LB GROUP

MANAGEMENT OF RAW MATERIALS AND RECOVERY OF PRODUCTION WASTE

The management of raw materials

The importance of having a correct dosage of raw materials to for the grinding process is known.

In the world there are still companies that mix the raw materials in the yard, using the wheel loader.

It is evident that, in this way, there is no certainty of a sufficient homogeneity of the mixture. An inconsistent homogeneity of the body mix can lead to instability of the ceramic production process.

A correct dosage of raw materials allows to have a constant ratio between the different components over time, to the full advantage of the stability of the ceramic production process.

There are two types of plant solutions that allow to obtain a correct dosage of raw materials.

Line with raw material hoppers

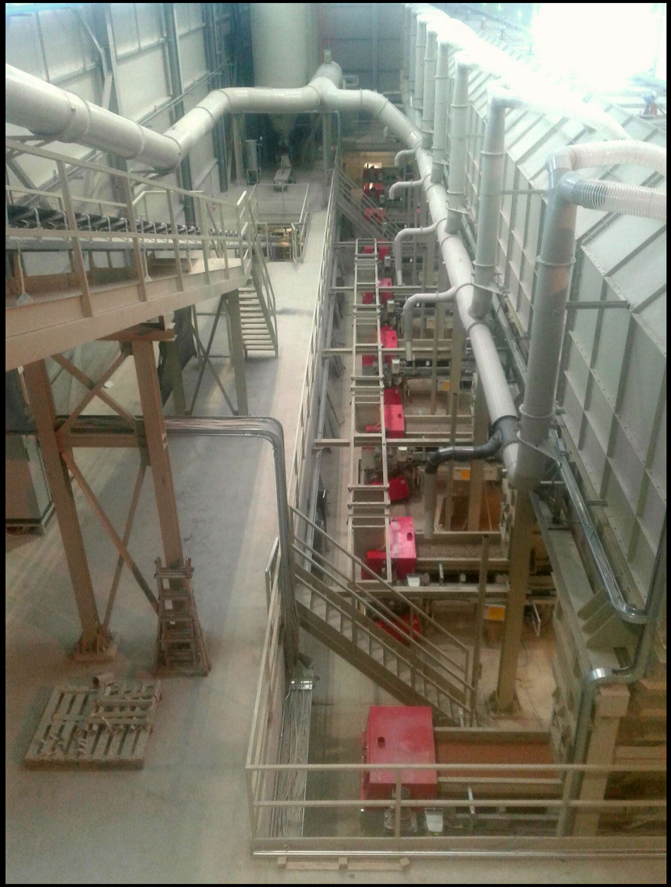
The first type of plant consists of a series of hoppers, each served by a weighing extractor belt. Each weighing extractor belts unload the individual raw materials onto a conveyor belt on which, therefore, the «body mixture» will be present.

Then, a series of conveyor belts bring the body mixture to the mill. The accuracy of the extractor weighing belts is ± 1%.

In this system configuration, the presence of the wheel loader is always required to fill the hoppers.

Line with raw material hoppers

Line with raw material hoppers



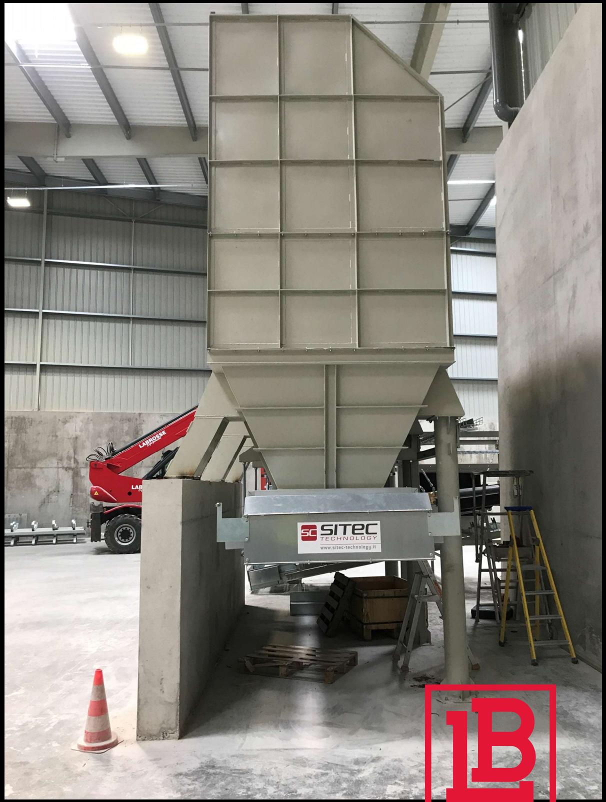
Line with raw material silos

The second type of plant consists of one or two hoppers, through which storage silos for the individual raw materials are loaded. At the base of the storage silos, there are weighing extraction belts which dose the individual raw materials in the correct proportions on a conveyor belt. A series of conveyor belts then bring the dough mixture to the mill.

