

## Granulated metal product from direct tapped furnace - experience from operation at BEFESA Sweden

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### RECYCLING OF STAINLESS STEEL DUST

European stainless steel producers generate some 20-30 kg dust per tonne produced stainless steel. When recycling this material it is important to find a suitable product shape for users. Traditional forms of solidification of recycled material involve casting, cooling, crushing and sieving. Crushing and screening of high carbon brittle materials generates fines and dust that is problematic both at the producer and at the final product user. The metal recycling industry is a growing area for applying the GRANSHOT<sup>®</sup> granulation process for solidification. This industrial process is already proven in iron and ferroalloy applications, where it directly produces metal granules ready for handling, packaging and transport.

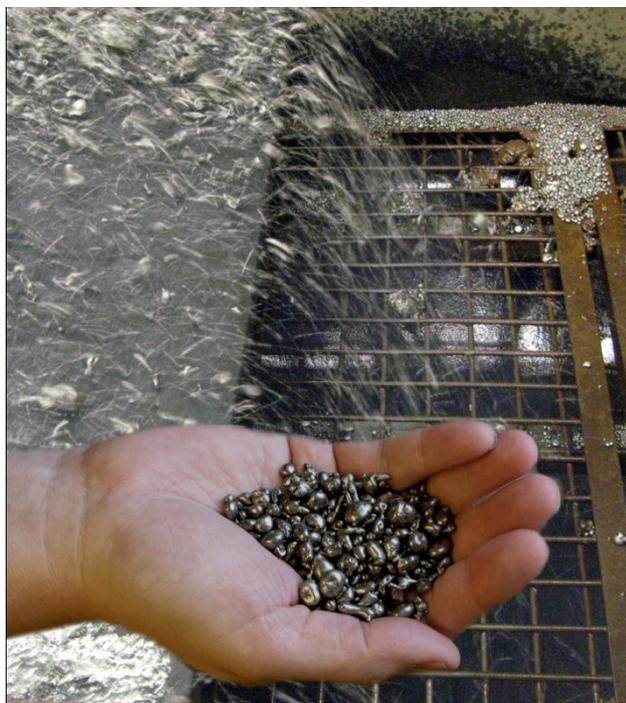


Fig1. Within 1 min recycled stainless steel dust, is granulated at BEFESA ScanDust, Landskrona, Sweden.

### BEFESA SCANDUST OPERATIONS

The BEFESA ScanDust plant in southern Sweden, Landskrona has an output of 30,000 tonnes of recovered metal per year, Fig 1. This plant features,

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since 2003, direct tapping of the hot metal from the plasma shaft reduction furnace to the GRANSHOT<sup>®</sup> granulation unit, Fig 2.



Fig 2. Hot liquid metal directly enters the granulation tundish.

Granulation at ScanDust is made at a rate of 1.5 tonnes/min, Table 1. After the dewatering and drying operation, the metal granules exit the unit within 1 minute. The final product is transported to a storage silo and packed for transport, ready for shipment back to the stainless steel plant from where the dust originated or it is to be sold on the open market [1].

Table 1. Data for GRANSHOT<sup>®</sup> unit at BEFESA ScanDust.

Plant design capacity	~ 144 tonnes/day
Granulation rate	1.5 tonnes/min
Heat size	12 tonnes
Water cooling capacity	4 MW

### GRANSHOT<sup>®</sup> METAL GRANULATION

The granulation process is a method for rapid solidification of metals in water. The process is based on the heat exchange between the liquid hot metal and cooling water.

The hot liquid metal is tapped into a preheated tundish and from the tundish the hot metal hits a spray-head of refractory material, placed in the centre over the granulation tank. The spray-head splits the metal stream into droplets that are evenly distributed over the tank water surface, Fig 3. The hot metal solidifies partly in-flight before penetrating the water surface. Further cooling takes place as the granules sink downwards in the granulation water tank transferring heat to the counter flowing cooling water.

