BRGM Experimental Facilities for Mineral Resources Processing and Waste Recycling
BRGM PLATFORM

A 2000 m² technology development facility

A R&D Platform for Technology Innovation in Raw Materials Processing and Waste Recycling

The BRGM Experimental Facilities for technology innovation are held in a 2000 m² hall dedicated to collaborative R&D studies and commercial applications in the field of mineral resources and waste.

This platform is composed of more than 200 mineral processing unit operations ranging from the laboratory to pilot scale. This equipment can be operated in batch mode or integrated in continuous processes. Various types of material can be studied: ores, concentrates, mining wastes, municipal wastes, urban wastes (WEEE, ELV,…). The sample size that can be studied varies from several grams to several tons.

All mineral processing operations for the treatment of mineral resources and wastes can be tested using our equipment: sampling, concentration (gravimetric, magnetic, flotation). The facility also contains equipment for hydrometallurgy (with a specific expertise in bioleaching), thermal processing and processing under pressure and in a controlled atmosphere (autoclaves).

BRGM staff are experienced technicians, engineers and researchers. They operate this multi-scale facility:

- To improve the knowledge of ore and urban deposits composition with better sampling and characterization methods,
- To elaborate innovative, integrated and optimized process flowsheets,
- To optimize the use of comminution, concentration and extractive metallurgy technologies on specific materials,
- To obtain reliable data to validate numerical models for the processes under development.

Collaborative R&D and commercial partnerships are covered by confidentiality and consortium agreements.
<table>
<thead>
<tr>
<th><strong>BRGM EQUIPMENT</strong></th>
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</thead>
<tbody>
<tr>
<td><strong>Comminution</strong></td>
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<td><strong>Sampling, classification and conditioning</strong></td>
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<td><strong>Electric and magnetic separation</strong></td>
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<td><strong>Thermal and pressure treatment</strong></td>
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<td><strong>Solid-liquid separation</strong></td>
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<th>4-7</th>
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</table>
CONTINUOUS MILL

<table>
<thead>
<tr>
<th>Jaw crusher</th>
<th>10 t/h</th>
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<tbody>
<tr>
<td>Roll crusher Wedag</td>
<td>1-2 t/h</td>
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<tr>
<td>Impact crusher</td>
<td>1-2 t/h</td>
</tr>
<tr>
<td>Gyratory crusher</td>
<td>3-5 t/h</td>
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<tr>
<td>Shredder</td>
<td>0.2-1 t/h</td>
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<tr>
<td>Jaw crusher</td>
<td>5-10 t/h</td>
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<tr>
<td>Vibrating mill Palla (20U)</td>
<td>20-500kg/h</td>
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<tr>
<td>Hammer mill</td>
<td>50-500 kg/h</td>
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CONTINUOUS MILL

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Capacity (kg/h)</th>
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<tbody>
<tr>
<td>Vertical agited mill</td>
<td>10-300</td>
</tr>
<tr>
<td>Roller mill</td>
<td>50-200</td>
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<tr>
<td>Giratory mill</td>
<td>10-100</td>
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<tr>
<td>Ball mill</td>
<td>50-100</td>
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<tr>
<td>Rod mill</td>
<td>10-50</td>
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<tr>
<td>Jaw cruscher</td>
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CONTINUOUS MILL

- Disk mill
  10-15 kg/h

- Cutting mill
  5-20 kg/h

- Hammer mill

- Wet high shear stress mill Netzch
  0.1-5 kg/h

- Jet mill Alpine
  3-30 kg/h

- Laboratory shredder
Autogeneous mill
550 L

Ball mill with ceramic coating
200 L

Ball and rod mill
70 L

Turbo-desliming washer
20 L

Bottles rig for ceramic or inox jar
2-5 L

Ball mill
3 L

Bond Work Index jar

Planetary mill with controlled atmosphere
**CLASSIFICATION**

- **Aerodynamic separator** Pfeiffer 50-200 kg/h
- Washing trommel (D = 0.9 m, L = 4 m)
- **Desliming deck**
- **Rotary sieves shaker** (400 mm and 200 mm)
- **Double deck screen** 1-3 t/h
- **Double deck screen** 2-5 t/h
- **Dry double deck screen** 2-5t/h
- **Screen for municipal solid waste** (batch)
- **Aerodynamic separator** for ultra-fine Alpine 50-200 kg/h
- Micro-hydrocyclone test rig
SAMPLING

