Germany

Review: Mineral Recycling Forum 2018

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IMFORMED's Mineral Recycling Forum 2018 took place at the Radisson Blu, Cologne 15-16 March 2018 where international delegates networked and discussed the latest trends and developments in recycling steel waste, refractories, foundry chromite sand, salt, and fly ash.
The conference was preceded by a well-attended and quite exceptional one-day tour of recycling leader Horn & Co. Group's facilities at Weitefeld, Hunsborn, and Siegen.
Delegates were able to see first hand how steel and refractory waste was expertly sorted (by both hand and laser based sensor system (LIBS)), crushed, sized, and packaged ready for customer delivery. Of particular interest was the state-of-the-art analytical laboratory at Hunsborn as well as the operational LIBS unit at Siegen.

Keynote

The keynote "The role of industrial minerals in the Circular Economy" was presented by Roger Doome, Secretary General, IMA-Europe/BE. Doome explained how the circularity of the industrial mineral sector was driven by resource optimization, functional recycling, and recovery of secondary raw materials.However, he stressed that "Industrial mineral recycling and re-use alone will not be sufficient to meet the demand for raw materials. Circularity without sustainability is stillborn."
Doome went on to detail industrial minerals use in certain sectors with a view to future recycling, such as in renewable energy, mobile phones, and transport as well highlighting the EU Raw Materials Initiative and the 2018 measures for "An ambitious EU Circular Economy package". Waste valorisation examples included limestone processing waste slurry (calcite, wollastonite, dolomite and silicates) used as filter sand and kaolin waste used to make lightweight materials for construction.

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Fig. 1 EU industrial mineral recycling rate examples (IMA-europe 2018)

Mineral/Market	Market share [%]	Market recycling rate [%]	Mineral recycling rate [%]
Calcium carbonate			
Paper	24	72	
Plastics	6	31	2
Paints, Coatings, Adhesives	7	46	3
Container glass	2	73	1
Flue gas treatment	17	93	16
Cement & Concrete, Roadworks and Mortars	27	46	12
Other uses	16		
Total	100		52
Silica			
Construction ans Soil	36	46 %	17
Container Glass	17	73 %	12
Flat Glass	13	8 %	1
Foundry	10	80 %	8
Electrometallurgy	8		
Other uses	15		
Total	100		38
Talc			
Paper	21	72	15
Polymers for a industry	34	88	30
Paints and Coatings	18	46	8
Building material	7	46	3
Other uses	20		
Total	100		57

Source: Roger Doome, IMA-Europe (2018)

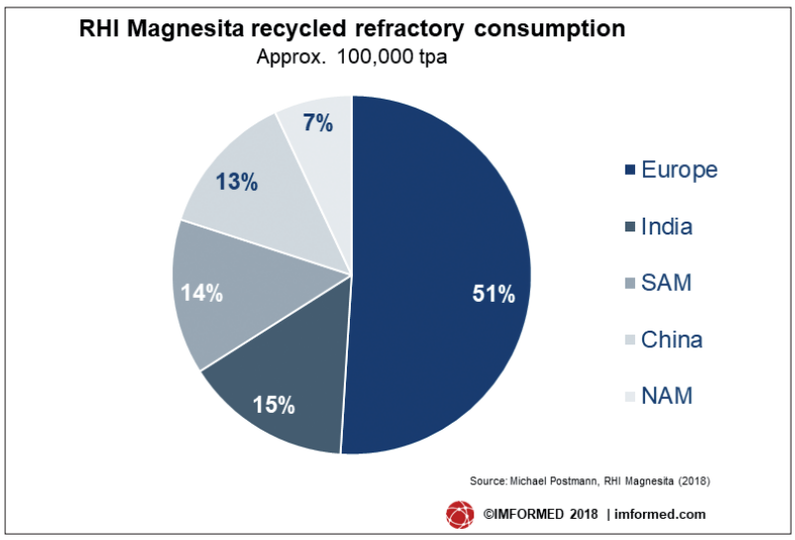

Fig. 2 RHI Magnesita recycled refractory consumption

According to Doome, today the industrial minerals sector estimates that a up to 50 % of all the minerals consumed in Europe are recycled along with the steel, glass, paper, plastic, concrete they are used in (Fig. 1).He concluded: "Industrial minerals consumption would increase by 50 % in the absence of functional recycling. Recycling should be sustainable."

Technical session

Steel waste recycling

In "Efficient use of steel waste resources using methodology and technological innovation" Jitka Halamová, ArcelorMittal Ostrava/CZ, explained how since 2012 the company had aimed to increase recycling of waste material to save operational costs. The project was implemented in Q2 2016 and is still increasing waste recovery, with some 40 % waste now being consumed. Key benefits are costs savings through reduction of raw materials and avoiding landfilling. One example is in steel ladle slag recycling, in the past only iron was removed and the remainder landfilled. Today, after screening a small fraction, most is now used in the sinter plant thus replacing previously required dolomite and limestone inputs.

"Thermal treatment of steelworks dust and waste chlorides for recycled use in steel and cement applications" was presented by Gerhard Auer, Ferro Duo GmbH/DE. He shared the main elements and objectives of a new project startedon 1 April 2018. The project is the development of a "ready for implementation process" for the economic processing of chloride-containing by-products (eg. by-pass dust from cement production) and heavy metal comprising by-products (in particular, dusts from blast furnace or steel production comprising Zn and Pb) by joint thermal treatment.The project is run for two and half years with funding from the German Federal Ministry of Economics.Key objectives will be basic feasibility assessment (for different combinations of materials), assessment of process parameters, integration into steel or cement processes, and the set-up of a demonstration unit.