The accuracy of the extractor weighing belts is around ± 1%.

In this system configuration, once the raw material storage silos have been filled, based on the capacity of the silos themselves, the system can work independently, for a certain time, without the presence of the wheel loader.

Line with raw material silos



Line with raw material silos

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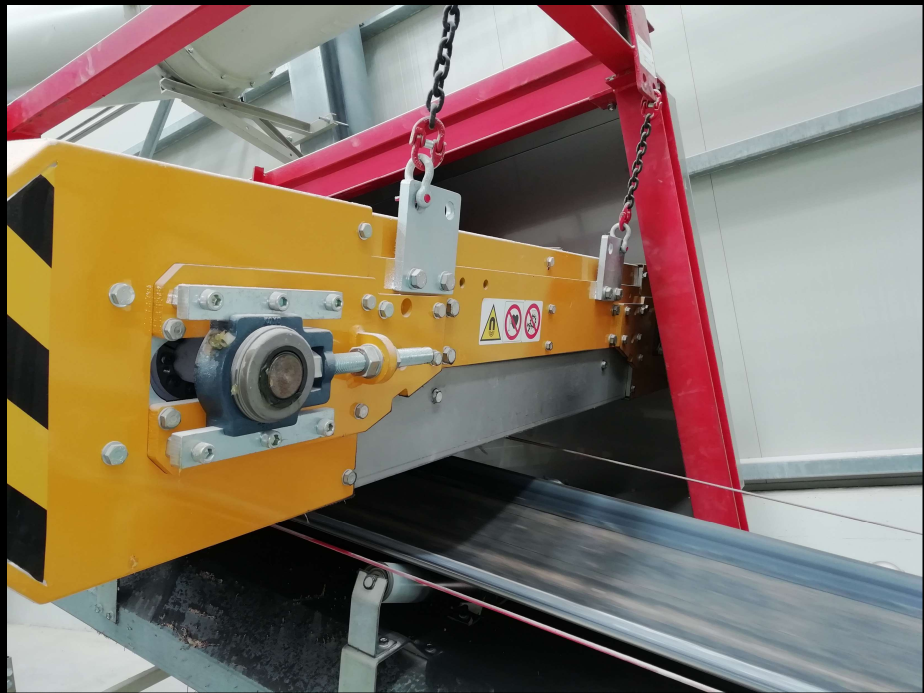
Line with raw material silos

In all the mix preparation plants, on one of the belts that convey the mixture to the mill, there is an iron magnetic separator, to remove any ferromagnetic pollutants.



Scraps or secondary raw materials?

The ceramic industry is able to reuse internally most of the waste that is created during the production phase. The development of production technology makes it possible to use most of the production waste (raw waste, fired waste, sludge coming from washing lines, sludge or powder from polishing line), reinserting them into the ceramic production cycle.

99.5% of the production waste in the ceramic sector is reused within the production cycle and allows to cover 8.5% of the need for mineral raw materials necessary for the manufacturing process.

This avoids the extraction, transport and use of thousands of tons (600,000 t/year) of materials of natural origin such as sands, feldspar, alumina, zirconium oxide, mullite, clays.

Scraps or secondary raw materials?

On the basis of what has been said, the reuse of waste in the ceramic production cycle leads to a reduction in the handling of heavy vehicles used for the procurement of raw materials, thus saving fuels and thus contributing to the reduction of "greenhouse gases". At the same time, a similar amount of materials is subtracted from the waste cycle.

Even the processes of reuse of sludges have been activated for decades in companies in the sector, achieving absolutely remarkable results: all sludges is now recycled during the grinding process. The recycling of sludges contributes about 70% to the water needs of the process (with consequent containment of the withdrawal of water from the groundwater).

Scraps or secondary raw materials?

