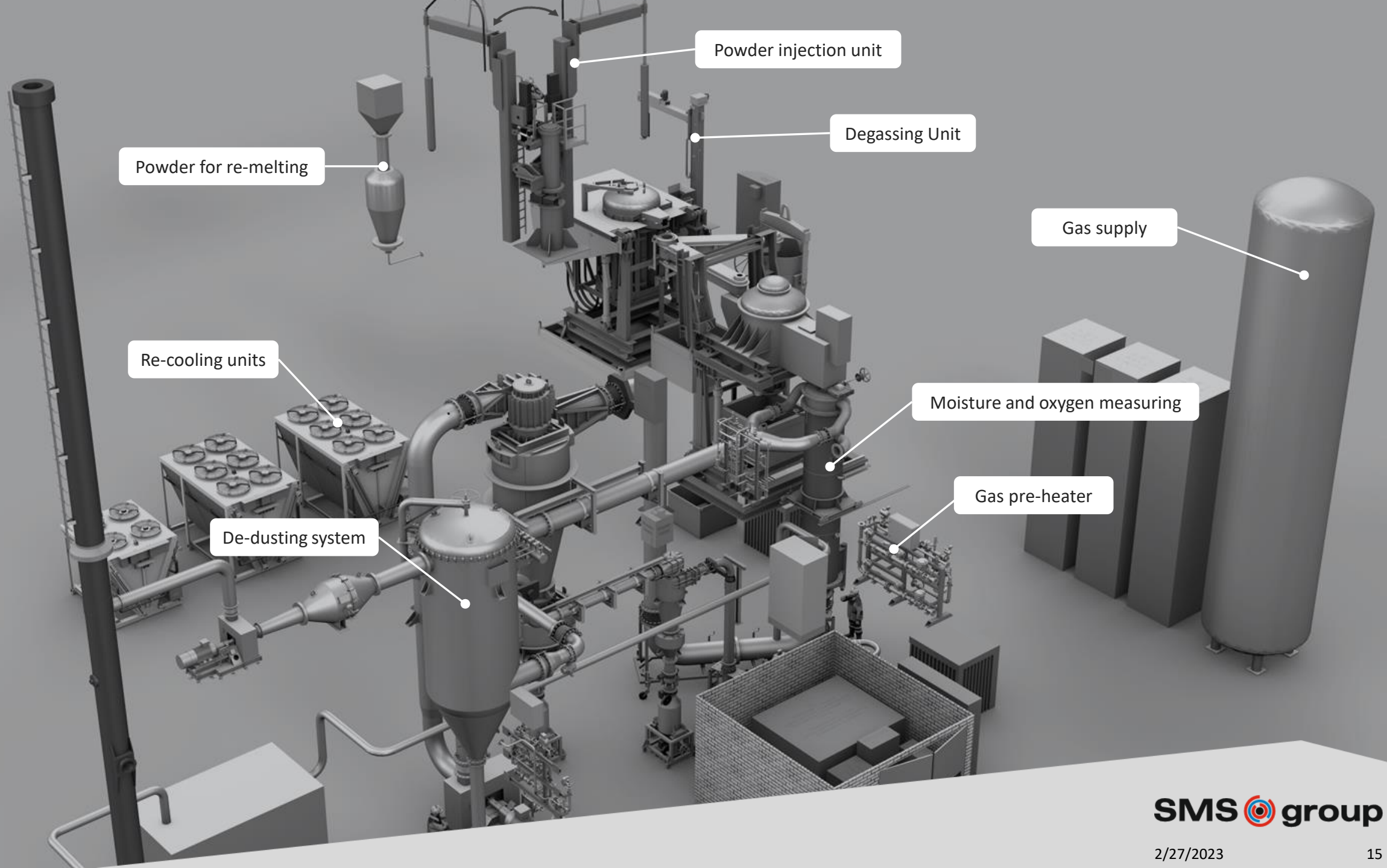
Holding furnace

Atomization

Atomization tower

Cyclone

Powder container



Powder for re-melting

Powder injection unit

Degassing Unit

Gas supply

Re-cooling units

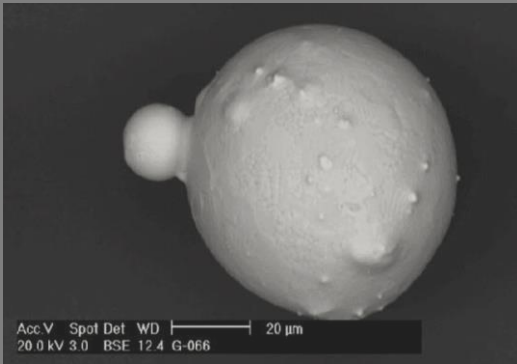
Moisture and oxygen measuring

De-dusting system

Gas pre-heater

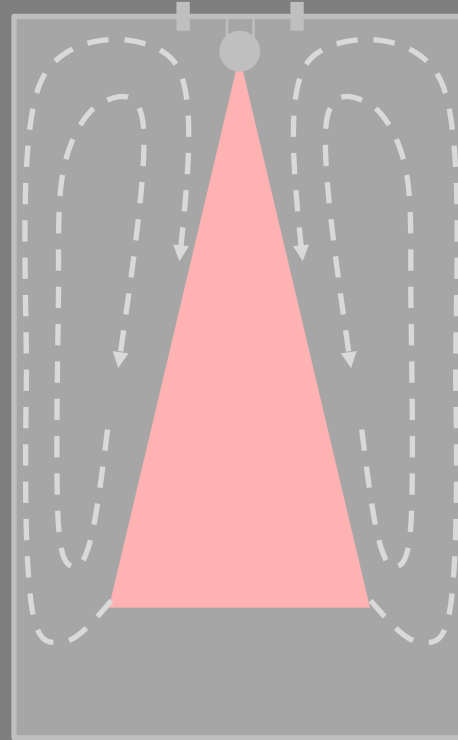
PARTICLE MORPHOLOGY IS INFLUENCED BY DEFECT FORMATION

Satellites

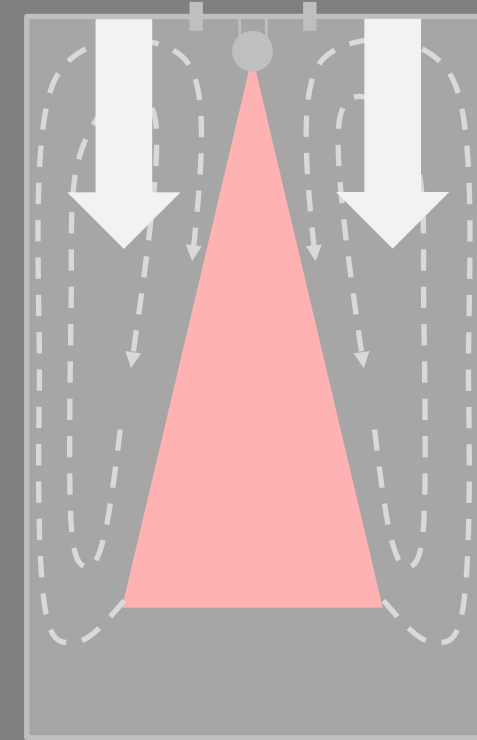


- Partikel defekt
- Forms in powder production
- Undesired
- Decreasing morphology and flowability

Satellite formation



Anti satellite system



Source: DUNKLEY, J. J.; TELFORD, B. Control of " Satellite" Particles in Gas Atomisation. *Advances in Powder Metallurgy and Particulate Materials*, 2002, Nr. 3, S. 3-103.

ACCELERATING ADDITIVE MANUFACTURING – EQUIPMENT AS A SERVICE



Equipment as a Service at a glance:

- **Payment per produced ton/kilo of powder**
- SMS will build, commission and maintain the plant
- Customer will provide building/ infrastructure + auxiliary facilities

Your benefit:

- **No Capex requirements** from customer
- Latest plant technology and most advanced powders
- **Limited technical risk**
- Limited contract term – possibility to leave business

Business case:

- High market prices for powders
- **Fixed fee per kilo of powder**
- Full package, including maintenance
- Production is run by customer
- Fixed rate for spare and wear parts

Let us stay #connected!



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The information provided in this presentation contains a general description of the products concerned. The actual products may not always have these characteristics as described and, in particular, these may change as a result of further development of the product. The provision of this information is not intended to have and will not have legal effect.

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