Loesche Mills for
Metal Recovery
and Filler Production
from Steel Slag
Features of the Loesche process for the complete and dry processing of steel slag

This dry process developed by Loesche for recovering metals from steel slag combines all the advantages of conventional processes:

- Efficient and cost-effective metal recovery in the coarse range
- Virtually 100% metal recovery down to the finest fractions range by means of optimised dry grinding, classification and sorting technology
- Production of a high-quality mineral filler product with precisely definable grain size distribution

The process is particularly suitable for

- Slag from the production of stainless steels
- LD slag
- Metallurgically modified slag

Following coarse slag processing (recovery of metal e.g. +20mm, crushing of the mineral components to -20mm) by means of crushing, screening and sorting technologies such as handpicking, sensor sorting, magnetic separation and/or dry density separation, a pre-crushed slag fraction is fed into the Loesche mill. Selective grinding and classification of the mineral fraction to the desired fineness, and treatment and pre-concentration of the metal content are performed simultaneously in the mill. The range of fineness of the mineral fraction can be varied, thereby allowing fineness levels of -2mm as well as 5,000 Blaine or more to be adjusted. The mills operating principle permits the utilisation of both the different levels of grindability and the different specific densities of the substances contained in the grinding stock for separation.

While a defined filler product exits the mill through the classifier situated at the top of the mill in the direction of the filter and silo plant, a high grade metal fraction is discharged via a chute outlet in downward direction. If the flow of metal does not yet achieve the desired purity of +90% metal, further concentration stages by means of sensor, magnetic and/or density separation are installed downstream. In that case the non-metallic product of the sorting process is recycled to the mill. This way, it is possible to recover virtually 100% of the metal as metal product and 100% of the mineral product as precisely defined and metal-free filler.

The Loesche process therefore offers the possibility of creating two marketable products in a single unit and additionally has the advantage of avoiding the necessity to treat the residual slurry that is otherwise customary in wet processes.

A typical process variation for special steel slag reduction is depicted in the following flow diagram.
Operating principle of metal recovery in a Loesche mill

The metalliferous slag to be comminuted is introduced centrally or from the side into the mill.

On the grinding table the material moves under effect of centrifugal force towards the edge of the grinding table and in this way passes under the hydropneumatically spring-loaded grinding rollers.

The mineral fraction is selectively ground by the mechanical strain during the comminution process under the grinding rollers, while the metal particles are only superficially liberated from adherent mineral particles and their particle shape is retained to the greatest possible extent. The heavier metal particles concentrate on the grinding table, while the mineral fraction concentrates above.

The ground particles are transported over the dam ring into the gas flow.

The light mineral fraction is carried by the gas flow to the classifier. The metal particles – on account of their higher specific density – are not intercepted by the gas flow and descend against the gas flow into the discharge system.

Material of the mineral fraction to which metal still adheres is rejected by the classifier and returned via the so-called grit cone to the grinding process.

Small amounts of the mineral fraction still naturally adhere to the metal fraction discharged in the downward direction. If necessary these mineral particles can be separated in subsequent sorting steps.

With this operating principle it is possible to recover nearly 100% of the metals.
Example of a process flow diagram for the complete and dry processing of slag with the Loesche vertical mill

1 Wheel loader
2 Conveyor belt
3 Jaw crusher
4 Impact crusher or cone crusher
5 Conveyor belt
6 Screen
7 Handpicking, sensor sorting, magnetic separation, dry density separation
8 Conveyor belt with metal detector
9 Intermediate silo
10 Proportioning conveyor
11 Rotary star gate feeder
12 Loesche mill
13 Filter
14 Volumetric flow measurement
15 Mill fan
16 Stack with flap
17 Recirculation gas line with flap
18 Hot-gas generator
19 Rotary star gate feeder
20 Conveyor belt
21 Bucket elevator
22 Product silo, filler
23 Filler transportation
24 Discharge system, metal fraction
25 Conveyor belt, metal fraction
26 Magnetic separation
27 Sensor sorting
28 Dry density separation
29 Conveyor belt
30 Metal fraction
31 Conveyor belt, returning mineral fraction to grinding circuit
Coarse grain processing
(metal recovery: 50–70%)
CG
Metal recovery only in the coarse size range (~ +20 mm) by means of simple sorting processes
Products: Coarse metal, pre-crushed mineral matrix with residual metal and hardly defined grain size distribution

Wet grinding
(metal recovery: >95%)
WG
Complete wet fine grinding of the mineral matrix, separation of the metal by means of classification, density separation and/or magnetic separation
Products: Metal, de-watered slimes with hardly defined grain size distribution

Process with wet pre-concentration
(metal recovery: 65–85%)
WPC
Concentration of the metal in pre-concentrates (e.g. by jigging, rising current sorters); wet grinding of the pre-concentrates only
Products: Metal, washed and classified mineral aggregates (e.g. 0/2, 2/8, 8/16…), proportion of finely ground, de-watered slimes with hardly defined grain size distribution

Process with dry pre-concentration
(metal recovery: 50–85%)
DPC
Concentration of the metal in pre-concentrates (e.g. by air jigs, fluidised bed separators); dry grinding of the pre-concentrates only
Products: Metal, classified mineral aggregates (e.g. 0/2, 2/8, 8/16…), proportion of finely ground dust as defined filler product

Dry grinding Loesche
(metal recovery: >95%)
DGL
Complete dry grinding of the mineral matrix, separation of the metal by means of classification, density sorting and/or magnetic separation
Products: Metal, variable filler product (e.g. filler quality, 5,000 Blaine…)

Precondition: High-value application for the filler product compared to low-value application of the dewatered slimes product from wet processing.

Extensive application analyses have shown that dry grinding by the Loesche mill produces a high-quality and versatile mineral filler.
Model series and capacities

Product rate [t/h] as a function of LM size

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<tr>
<th>Product rate [t/h] as a function of LM size</th>
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<tbody>
<tr>
<td>LM 24.2M</td>
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<td>LM 12.2M</td>
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Fineness
- fine
- coarse

Grindability
- heavy
- light

Gearboxes ready for shipment
Stainless steel slag with metal inclusions

Reflected light microscopy with typical phases of a stainless steel slag

Typical element distribution in a stainless steel slag

Filler product

Heavy product (metal) & light product after dry density separation (-2mm)