Loesche Mills for

Metal Recovery and Filler Production from Steel Slag

LOESCHE®

INNOVATIVE ENGINEERING

Features of the Loesche process for the complete and dry processing of steel slag

Loesche Mill type LM 15.200 under construction

Loesche Mill type LM 15.200, Wolica, Poland, 2009

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. +20 mm, crushing of the mineral components to -20 mm) 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 -2 mm 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 ① is introduced centrally or from the side into the mill.

On the grinding table ② 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 ③.

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 ④ concentrate on the grinding table, while the mineral fraction ⑤ concentrates above.

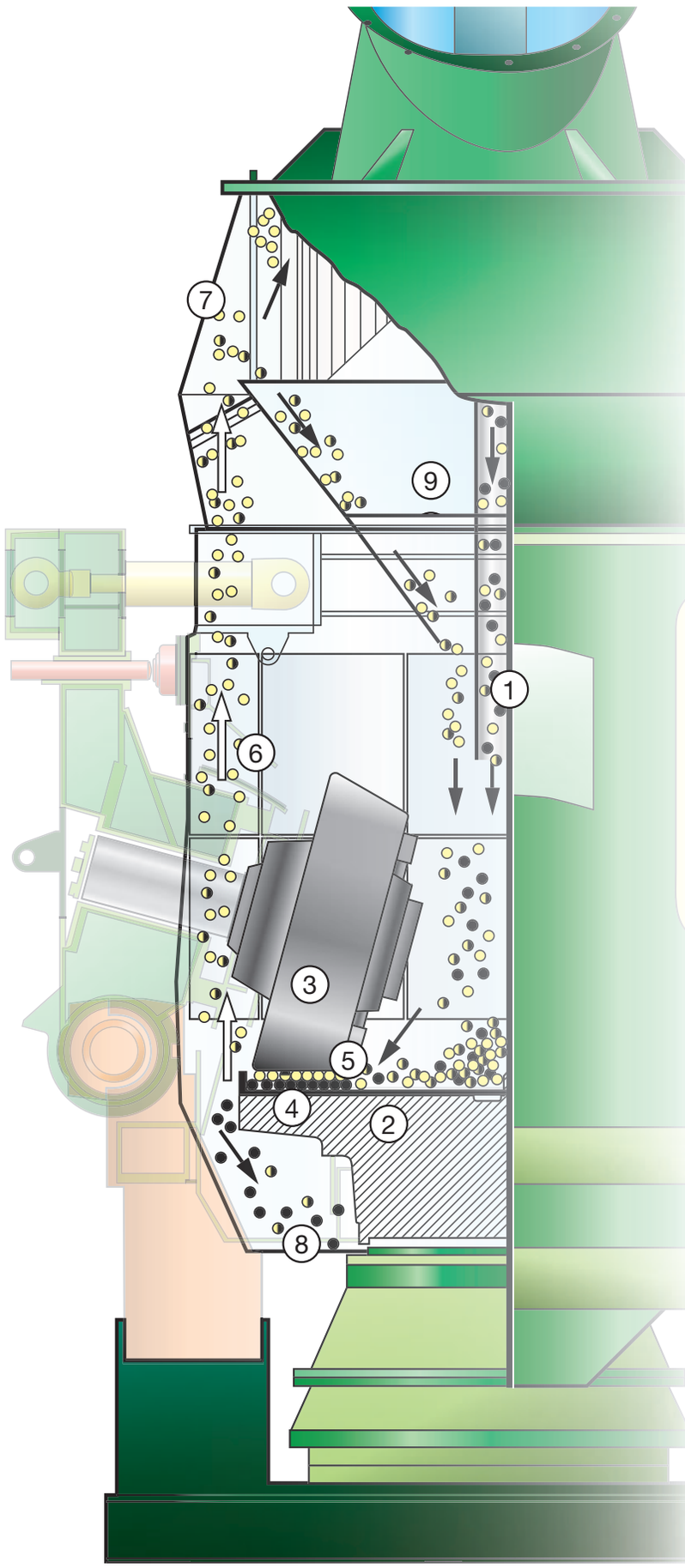
The ground particles are tranported over the dam ring into the gas flow.