The solid industrial waste from the ceramic production process can be summarized in 4 categories:

- **Raw ceramic waste powders**: mixture of raw materials, coming from waste or from dedusting plants, originated before the heat treatment.
- **Formed raw ceramic waste**: mixture of pressed raw materials (possibly glazed) originated before heat treatment.
- **Formed fired ceramic waste**: mixture of pressed raw materials (possibly glazed) and subjected to heat treatment.
- **Dust fired ceramic waste**: mixture of powders from dry cutting and squaring operations downstream of the heat treatment.

All these scraps can and must be recovered inside the dough, as a secondary raw material, in the correct percentages.

LB solutions for the recovery of production waste

The raw ceramic waste powders and the fired ceramic waste powders are reintroduced into the production cycle as a small percentage within the body mixture. The powdered waste is collected in dedusting filters. From these filters, the powders are sent, by pneumatic transport, to dosing silos, placed in the raw material dosing area. From the dosing silos, the powders are usually extracted using fixed speed screw conveyors.

LB is also able to offer powder humidification systems, to facilitate the loading of dusty material.

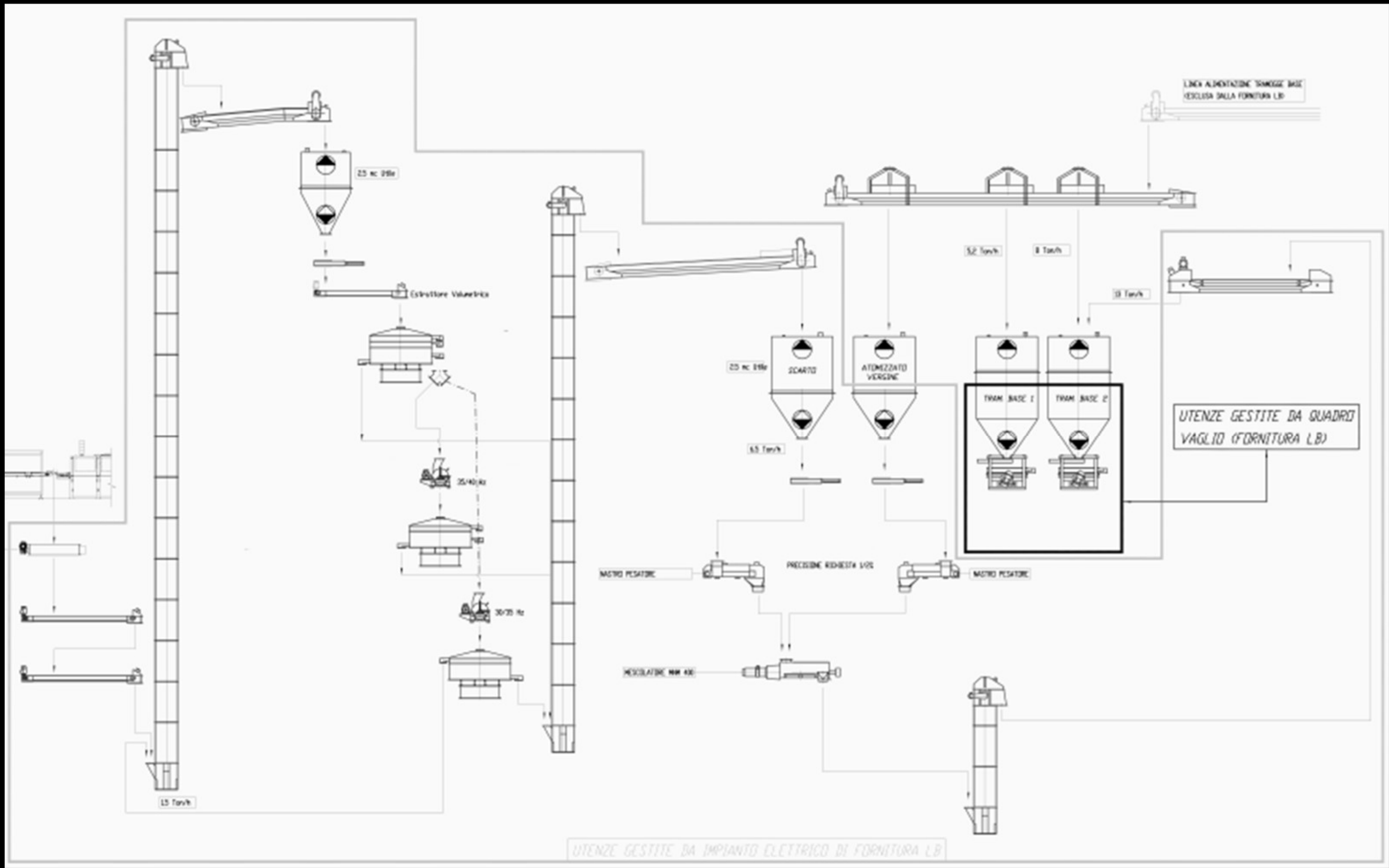
LB solutions for the recovery of production waste