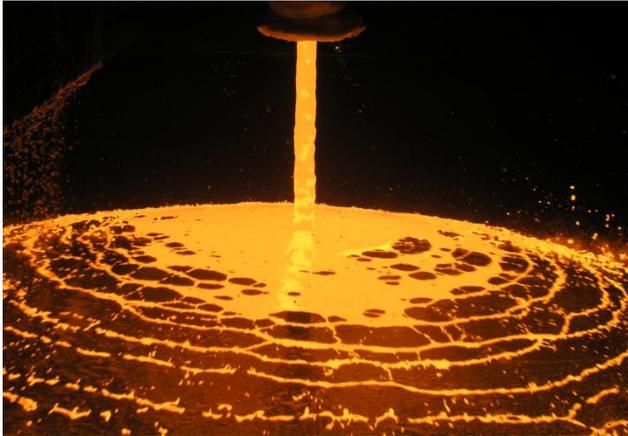


Fig 3. In the GRANSHOT<sup>®</sup> process the hot liquid metal hits a refractory target and the drops are cooled by water.

The solidified granules, at  $T < 100^{\circ}\text{C}$ , are discharged from the lower end of the tank by an air and water ejector on to a dewatering screen, Fig 1. The solution with spray-head and ejector allows for an industrial high capacity operation, currently up to 300 tonnes/hr. After dewatering the metal granules can if requested, as at BEFESA, be further dried in a rotary dryer.

There are several GRANSHOT<sup>®</sup> implementations in the recycling industry but the majority is for ferroalloys, as for ERAMET Doniambo, BHP-Billiton, SNNC, VALE and AngloAmerican, XSTRATA. There are also pig iron being granulated at ArcelorMittal Saldanha, SSAB, Voestalpine and ESSAR Steel.

**RESULTS AT BEFESA**

The final composition of granulated stainless steel process dust is determined by the ingoing raw materials, a typical composition is shown in Table 2.

Table 2. Typical composition of granulated material.

	Fe	C	Cr	Ni	Mo	Si
Weight %	55-65	4-6	15-20	3-10	0.5-3	0.2-0.5

**Rapid & Safe Operation**

Granulation and drying of granules take 1 minute as compared to the earlier casting, cooling, crushing and handling operations, which were also hazardous to the staff.

**Close to 100% Metallic Yield**

By granulating the recycled stainless steel dust, close to 100% metallic yield and almost no fines is achieved in the solidification. This is appreciated by BEFESA and the end-users of the granulated material.

**30% Cost Reduction**

Direct tapping to the GRANSHOT<sup>®</sup> unit and the simple handling of the granules have reduced the cost at BEFESA ScanDust with some 30% as compared to the earlier casting in moulds, crushing and the extensive material handling that was necessary.

**Granules for Simplified Logistics**

The main fraction lies in the size range between 5-25 mm with a typical deformed spherical shape, having a bulk density over 3.5 tonnes/m<sup>3</sup>. The size distribution of the granules will vary slightly with metal composition, hot metal temperature and granulation rate. The granule size, weight and shape make the product excellent for bulk handling. It can easily be handled by conveyor belts, vibrating feeders, magnet, baskets and front-end loader, Fig 4. The free flow properties also make it suitable for silo storage and as a continuous process addition, for example through the 5<sup>th</sup> hole of the EAF.



Fig 4. Granulated recycled stainless steel dust being packed.

**Ideal Metallurgical Properties**

The granules are free from oxides and slag, also inert while heated. The high specific surface area results in good preheating properties, quick melting and dissolution when added into a liquid melt. This is combined with a high density that enables the granules to penetrate the slag layer.

**SUMMARY**

BEFESA ScanDust has by applying direct tapping and GRANSHOT<sup>®</sup> metal granulation as solidification of the recycled stainless steel dust achieved several important results in their operation.

- Safe and industrial process, with high solidification capacity, 90 t/hr and solutions up to 300 t/hr exists.
- Close to 100% metallic yield and almost no fines.
- 30% cost reduction by direct tapping from the furnace and the use of granulation process.
- Metal granules have ideal logistical properties for producer, transporter and the end-users.
- The shape and absence of moisture, slag and oxides makes metal granules well suited in any downstream metallurgical process.

**REFERENCES**

[1] Beskow K, et al, The sustainability of valuable metals – recycling of residues from stainless steel production, Baosteel BAC 2010 conference, China.