

Impulses to enhance resource efficiency in mineral processing

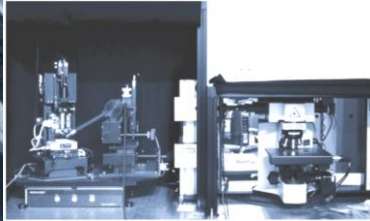
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Overview

- German Research centers for mineral processing
 - Freiberg Mineral Processing Cluster
 - TU Clausthal
 - RWTH Aachen University
- Dry gravity separation
- Sensor-based sorting
- Summary

Freiberg Resource Technologies

Particle Analysis (e.g., Raman-AFM), Flotation Testwork, Hydrometallurgy (e.g., Mixer-Settler)



Logos for TU Bergakademie Freiberg, Helmholtz Institute Freiberg for Resource Technology, Helmholtz Zentrum Dresden Rossendorf, and LVR FIA Verfahrenstechnik für Rohstoffe.

Freiberg Mineral Processing Cluster

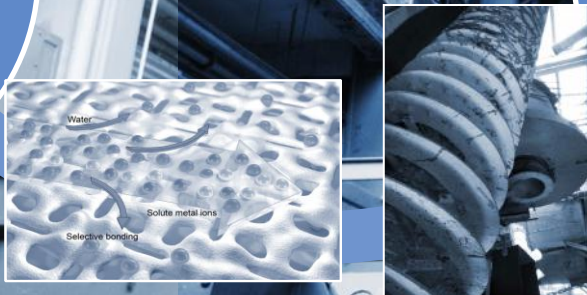


Quartz	41.14
Fe	21.21
Dark Matrix	16.88
Chromopyrite	16.88
White Matrix	7.27
Galena	1.81
Fluorite	1.23
Calcite	1.23
Albite	0.47
Muscovite	0.20
Carbonates	0.84
Ironstone	0.84
Other	0.84

A photograph of a mineral characterization machine next to a data table and a microscopic image of mineral grains.

Mineral Characterization (e.g., MLA, LA-ICP-MS, etc.), Biomining, Geometallurgy, Economics

Pilot tests up to 1 t/h feed:
• Crushers, mills
• Spirals, jigs
• Magnetic sep.
• Flotation banks
• etc.





CUT Clausthal University of Technology

- IFAD Institute of Mineral and Waste Processing, Waste Disposal and Geomechanics
 - Recycling of fine grained or strongly intergrown metal bearing waste streams
 - Ore dressing
 - Special comminution technologies
 - Flotation (new approaches for surface treatment before flotation)
 - Preconcentration hydrometallurgy: esp. leaching, solvent extraction, ion exchange processes

From lab scale to small technical plant machinery

- CUTEC Institute GmbH (state (Lower Saxony) research institute at Clausthal connected to CUT)
 - Department of Metal Recycling
 - Upscale of developed technologies (at CUT) to pilot scale plants
 - Transfer development to industry
 - Major fields of competence are ores and waste streams containing
Cu, Pb, Zn, In, Ga, Ge, Ta, W, REE

RWTH Aachen University, Germany



Homepage RWTH Aachen, © Martin Lux

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In year 2013

- about 40400 students
- 9 Faculties and 260 institutes
- Ca. 500 professors
- AMR is part of the faculty
Georesources and Materials
Engineering

Focus of Research at AMR

1. Dry gravity separation
2. Sensor-based sorting
3. Processing of fines (e.g. flotation)
4. Small scale mining

Dry gravity separation

Motivation for dry processing

- Large amounts of water required for mineral processing
- Water is a limited resource
- Many future deposits will be in permafrost and arid climates

→ Dry Processing?!