The “green” ceramic waste is reintroduced into the production cycle as a raw material. There is usually a dedicated hopper, in which load the raw waste. The material is then extracted with an extractor weighing belt and dosed in the correct quantity. Being a relatively soft material, it is not essential to pre-crush the material before loading it into the hopper.

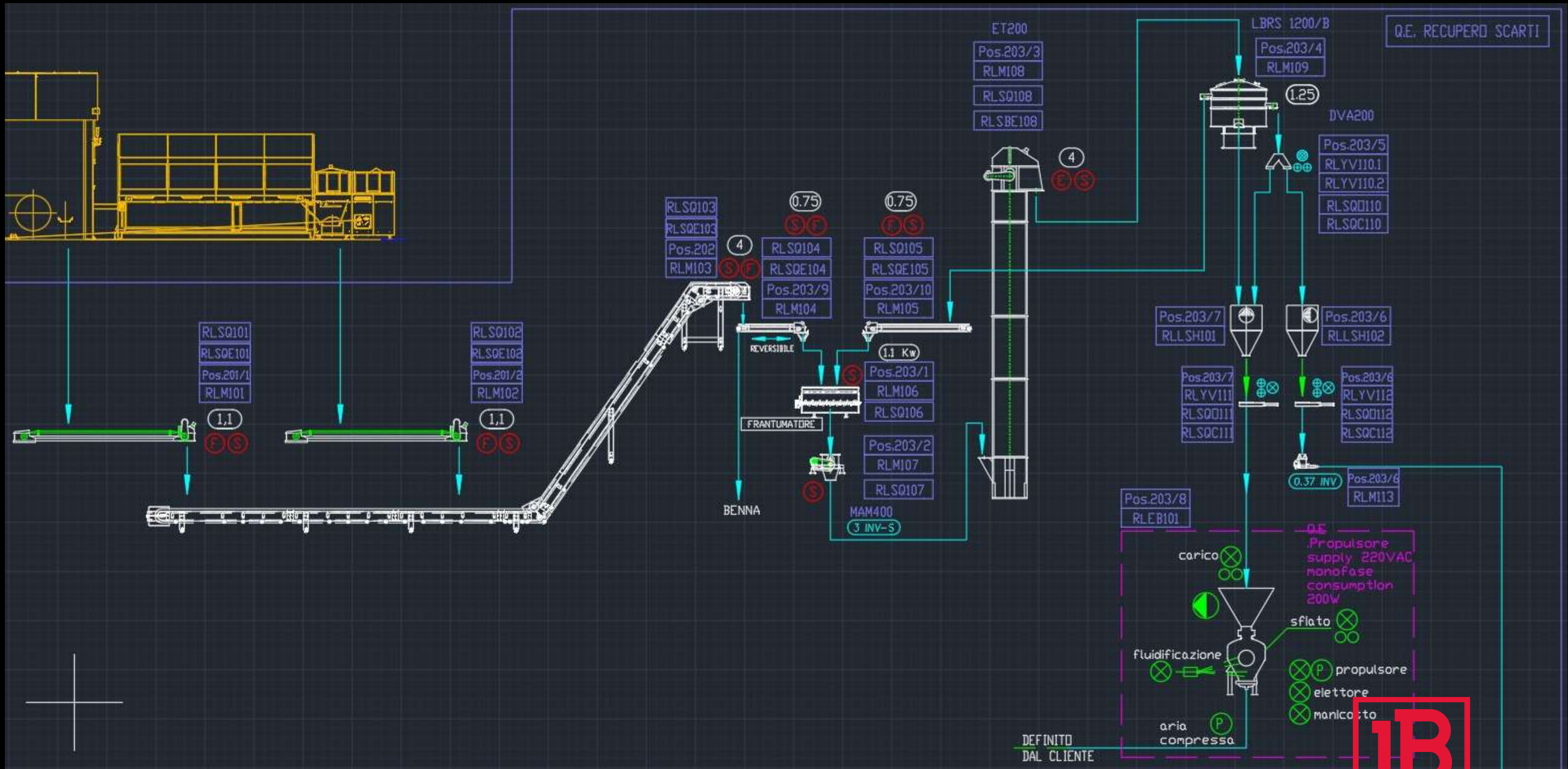
LB offers crushing plants for raw waste, to reuse the product directly in the press, mixed with spray dried powder. This type of plant is mainly used in the recovery of scraps from cutting of ceramic slabs, after the press.