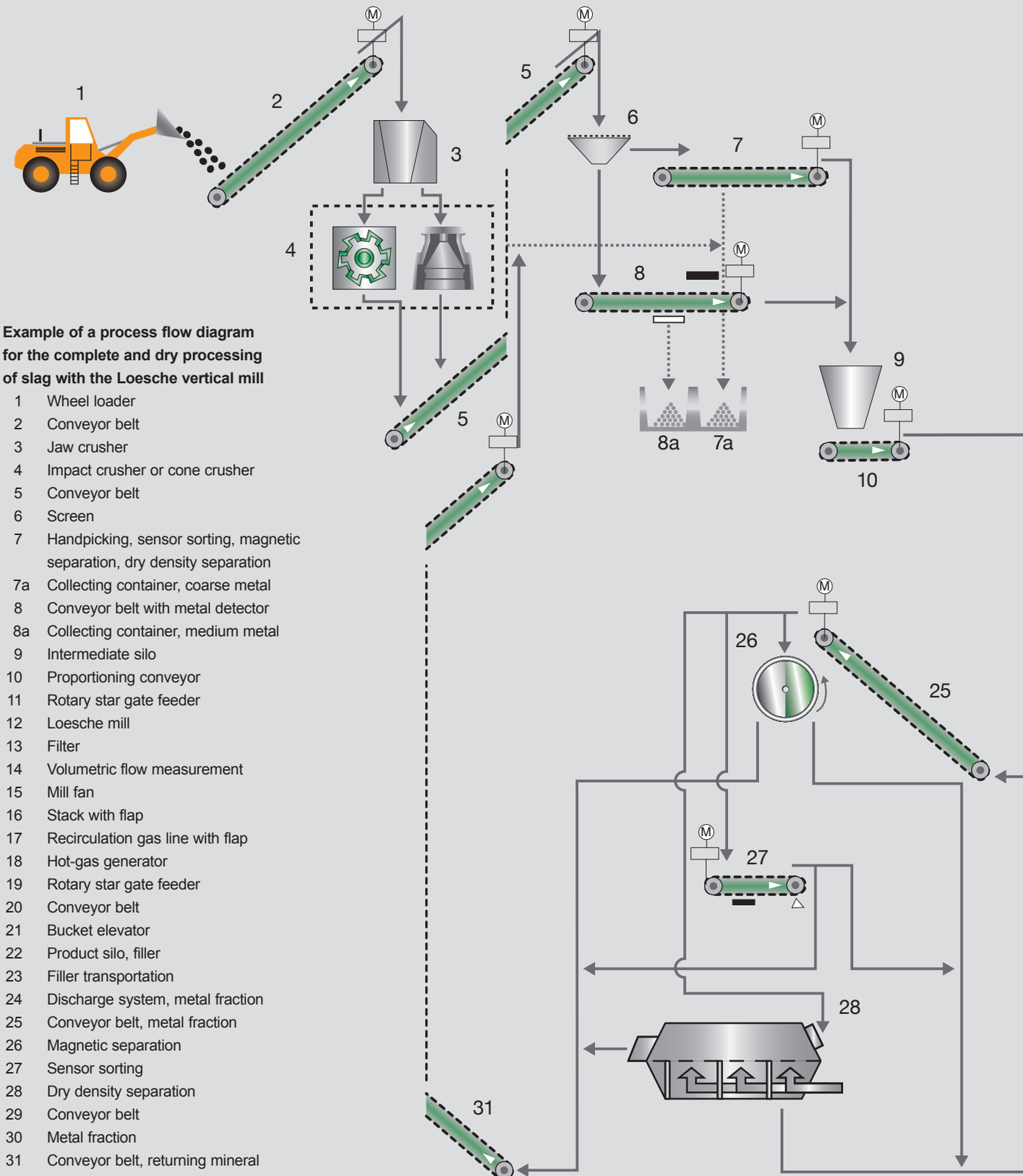
The light mineral fraction is carried by the gas flow ⑥ to the classifier ⑦. The metal particles – on account of their higher specific density – are not intercepted by the gas flow and descend against the gas flow into the discharge system ⑧.

Material of the mineral fraction to which metal still adheres is rejected by the classifier and returned via the so-called grit cone ⑨ 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.