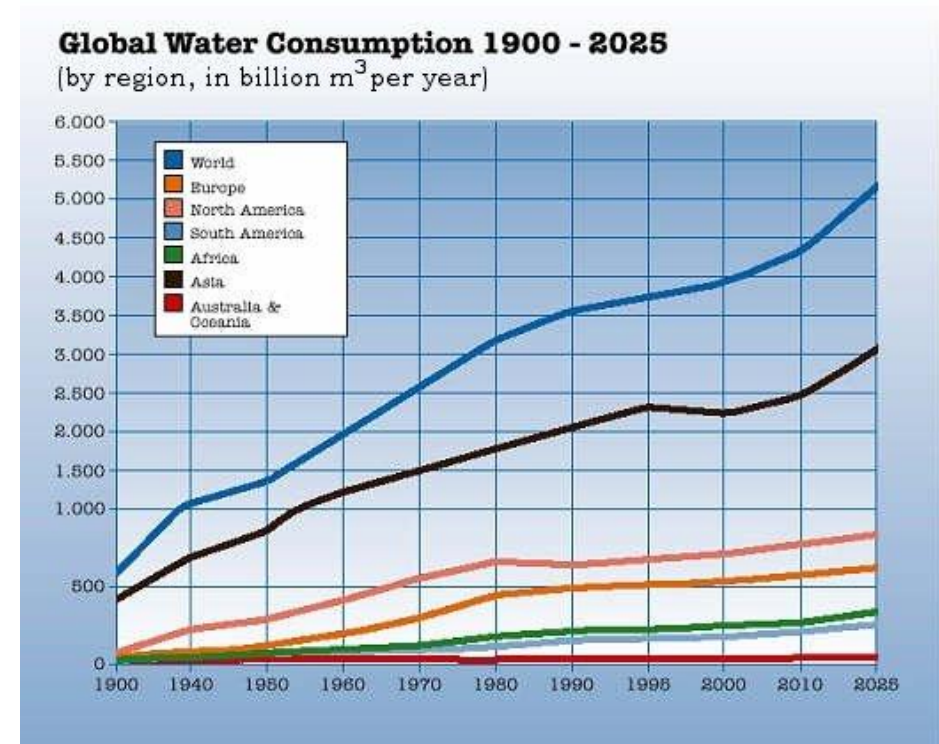
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Historical and future water consumption



2000: 3900 km³

2025: 5100 km³ (+31%)

Dry jigging

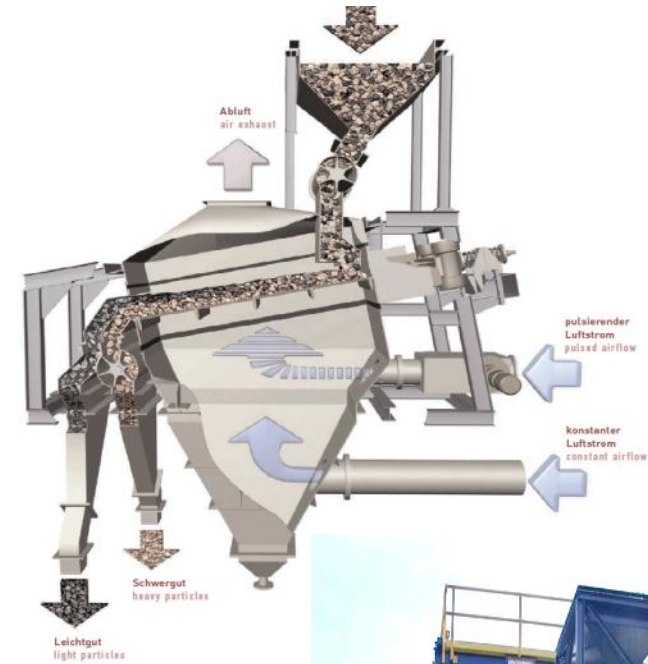
- Developed between 2000-2001 in cooperation with Allmineral
- Feed: coal, slag, iron ore, ...
- Size: 3-50 mm
- Throughput about 50m³/h

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Principle of dry jigging



Dry air-jig in production

Today, about 50 machines are in use worldwide

Fluidized bed separator for fines

- A new generation of dry separation of fines (-2 mm)
- Developed in 2006-2008 in cooperation with Cala Processing
- Main fields of application is slag, mineral sands

