

Italy

A New Circular Economy: ReStoRe – Refractory and Steel Recovery by Deref

Deref S.p.A., an Italian company based in Genoa, is one of the main actors in the European markets of refractory recycling and products for the steel industry (i.e. metallurgical additives and granulated powders). Thanks to its long experience (over 50 years) in the field of glass and steel refractory demolition, industrial waste management and in the production of metallurgical additives, Deref has developed ReStoRe, the world's first plant to manage and treat spent refractory to reuse within the same steel production cycle.

The steel industry is a strategic production sector; however, it puts strong pressure on the environment because of the nature and quantity of the materials involved, gas emissions and waste. In particular, for every ton of liquid steel manufactured, 8–12 kg of refractory material is consumed. Only 33 % of the spent refractory materials produced in Europe is recycled every year, the rest is disposed of in landfill, thus causing high operation costs and negative environmental impacts.

So far, no technology in the steel industry has been developed to achieve recycling rates higher than 50 %. The ReStoRe technology, Deref's latest innovation, is the ultimate Circular Economy solution in the field of steelmaking refractories, allowing up to 94 % of recycling rate, 80 % of which is reused in-house.

ReStoRe consists in the transformation of low-value spent refractory waste into high-value products for steelmaking. After an upgrading process, spent refractories are re-

used in the steelmaking production process instead of primary raw materials such as lime, dolo-lime, bauxite and metallic scrap.

The process implies the treatment and processing of spent refractory materials coming from the periodic demolitions of the different refractory units. Exhausted material is then recycled to be reused in electric arc furnace and blast furnace cycles.

A high quantity of steel retained in the bricks is recovered by means of magnetic separators. Selected bricks are crushed and sieved in order to obtain the suitable grain size before introducing it into the liquid steel.

In order to increase the refractory life of electric arc furnaces, converters etc., the quality of the output materials is carefully monitored.

ReStoRe's key word is efficiency: by adopting this solution, steel companies will considerably cut down the in and out material flows. Indeed, a double goal can be pursued: up to 94 % of spent refractory material can be recycled in-house to produce remarkable quantities of consumables

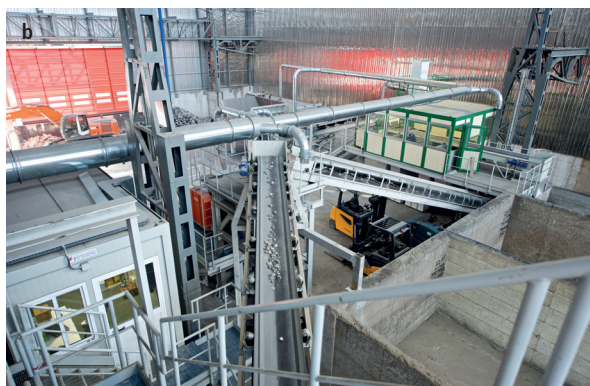


Fig. 1 a–c First ReStoRe plant installation

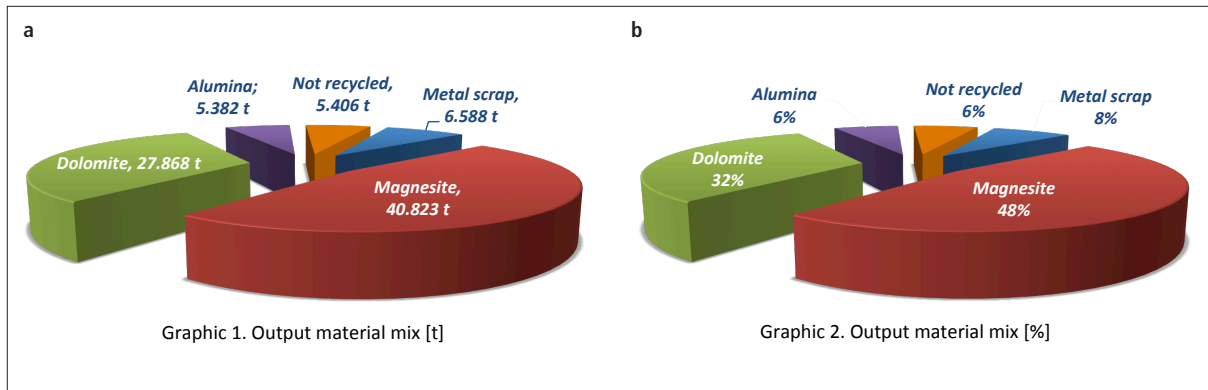


Fig. 2a–b Output material mix

instead of purchasing them elsewhere. As the primary production of consumables (i.e. lime and alumina flux) has a strong environmental impact due to the high temperature calcination reaction involved, the ReStoRe technology has the potential to achieve a significant reduction of CO₂ emissions. Thanks to this patented technology, Deref's technicians are able to set up a tailor-made recycling plant for any customer, thus optimising every stage of the cycle, from demolition to the reuse of materials. The first ReStoRe plant was set up in 2014; there the steel producer consumed 30 000 t of new refractories and produced 15 000 to 20 000 t of exhausted materials per year. In five years of operations (2014–2018), excellent results exceeding expectations have been achieved. The charts in Fig. 2 a–b show quantities and types of materials produced: in particular, a significant amount of basic materials (magnesite and dolomite)

was reused as a replacement of lime in the steel production process in a 1:1 replacement ratio and a large percentage of metal was recovered (about 8 %). Only 6 % of the material was not recycled.

The ReStoRe technology is currently being expanded for application to all kinds of steel manufacturing processes through collaborations with major steel manufacturers and an intensive developing program.

In short, ReStoRe technology's benefits are:

- Basic granules can be recycled during the melting process in the Electric Arc Furnace or in the converter using two possible different grain sizes, thus replacing the lime or dolo-lime to be used in the process.
- Aluminous materials can be recycled as fluxes in the secondary metallurgy.
- Metal fractions can be reused in the production cycle as scrap in an electric arc furnace or as cooling scrap in the converter.

- Drastic reduction of materials disposed of in landfill.
- Significant reduction of CO₂ emissions and use of primary resources.

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