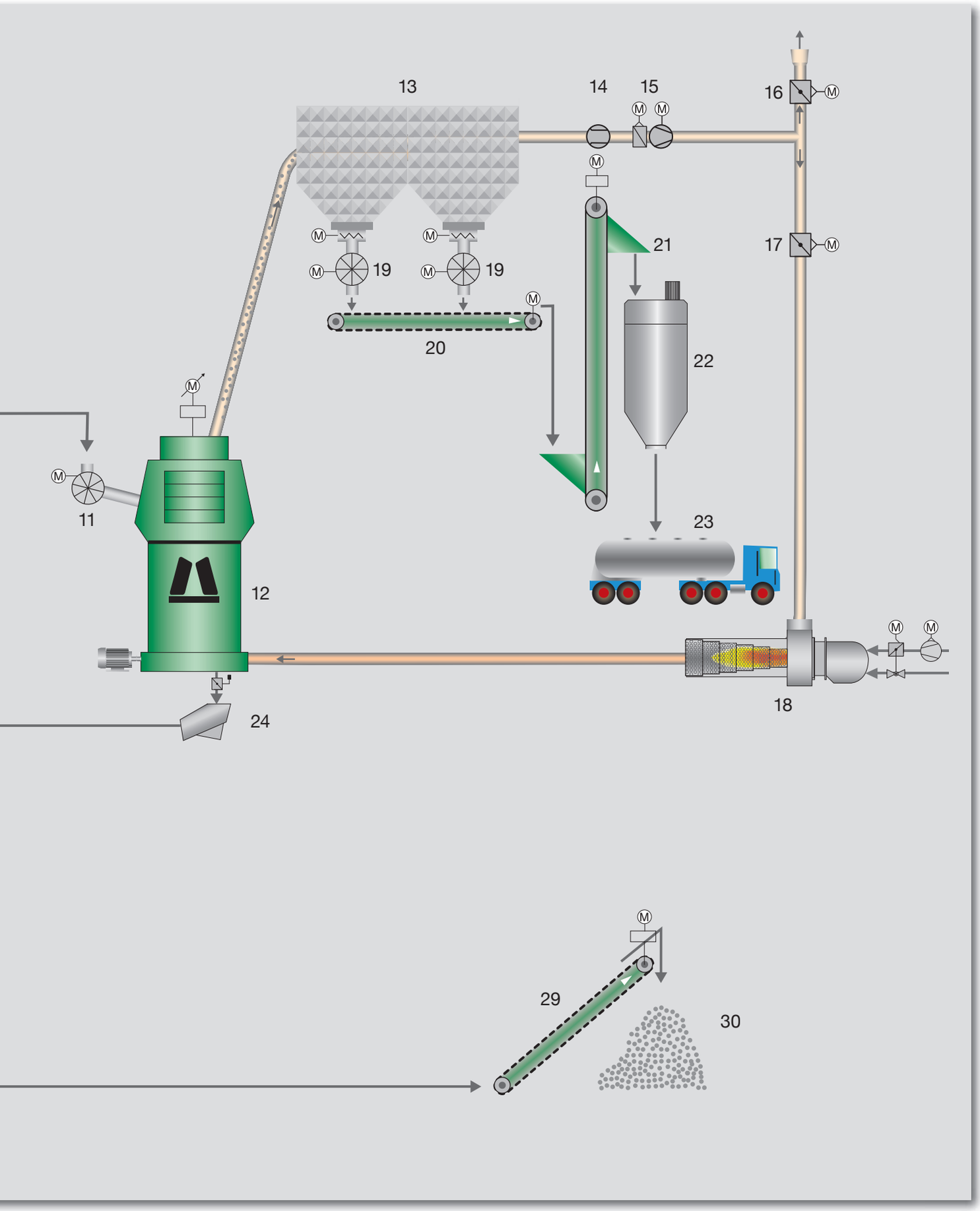
With this operating principle it is possible to recover nearly 100% of the metals.