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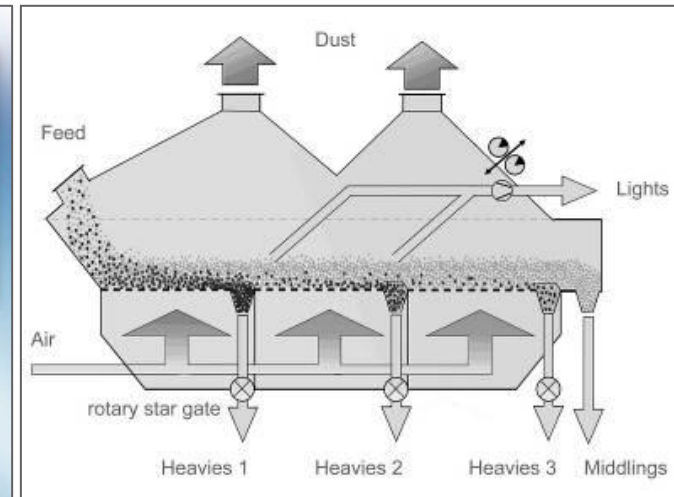
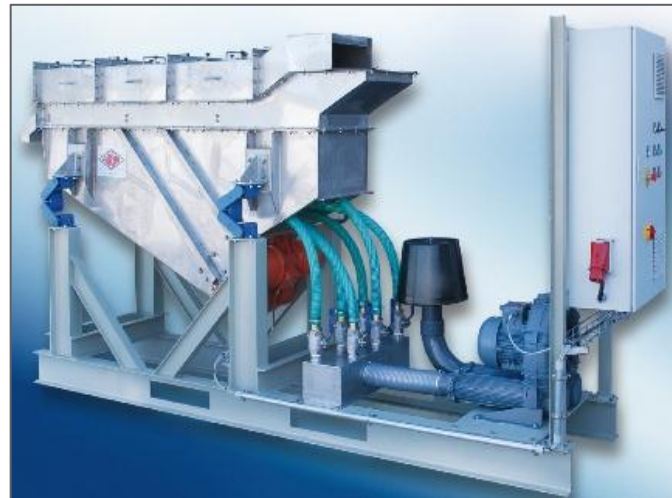
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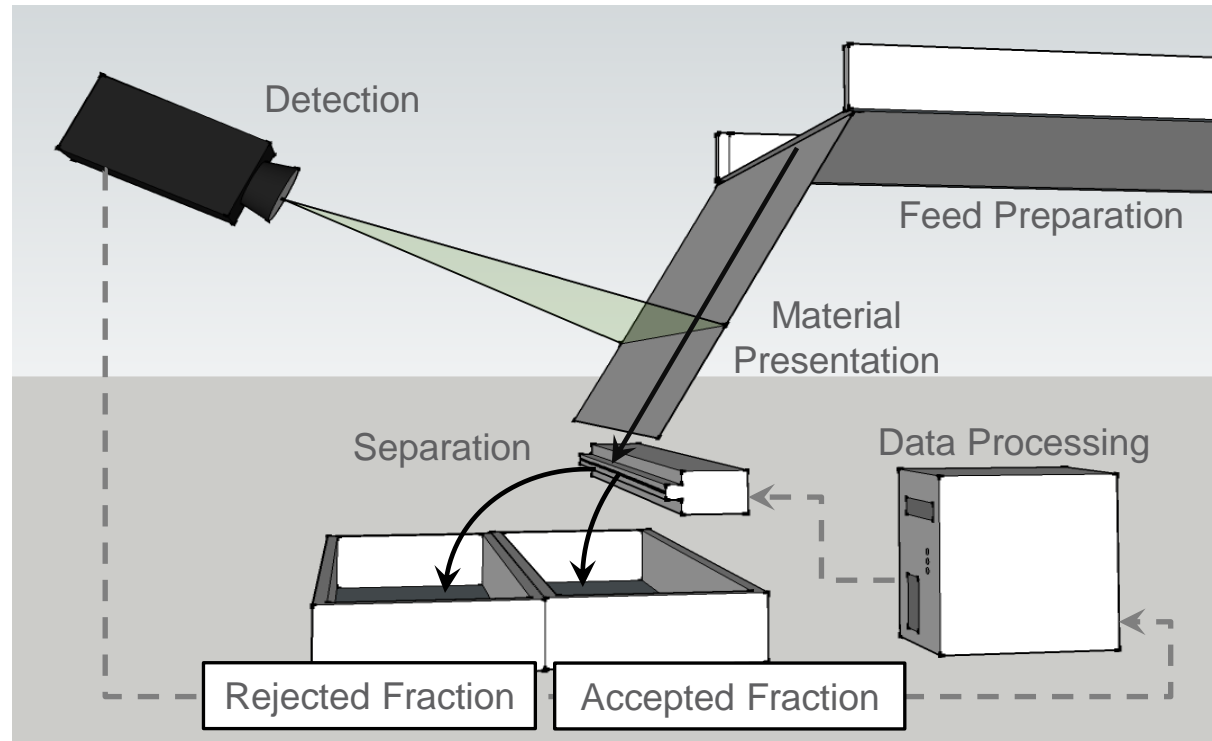
Successful test work has been conducted on commodities such as:

- Iron ore
- Platinum
- Slag
- Salt
- ...



Sensor-based sorting

Sensor-based sorting



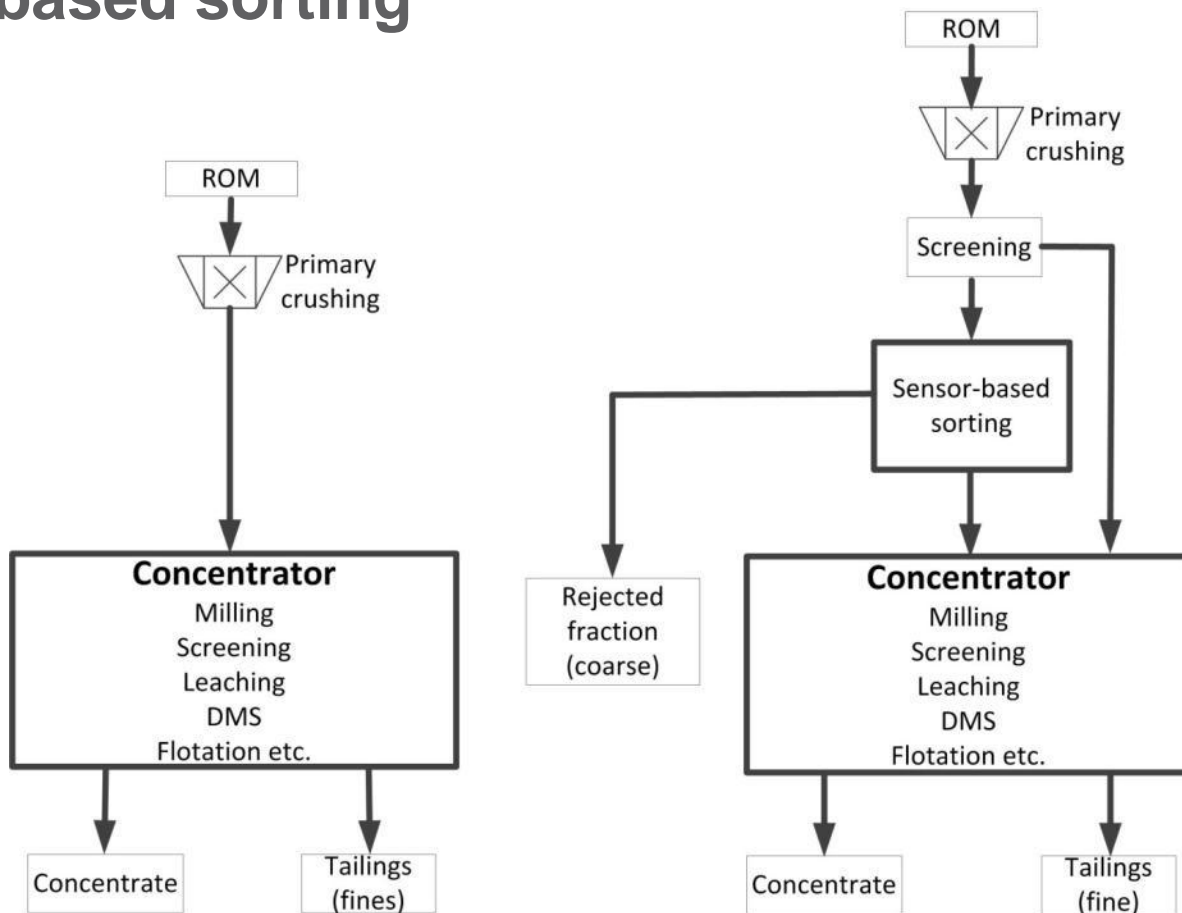
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Available and applied sensor systems for the raw materials industry