There are two types of systems, similar in philosophy, different in execution. Two schematic flowsheets will be displayed in the following slides.

LB solutions for the recovery of production waste



LB solutions for the recovery of production waste



LB solutions for the recovery of production waste

The fired ceramic scraps is reintroduced into the production cycle as a raw material. There is usually a dedicated hopper, in which load the fired scraps. The material is then extracted with an extractor weighing belt and dosed in the correct quantity.

Fired scraps must be pre-ground in order to be reused in the ceramic production cycle. As with feldspars, in order not to penalize the body grinding phase, the fired sraps must be reduced to a maximum size of 3 ÷ 5 mm.

LB offers some solutions for grinding fired scraps, with thicknesses up to 20 mm:

- SOLUTION 1: the fired scraps must be previously broken with the wheel loader, before they can be fed into the system. The maximum feed size is 150 ÷ 200 mm.
- SOLUTION 2: the line can receive material with feed width up to 1400 mm.

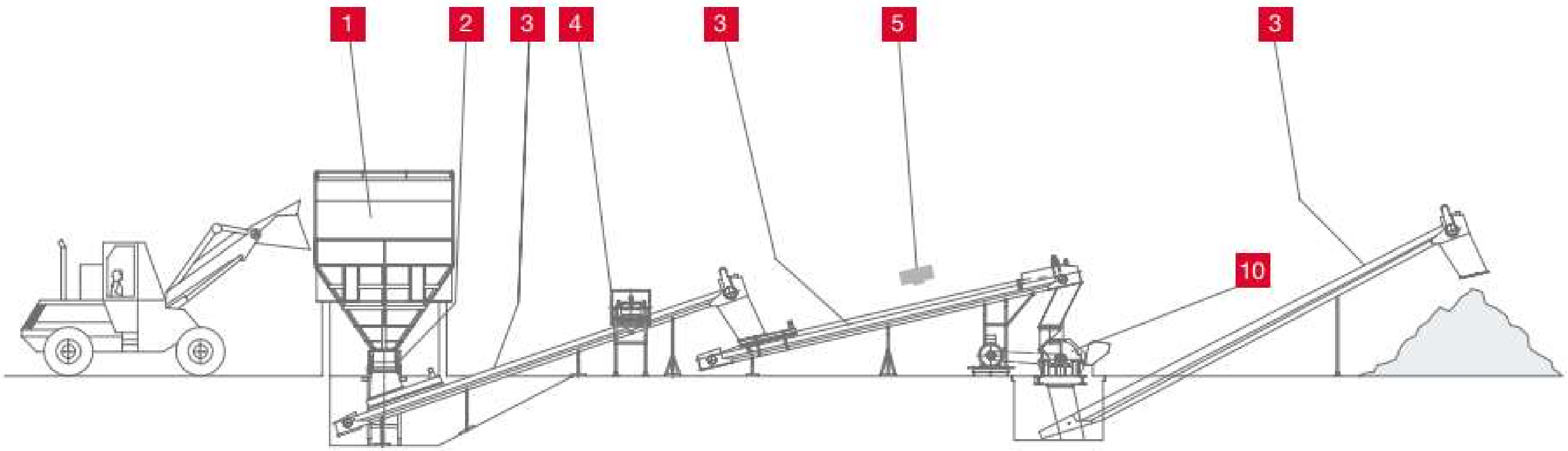
LB solutions for the recovery of production waste: SOLUTION 1

The line consists of a hopper in which load the material. An extractor extracts the fired scraps fragments from the hopper and doses them on the conveyor belt, with which the scraps are sent to the MHP finishing mill. The finishing mill is an impact mill with fixed hammers; in the lower part of the mill there is a grid, for the granulometric control of the ground material.