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
7a	Collecting container, coarse metal
8	Conveyor belt with metal detector
8a	Collecting container, medium metal
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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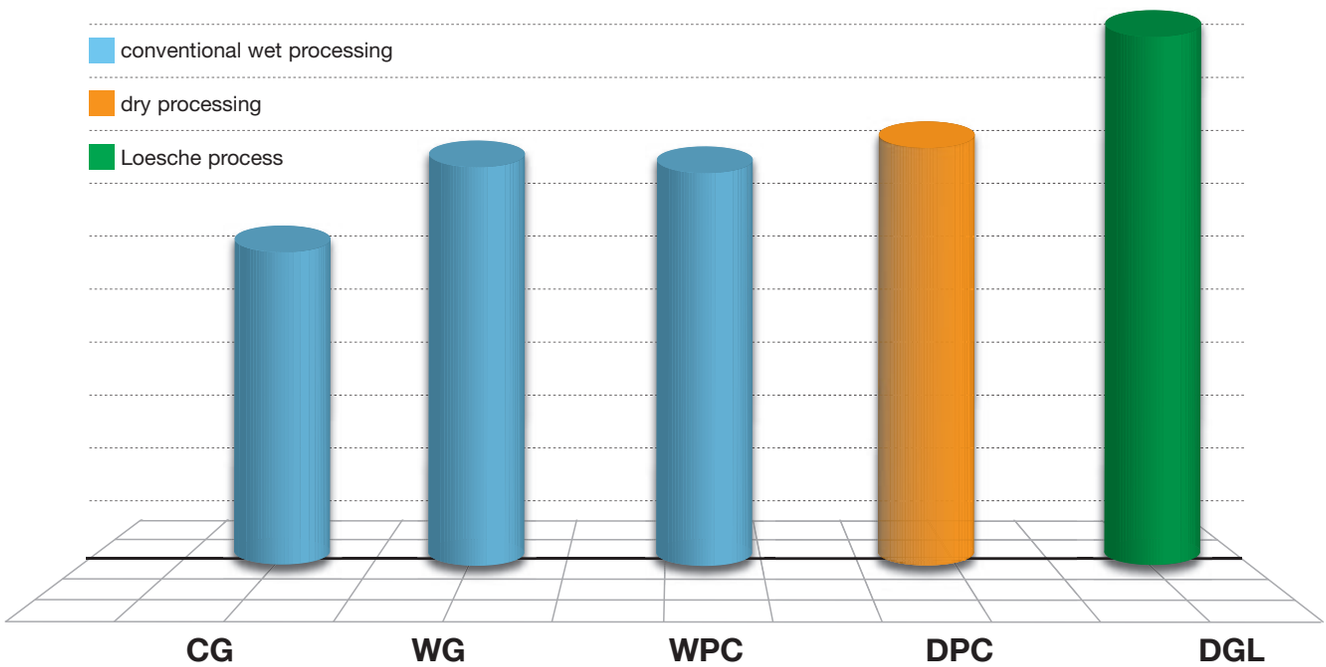
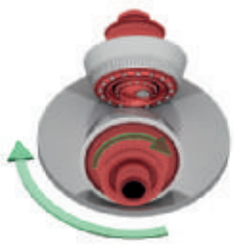
Economic Comparison



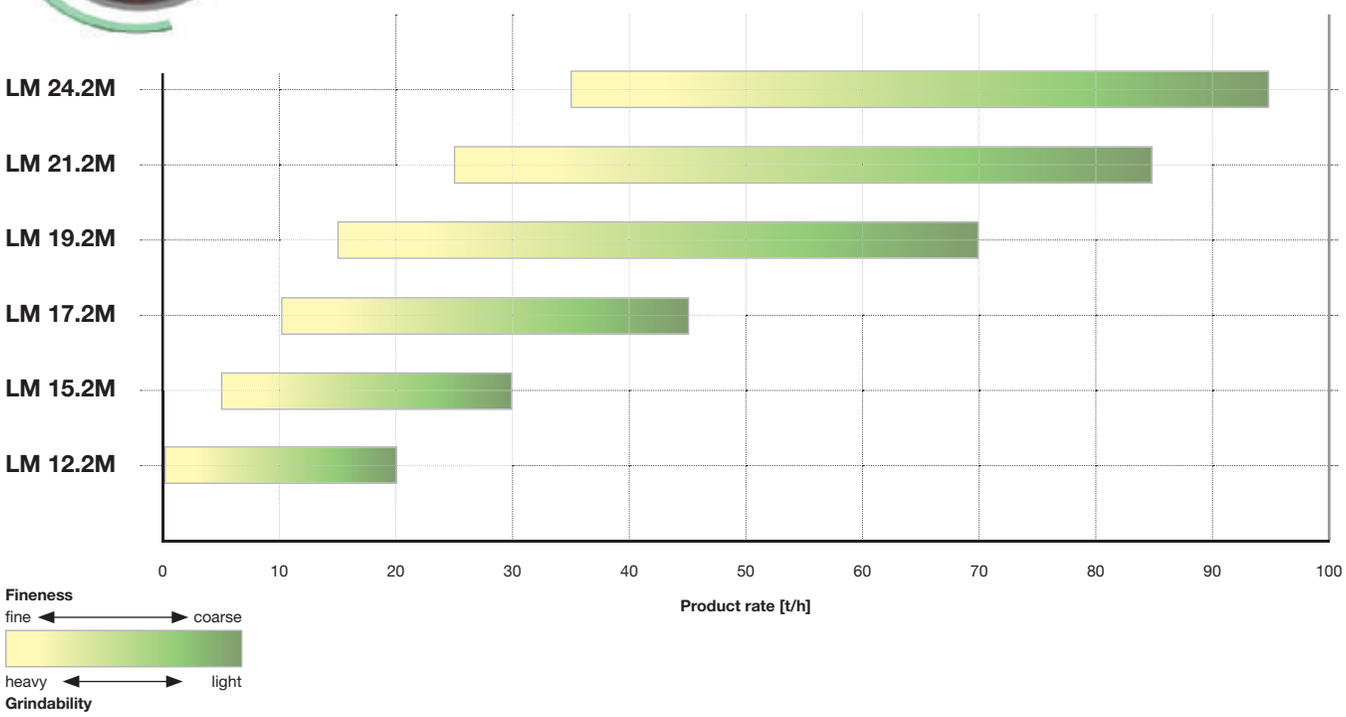
Precondition: High-value application for the filler product compared to low-value application of the dewatered slimes product from wet processing.
Extensive application analyses have shown that dry grinding by the Loesche mill produces a high-quality and versatile mineral filler.