Rotating sampler 4 parts
Coarse material < 150 mm

Pulp cross sampler 3 Minemet
0.1-5 m³/h

Rotating pulp sampler

Pneumatic sampler (complete bypassing)

Automatic cross sampler 1/100
Solid < 10 mm

Pulp sampler

Half size static sampler
50 mm

Pulp sampler
SAMPLING, CLASSIFICATION AND CONDITIONING

**CONDITIONNING**

- Arm mixer
  - 10 L

- Screw extruder
  - 50-200 kg/h

- Wet drum scrubber
  - (D = 500 mm)

- Lump breaker

- Mixed Manurhin

- mixer

- Disc pelletizer

- Attrition cell (double wall)
  - 7 L

- Attrition cell
  - 2x30 L

- Laboratory attrition cell

- Attrition cell
  - 2x60 L
Electrostatic separator Carpco

Dry high gradient magnetic separator Lenoir 1000/1300 G

Low intensity magnetic separator Sala 1000 G

Eddy current Separator Goodsmit

Dry low intensity magnetic drum separator

Magnetic over-band

High intensity magnetic drum separator Sime 0,1-0,5 t/h

Wet high gradient magnetic separator Boxmag 0,5-2t/h

Wet high gradient magnetic separator Boxmag 18 000 G
GRAVIMETRIC SEPARATION

Screw classifier
50-75 m³/h

Screw classifier
5-15 m³/h

Pneumatic table Lenoir
S = 1 m²

Shaking table Wilfley
S = 1 m²

Shaking table Wilfley half size
S = 3 m²

Gravimetric centrifugal concentrator Falcon

Screw classifier

Gravimetric centrifugal separator Mozley MGS-C900

Gravity test table superpanner Mozley

Jig bench test Krupp
GRAVIMETRIC SEPARATION

Jig Schabaver

Spirals
Laboratory flotation cell

Stainless steel triple flotation cell
Wemco 3x60 L

Stainless steel simple flotation cell
Wemco 60 L

Stainless steel double flotation cell
Wemco 2x60 L

Stainless steel conditionning tank
**Microwave oven**
Power 600 W to 6 kW

**Muffle furnace**
5 L, T° max = 1450°C

**Leak tube furnace with controlled atmosphere**
50 ml, T° max = 1600°C

**Muffle furnace**
3 L, T° max = 1100°C

**Box furnace**
T° max = 1100°C

**Autoclaves**
2 L, P max = 300 bars, T° max = 200°C
Glass reactor vessel with double wall 5 L

PTFE mixer-settler

Inox reactors with double wall 1x50 L + 3x20 L

Reactor 1m³ with double wall and brogim agitator
Belt filter Philippe
S = 0.5 m²

Press filter Choquenet
Frames = 0.4x0.4 m

Filter bell
S = 0.3 m²

Press filter Netzsch
Frames = 0.2x0.2

Press filter Choquenet,
Frames = 17.5x12.8 cm

Rack thickener
20 m³
BRGM is the French Geological Survey. It is the leading public institution in the Earth Science field for the sustainable management of natural resources and surface and subsurface risks. The various role of BRGM can be described as follows: technology research and development aid, support for public policies and citizen information, international cooperation and development aid, safety and monitoring of former mining sites. Details are available at www.brgm.fr.

The BRGM Pilot Facilities team has substantial experience in the development of innovative processes for recycling and waste management, and has recognized expertise in mineral processing and biohydrometallurgy from lab scale to the engineering of industrial scale plants.

References:

- Concrete Waste recycling (collaborative R&D French projects ANR COFRAGE and

- Polluted sediments treatment (collaborative R&D French and European projects ANR PROPSED and InterReg GEDSET)

- Recovery of strategic metals in electrical and electronic waste and residues from automobile shredding (collaborative R&D French and European projects FP7 REWARD; ANR VALOPLUS, ANR REFORBA, ANR EXTRADE)

- Treatment of ores and tailings with low concentration (European projects FP6 BIOMINE, BIOSHALE, FP7 PROMINE, ANR ECOMETALS)

- Sulphide ores biolixiviation (commercial services)

- Sampling, fragmentation and classification of solids (commercial services)