Mulino con sistema idraulico di apertura e manutenzione rapida
Mill with hydraulic opening system and quick maintenance

Controllo alimentazione mulino con deferrizzatore e metal detector
Mill's fedding control with iron remover and metal detector

LB solutions for the recovery of production waste: SOLUTION 1



1 Tramoggia di alimentazione *Loading hopper*	4 Deferrizzatore a placca *Plate iron-remover*	7 Dosatore *Batching unit*
2 Estrattore a carrello *Car-type extractor*	5 Metal detector *Metal detector*	8 Vaglio inclinato *Sloping sieve*
3 Trasportatore a nastro *Belt conveyor*	6 Elevatore a tazze *Bucket elevator*	9 Polmone alimentazione *Loading compenser*
		10 Mulino MHP *MHP mill*

LB solutions for the recovery of production waste: SOLUTION 1

TUSCANIA® ceramiche

LB solutions for the recovery of production waste: SOLUTION 1

The particle size distribution obtained from the fired scraps grinding plant has an 80% below 3 mm and 57% below 2 mm.

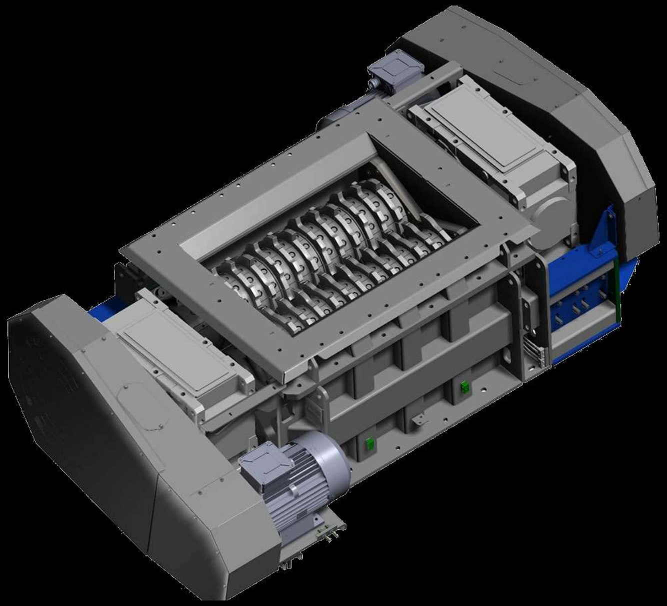
> 6000 um	0,6%
4750 ÷ 6000 um	3,6%
3360 ÷ 4750 um	15,4%
2000 ÷ 3360 um	23,2%
1000 ÷ 2000 um	23,8%
500 ÷ 1000 um	13,3%
0 ÷ 500 um	20,0%

The MHP 96 mill has a productivity of up to 20.000 kg/h, with a 5 mm grid, in the treatment of fired porcelain tiles scraps.

The total specific cost of production, including spare parts and energy consumption, amounts to 7÷8 €/t. This product is reinserted into the body mixture in percentages up to 6÷7% to replace feldspars.

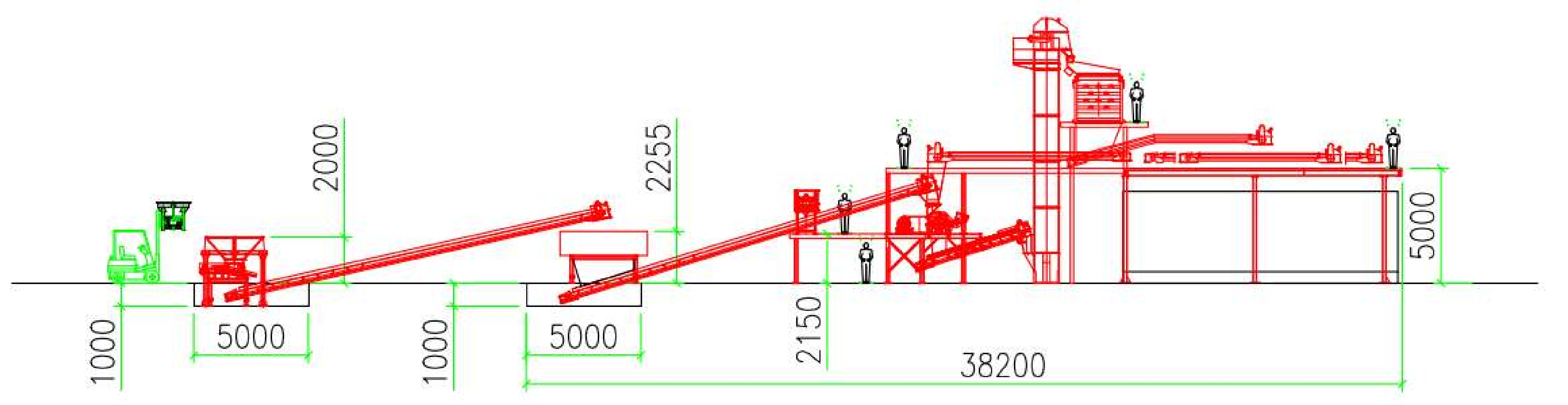
LB solutions for the recovery of production waste: SOLUTION 2