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: 60–85 %)	**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…)

Model series and capacities



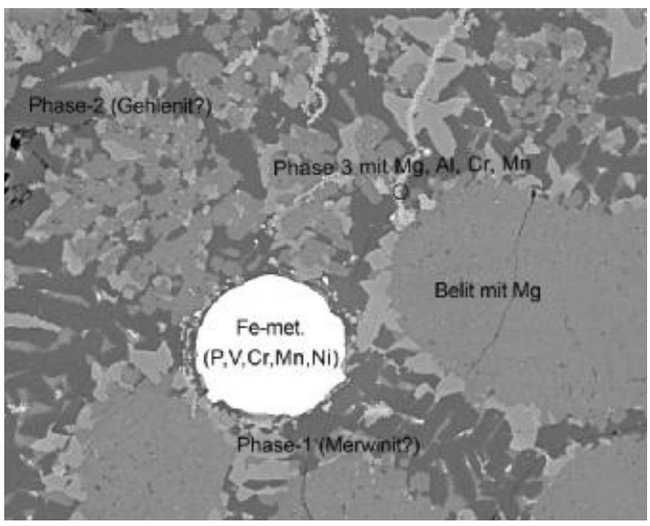
Product rate [t/h] as a function of LM size



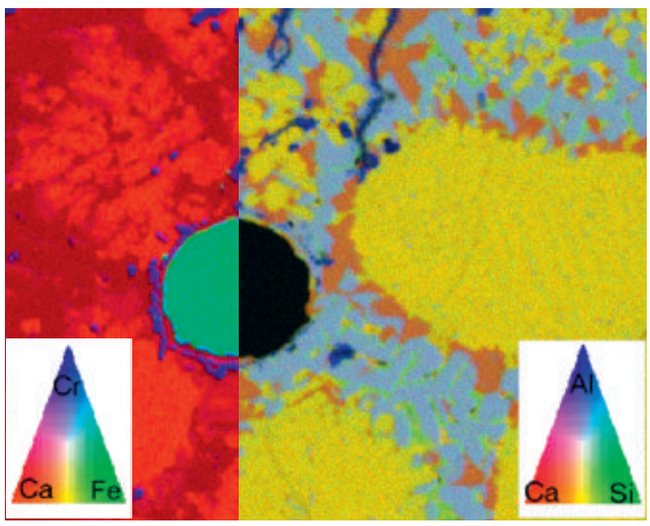
Gearboxes ready for shipment

Stainless steel slag with metal inclusions

Raw slag

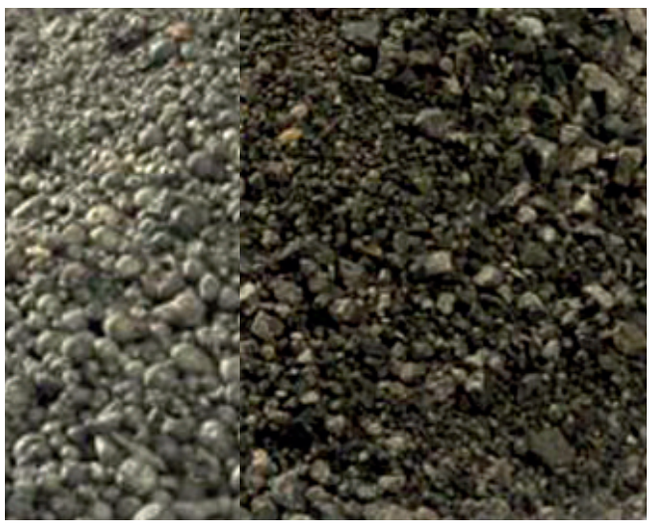


Reflected light microscopy with typical phases of a stainless steel slag



Typical element distribution in a stainless steel slag

Filler product



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

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