4.2 x 4.2 m shakeout grid with a total load of 50 t (Photos: F.A.T.)

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State-of-the-art sand regeneration system for furan resin sand

Gusszentrum Ostfriesland (GZO), the newly built foundry of wind power systems manufacturer Enercon GmbH has started up a sand regeneration system with an output of 60t/h. Plant design and construction were carried out by Förder- und Anlagentechnik GmbH (F.A.T.) a leading manufacturer of foundry production facilities for large and medium-sized castings

For some time now, major components for the wind power plants of Enercon, Aurich/Germany, have been manufactured at Gusszentrum Ostfriesland, namely castings made of highly resilient spheroidal graphite cast iron, such as rotor hubs or main frames of up to 6 m with a casting weight of up to 11 t.

However, the new foundry will only support Enercon's production, and cooperation with the existing suppliers will continue. When the new foundry was planned, Enercon's engineers attached great importance to designing buildings that allowed as much daylight as possible to enter the production facilities and to implement a state-of-the-art manufacturing concept.

As the moulding sand quality has a direct impact on the surface of the castings as well as the binder consumption, foundries have specific requirements as regards certain values, e.g. loss on ignition, residual dust content, sand temperature, and degree of recovery. Additional demands accrue from plant uptime, operator convenience and accessibility for maintenance, wear properties, service quality, and spare parts stock.

Requirements placed on sand regeneration

The following characteristic values apply to furan resin bonded sands as they are used for large castings at GZO:

- Loss on ignition: < 4 %
- Residual dust content: < 0.1 %
- Sand temperature: ~25 °C
- Degree of recovery: > 95 % (i.e., new sand demand approx. 5 %)
- Plant uptime: > 97 %

At GZO, the moulds are made with furan resin sand due to the large casting size and associated high sand strength. For environmental and cost reasons, the use of new sand is to be reduced as much as possible while maximizing the degree of efficiency of regeneration. The properties of the recycled sand must be sufficient to guarantee the required mould stability of the moulding sand even when the amount of new sand and binder consumption are low.

In 2008, F.A.T. Förder- und Anlagentechnik GmbH, Niederfischbach/Germany, won the tender for the delivery and installation of the entire system with an output of 60 t/h (**Figure 1**).

The contract also covers a 4.2 x 4.2 m shakeout grid with a total load of 50 t (Figure page 22), a crushing station with two lump crushers (**Figure 2**), a sand dust collection and cooling plant, the storage hoppers and loading silos, as well as the complete sand supply of the foundry with regenerated sand and new sand (**Figure 3**).

Figure 1: F.A.T. sand reclamation system with sifter and reflux cooler (output: 50 t/h)

The concept of mechanical sand regeneration

The shakeout grid is situated at ground level in a separate area. Here, whole moulds with a total weight of up to 50 t are knocked out by vertical directional vibration. For this purpose, the grid is set vibrating with two unbalanced shafts working in opposite directions to prevent the casting from shifting.

Due to the high load of 50 t and the resulting high weight of the shakeout grid and steel construction, the entire unit is placed on a countermass which absorbs the oscillation energy and prevents it from being transferred to the supporting structures and building.

The knocked out sand lumps and trickling sand are collected in a hopper and fed by vibrating chutes to the two lump crushers for further attrition and screening. Above the chute discharge two overhead magnets are situated to remove cooling iron, chills and tramp metal from the sand stream.

Due to the high sand throughput rate, additional chutes are interconnected between the vibrating discharge feeders and the lump crushers for uniformization of the sand stream, which improves iron separation and optimizes the performance of the lump crushers. Lump crushers reduce and screen the sand lumps to a grain size of < 2 mm. About 2 to 3 % of the sand used is screened in the form of coarse grains.

Screened, non-crushable components are collected in the crusher basket of the lump crusher as coarse material, and are also screened for oversize grains across the screening line and conveyed pneumatically to a loading silo. Roughly 3 % of the sand used is expelled in the form of oversize grains. The coarse material collected in the crusher basket is emptied once per shift by maintenance staff.

The screened sand has a temperature of approx. 150 to 200 °C. It is conveyed pneumatically to a hot sand silo and then fed batch by batch into a sifter/cooler situated underneath the silo. A screening machine is installed at the outlet of the hot sand silo to protect the downstream units against oversize grains in the case of operating disturbances during screening in the lump crushers.

A cascade sifter is used to dedust the sand. In the process, air is sucked

in through the cascade sifter to create a cross stream. Subsequently, the sand is passed through a reflux cooler while being retained in a heat exchanger unit. During cooling, the sand temperature is reduced from 150 to 200 °C to 25 °C. The throughput rate and amount of cooling water are controlled dependent on the outflow temperature of the sand (25 °C).

Figure 2: Shakeout and crushing station with two vibratory lump crushers (output: 2 x 25 t/h)

Figure 3: Pneumatic sand supply with F.A.T. shuffle-type conveyors

The dedusted and cooled sand is dispersed pneumatically to four reclaimed sand silos, where it is stored for use at the pneumatic sand supply of the hand moulding department.

Sand supply with pneumatic shuffle-type conveyors

GZO decided to use a sand system with F.A.T. shuffle conveyors to guarantee high levels of uptime and reliability of sand supply while keeping maintenance costs low. Pneumatic sand conveying means material friendly and wear resistant transport at low speeds. With this conveying method, plugs of sand are formed which are moved through the pipe. Velocity is about six times slower than in the flow stream process, which is a competitive method. As wear and tear in the tubing and bends is exponentially related to the conveying velocity, the lifetime of the tubing and bends of an F.A.T. shuffle conveyor is many times longer, which means that the feed pipe need not be maintained for several years.