- Optical (color)
- Near infrared spectroscopy
- Metal detector
- X-ray fluorescence
- X-ray transmission
- Radiometric sorting

Conventional processing vs. Processing with sensor-based sorting

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Conventional beneficiation process

Processing with sensor-based sorting

- Reduced processing costs
- Less water consumption
- Less fine waste
- Lower cut-off grade

Products of optical sorting

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Product



Eject



Feed



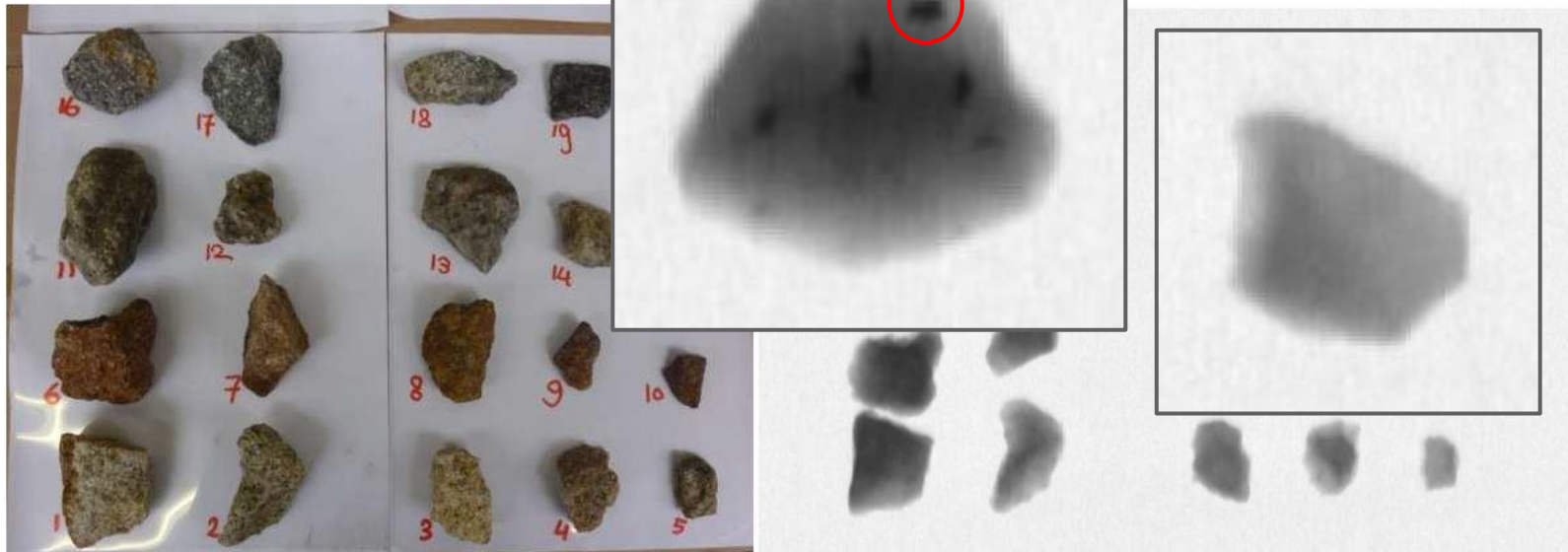
Product



Test measurement of scheelite with XRT

- Inclusions of scheelite can be identified on the XRT-image

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Source: CommodasUltrasort

Summary

- Dry gravity separation is an alternative to conventional wet gravity separation

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- Sensor-based sorting can reduce processing costs

➤ Dry gravity separation

➤ Sensor-based Sorting

- Sensor-based sorting can lead to a better resource utilization due to lower cut-off grade

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THANK YOU FOR YOUR ATTENTION!