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More important today than ever before:
Fluorine-free risers for more sustainability in the foundry.

Technical Paper

ASK CHEMICALS

The use of fluorine-free risers not only reduces surface defects on the casting, but also graphite degeneration. In addition to these aspects, however, the ecological properties are becoming increasingly important. The fluorine content of used sands and dusts plays a major role, especially in disposal and the associated classification in the various landfill classes. Increased fluorine content can thus become an undesirable cost driver.

For foundries that have a particular focus on sustainability and want to improve their environmental footprint, ASK Chemicals offers fully emission-free, inorganic mini-risers in addition to organically bonded, fluorine-free risers. The combination of state-of-the-art riser systems and fluorine-free exothermic compounds is convincing: It offers effective environmental protection with better quality and lower process costs!

Flourine-based defects

The basis of all exothermic risers is the thermite reaction, which is also known as the Goldschmitt process. In this process, aluminum reacts with iron oxide and releases large amounts of thermal energy. This is used in the riser technology to keep the metal in the riser liquid for longer and thus to feed the critical hot spots of the component.

To ensure that the exothermic reaction starts as early as possible and proceeds uniformly, fluorine-containing cryolite is used in conventional compounds. It acts on the surface of the aluminum granules like a flux and dissolves the oxide layer. Unfavorably, however, the fluorine can accumulate in the sand system. This increased fluorine content can lead to undesirable surface defects (see fig. 1a). Even with fluorine content in green sand of 250 ppm or more, these defects can occur depending on the thermal load of the sand, and at fluorine content above 500 ppm they are even more likely to occur. Furthermore, fluorine-containing riser fragments, which can repeatedly occur in the sand system, lead to special surface defects, commonly known as fish eyes (see fig. 1b).

For these reasons, it has been the effort of riser manufacturers to reduce fluorine levels in risers and offer so-called “low fluorine” riser blends.

Fig 1a: Surface defects on the casting surface due to excessive fluorine in the sand.

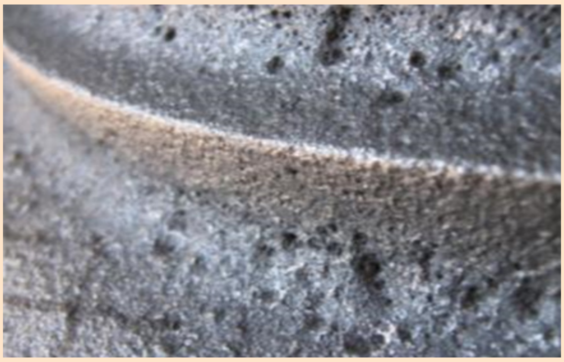


Fig 1b: Fisheye defect on the casting surface due to excessive fluorine in the sand.

A milestone was the market launch of the first completely flourine-free risers at the end of the 1990s by the Lüngen company, which is now part of ASK Chemicals.

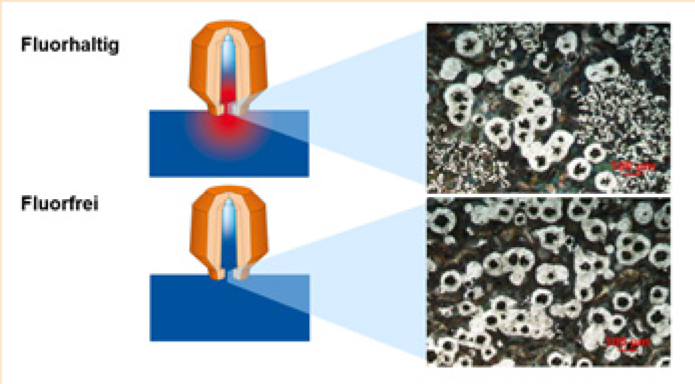
It was possible to substitute the fluorine completely. Magnesium proved to be a suitable substitute, as its extreme reactivity can promote the oxidation of aluminum without the need to add cryolite as a fluorine carrier.

Metallurgical effects

For the production of nodular cast iron, a magnesium treatment is necessary which ensures that the free graphite does not form as a lamella but as a nodule. However, this effect of the magnesium is subject to a decay effect, so that distinct nodules can no longer form with longer solidification times - graphite degeneration is the result. The extension of the solidification time in the area of the hot spot and riser, which is necessary for the tight feeding of the component, therefore has a negative metallurgical effect on the formation of graphite nodules. For this reason, graphite degeneration may occur in the area of the riser.

However, investigations show that this negative influence on graphite formation in ductile iron is noticeably reduced by using fluorine-free risers with magnseium (see fig. 2).

Fig 2: The use of fluorine-free risers with magnesium significantly reduces the negative influence on graphite formation in nodular cast irongen.



Waste disposal and environment

To ensure consistent sand quality in the foundry, new sand must be added. The core sand entering the sand system also leads to an increase in the overall quantity of "recycled" sand. In order to keep the quantity of sand constant, excess molding sand must be disposed of. In addition, dusts separated to reduce the fines content in the molding sand must also be disposed of.

A few foundries, for example, have the possibility to recycle dusts and used sands in the clay industry as secondary raw materials. However, the majority of these dusts and sands are nowadays still sent to landfills. In order to carry out the landfilling properly, analyses have to be carried out. These serve to assign the sand and dust to the various landfill classes. The classification into higher landfill classes is a cost factor for the disposing foundry that cannot be neglected. The fluoride concentration in the spent sand quickly becomes the driver of disposal costs here.

The use of fluorine-free risers is thus an important lever to reduce the fluoride content in the used sand or dust. Classification in more favorable landfill classes not only reduces disposal costs, but also improves the ecological footprint of the foundry industry.

The binder systems used in the riser are playing an increasingly important role in reducing emissions and environmental pollution.

Due to the higher proportion of fines in the riser - compared with core production - much higher binder quantities are necessary to give the risers the required strength. Here, inoganically bonded risers can help to undercut the increasingly demanding limits for air pollution control.

The use of inorganically bonded risers does not produce any emissions containing BTX or VOCs. In particular, the OPTIMA risers of the latest generation are characterized by their very good performance in terms of environmental protection, sustainability and efficiency (see fig. 3).

Fig. 3: OPTIMA risers in possible variations

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