Fig. 3 Refractory wreck-out: a steel ladle disgorges its spent refractory brick lining – once a waste product bound for expensive landfill sites, now a keenly sought after secondary raw material. (Courtesy Sidenor9

Refractory recycling

"Building a refractory recycling business through the use of PDCA/SDCA methodology" was explained by Mario López, RHI Magnesita/BR outlined Brazilian environmental policy and regulations and South American refractory recycling rates, before detailing the methodology involved in creating a sound refractory recycling system. The results spoke for themselves, with vastly increased recycling volumes and 2017 targets either hit or exceeded. The 2018 action plan includes projects on developing supply and production chains for mag-carbon recycling in Brazil and mag-spinel recycling in Argentina.

In Brazil, total spent refractories are estimated at 50 000 tpa. In 2016, Magnesita recycled 15 500 t. Since the beginning of the project in 2016, some 50 000 t of spent MgO refractories have been recycled, equivalent to 98 000 t of magnesite ore and 3500 l of fuel.

In "RHI Magnesita refractory recycling: the past and the future" Michael Postmann, RHI Magnesita/AT presented a very frank review of where the company is now and where it wants to be in refractory recycling. At present, RHI Magnesita possesses only limited crushing/drying capacity for recycling material at various plant sites, and there is no single plant with a sole focus on refractory recycling.

Postmann said: "Use of recycling material is limited due to quality and economics, and RHI Magnesita is using at present around

100 000 tpa of recycling materials in its own products globally." Looking ahead, Postmann said that RHI Magnesita aims to gain access and participate in sourcing of alternative raw materials, to open its product portfolio to use more recycled materials, and develop new products for recycled materials.
A very comprehensive review of Sidenor's strategy and activities was presented by David Maza, Sidenor/ES in "Refractory waste valorisation under Sidenor steel plant strategy" – this was illustrated by some superb images and a memorable video clip of a spent refractory wreck-out of a steel ladle.
Maza reviewed the last five years of the company's efforts in refractory waste management, demonstrating how the best practices were consolidated in 2014–15, the ISOVAL (isostatic refractory valorisation, eg. nozzles, stoppers, LS tubes) project of 2015–16, to the pursuit of "Excellence" in recycling by 2017. Today, Sidenor is using emergency ladles totally lined with recycled bricks and manufacturing higher value added products from recycled isostatic refractories, such as LS tubes.

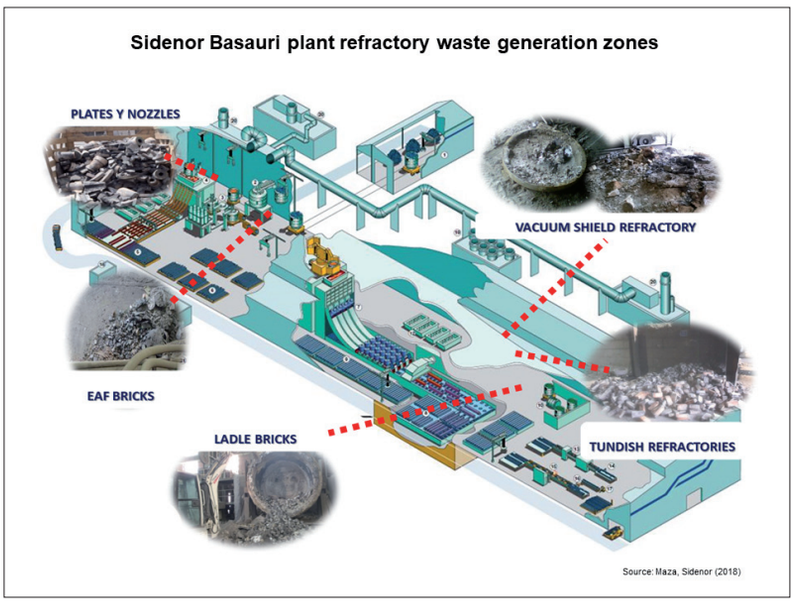

Fig. 4 Plant for refractory waste generation

Foundry sand reclamation

Another important area of recycling in the metallurgical industry is with foundry sands. Chris Wilding, Omega Foundry Machinery Ltd/GB provided an excellent summary in "Chromite sand reclamation from foundry waste."Wilding started with an overview of the chromite sand market, underlining, with a view to the enhanced value of recycling foundry sands, the rather stark outlook of a potential chrome ore deficit of up to one million tonnes in the short to medium term, driven by burgeoning stainless steel demand.
With increased interest in recycling chromite foundry sands for obvious reasons, Wilding explained that for foundry sands to be recycled, a good separation process is required to give >98 % purity in the final product.
Omega's process uses a combination of medium and high intensity drum magnets, plus a density separator. Up to 99 % purity of chromite sand is achieved with this system, and the sand can be re-used in the foundry from 50 % up to 75 %, the separated silica sand can also be re-used. Wilding commented that the chromite becomes more magnetic as it is reused, so it is eventually removed by the ferrite magnet. Of significance for future potential "resources" of chromite foundry sand, Wilding said: "We can also start looking at recovering previously dumped chromite/silica sand deposits in landfill sites." He revealed that Omega were already involved in conducting such work at a site in Turkey.

Sorting with laser sensors

Already familiar to those delegates on the earlier Horn field trip, "Maximising value in recycling: mining and metal applications by fast inline elemental analysis (LIBS)" by Dr Christian Bohling, SECOPTA analytics GmbH/DE, provided the science and development behind this state-of-the-art laser sensor sorting system.
LIBS is extremely fast, achieving >350 measurements/second, and can be used under harsh industrial environmental conditions for sorting primary and secondary raw materials, such as refractory bricks at Horn's Siegen facility.