The plant was constructed in close cooperation between the plant management of GZO, Enercon's factory planning and the architecture firm working for Enercon.

The complexity of the entire project required very thorough work and great coordination skills of all parties involved. Commissioning of the sand reclamation plant was successfully performed with inspection and approval of the unit at the beginning of November 2009 at GZO.

F.A.T. is an internationally operating company. Facilities like the one installed at GZO were commissioned

- in France in autumn 2009;
- in China in winter 2009/10;
- in Russia in spring 2010;
- and in Germany and China in autumn 2010.

In addition, further start-ups are scheduled for summer 2011 in Russia, Ukraine, Portugal, and China.

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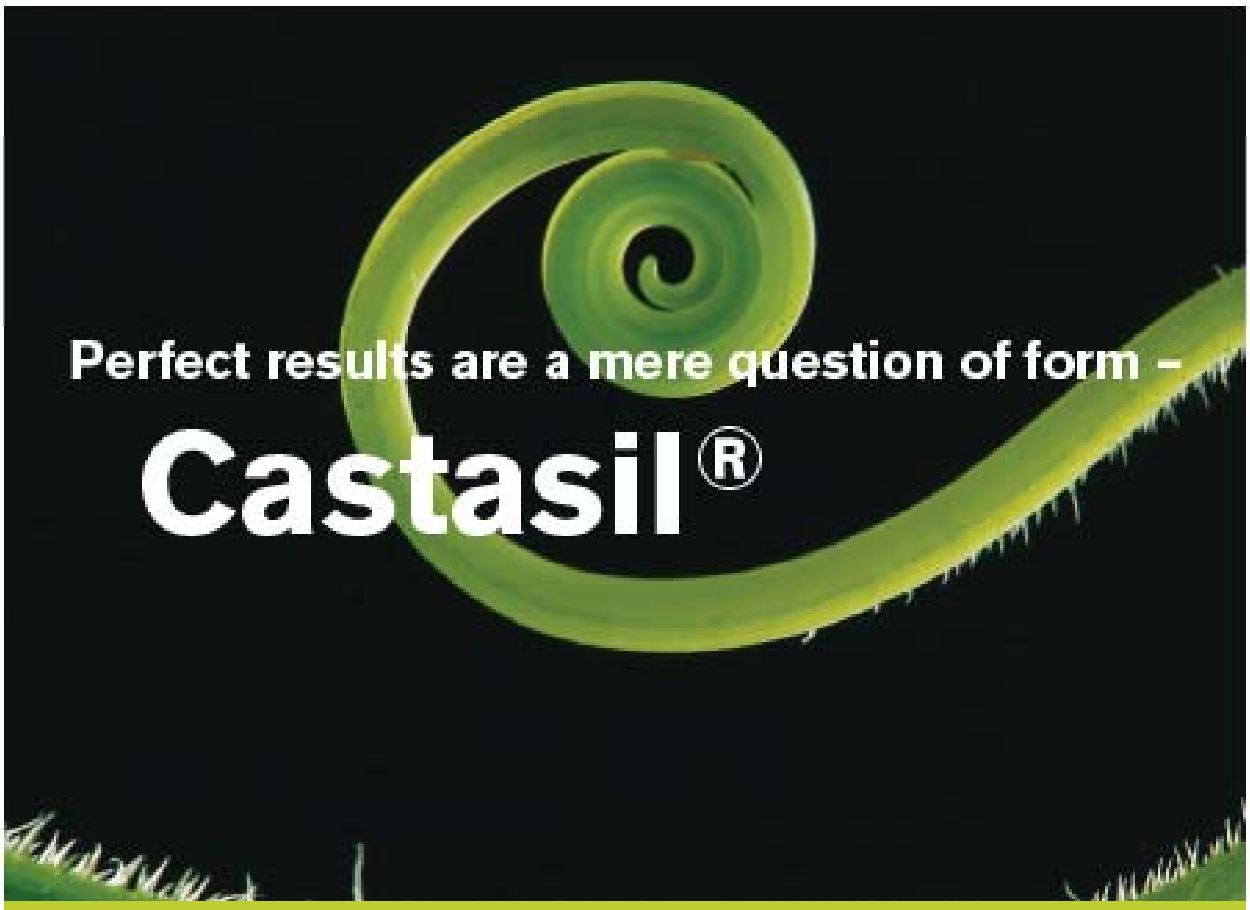

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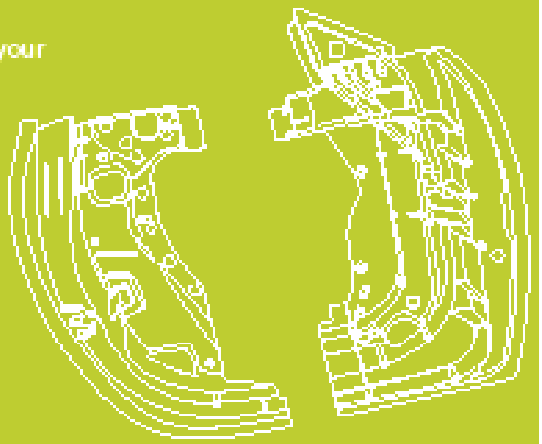

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