In this plant, a crusher is inserted upstream of the MHP finishing mill; the crisher can be fed with material up to 1400 mm (maximum feed width), giving fragments with a maximum size of 100 ÷ 150 mm at the outlet. The system then continues with SOLUTION 1.



LB solutions for the recovery of production waste: SOLUTION 2

Example of a scraps crushing line, SOLUTION 2, with elevator and final screening.



LB solutions for the recovery of production waste

As an alternative to the MHP mill for grinding fired scraps, LB can offer a machine with opposed cylinders. The machine can produce a specific pressure of 260 kg/cm2 on the material.

LB solutions for the recovery of production waste

The particle size distribution obtained from the laboratory opposing cylinder machine, without screening, has an 85% below 3 mm and 70% below 2 mm, therefore a higher efficiency than an impact mill.

> 6000 um	1,3%
4750 ÷ 6000 um	3,2%
3360 ÷ 4750 um	10,1%
2000 ÷ 3360 um	16,0%
1000 ÷ 2000 um	20,4%
500 ÷ 1000 um	12,5%
0 ÷ 500 um	36,6%

The machine with opposed cylinders is sized according to the production needs of the customer.

As this machine is a "slow" machine, compared to a "fast" impact mill, the wear of the grinding media is lower. From an estimate of the specific cost of the grinding parts, we can state that an impact mill has an indicative specific cost of 2,7 €/t against a cost of a machine with opposed cylinders of 1,0÷1,2 €/t.

LB solutions for the recovery of production waste

LB solutions for the recovery of cooked waste

As previously mentioned, with an impact mill, the total specific cost of production, including spare parts and energy consumption, amounts to 7÷8 €/t. Assuming a plant that produces 330 g/a, a weight of 20 kg/m^2 for the finished product, we can summarize in the following table how much is the annual saving based on production.

2% fired scraps produced			
Prod.	Scraps	Feldspar	Saving
m^2/d	€/t	€/t	€/year
10.000	8	40	42.240,00 €
15.000	8	40	63.360,00 €
20.000	8	40	84.480,00 €
25.000	8	40	105.600,00 €
30.000	8	40	126.720,00 €

3% fired scraps produced			
Prod.	Scraps	Feldspar	Saving
m^2/d	€/t	€/t	€/year
10.000	8	40	63.360,00 €
15.000	8	40	95.040,00 €
20.000	8	40	126.720,00 €
25.000	8	40	158.400,00 €
30.000	8	40	190.080,00 €

Pre-grinding hard fraction of the body mixture

An interesting discussion is that relating to the pre-grinding of the hard fraction of the body mixture.

Pre-grinding the hard fraction of the body mixture it is possible to obtain two interesting results:

1) Pre-grinding the hard fraction to a D90 = 45 µm, the productivity of a continuous mill increase up to 33÷35%.

2) Pre-grinding the hard fraction to a D90 = 450 µm, maintaining the productivity of a continuous mill unchanged, it is possible to drastically reduce the grinding residue. The drastic reduction of the residue gives a greater reactivity to the body during the firing phase, improving the technological features of the finished product (<WA, >MOR) and/or allowing a decrease in the maximum firing temperature, with consequent savings in thermal energy and reduction of CO_2 emissions.

This last point certainly deserves an in-depth study, to transform the concept into numbers.

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Thanks

for your attention