THE BENEFITS OF FEEDEX* NF1 EXOTHERMIC SLEEVES IN ALUMINIUM AND COPPER CASTING

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Since the development of FEEDEX NF1 exothermic sleeves for non-ferrous casting applications, they have demonstrated significant value in the aluminium sector. Benefits include significantly extended solidification time, increased casting yield, lower fettling and remelting, and lower emissions. The result is lower production costs and a reduced carbon footprint. These advantages have also now been demonstrated in copper casting applications, where the higher melt temperature and melt density further extends the value delivered.

THE CHALLENGE: INSULATING FEEDERS AND EXOTHERMIC POWDERS

The use of insulating feeders is common in aluminium sand casting applications with many products available on the market. These can be made from a variety of materials (fibres, spheres with organic or inorganic binders) and in a variety of shapes. The different insulating properties of these various materials result in different modulus extension factors with typical values between 1.4 and 1.5.

The insulating properties of these sleeves is often insufficient for the specific application. The feeder size may also be limited due to space constraints. In such instances, exothermic hot topping powders are applied to increase feeder performance and slow solidification.

Although the use of exothermic powders is common practice, the process is not without its challenges:

- The powders are manually applied, which can lead to variability in the amount and rate of addition.
- The time and labour involved can be significant, especially with large castings with many risers and sleeves.
- The exothermic reaction releases smoke and fume that must be extracted from the foundry environment.
- The surface of the feeder must be open during the moulding process, which can place limitations on the casting.

As a result of these issues, the idea to develop an exothermic sleeve formulation for non-ferrous applications was born, which led to the development of FEEDEX NF1 sleeves. Initially developed for use in aluminium applications, the technology has now also been successfully applied to copper casting.

THE SOLUTION: FEEDEX NF1 EXOTHERMIC SLEEVES

Exothermic sleeves have been widely used in the ferrous sector for some time. However, previous attempts at applying the same technology to non-ferrous casting had proved unsuccessful due to the lower pouring temperatures of non-ferrous alloys. An new formulation, specific to non-ferrous applications, was therefore needed with the following requirements:

- No negative impact or influence on the quality of the melt.
- Low emissions.
- Simple disposal of sleeve and sand.
- No negative impact on the sand system.
- Fast ignition.

The new FEEDEX NF1 recipe was developed to meet the above specifications. FEEDEX NF1 sleeves are highly exothermic, making the application of exothermic powders unnecessary. When the sleeve comes into contact with molten aluminium (>600°C), ignition starts within 20 sec. and the exothermic reaction continues steadily, significantly extending solidification time of the metal in the sleeve and thus delivering feed metal for a longer period (Figure 1). FEEDEX NF1 sleeves have a modulus extension factor of about 1.65. This offers several benefits:

- Manual application of exothermic powders is eliminated, improving process efficiency.
- It is no longer necessary to leave the feeder open, reducing emissions.
- Even with open FEEDEX NF1 sleeves, emissions are still reduced.
- Due to better feeding performance, sleeve dimensions are reduced, increasing casting yield and lowering remelting costs.
- The high-strength of FEEDEX NF1 sleeves makes them suitable for use on automatic moulding lines.

These exothermic sleeves are available in all common dimensions, and can be combined with breaker cores for easy knock-off – thus lower fettling costs. It is also possible to manufacture exothermic Williams cores with the FEEDEX NF1 formulation, which can be used in combination with sand feeders.

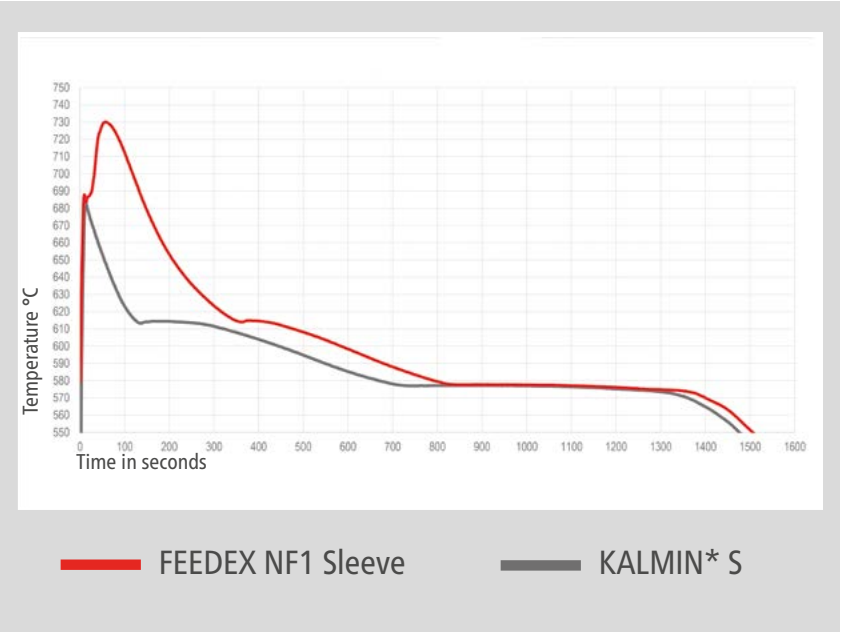

Figure 1: Typical cooling curve of a FEEDEX NF1 sleeve and a traditional KALMIN S sleeve. The exothermic reaction is clearly visible after about 20 sec. The released energy significantly delays solidification.

CASE STUDY: MARSBERGER METALLGUSS OHG

Marsberger Metallguss ohG (MMG) was founded in 1996 and is a medium-sized foundry, casting products via both sand and die casting processes. When sand casting an aluminium (AlZn-10Si8Mg) machine slide, the foundry was using eight KALMIN 50 insulating feeders and FEEDOL 20 exothermic powder to avoid shrinkage and ensure defect-free casting. Casting weight is 72kg of a poured weight of 82kg; casting temperature is 720°C.

After switching to FEEDEX NF1 sleeves, the foundry found it could reduce the number (to six) and volume of sleeves used to cast the machine slide – without impacting casting quality. The use of exothermic powder was also eliminated. As a result, the foundry saved 9kg of aluminium per casting. This significantly lowered the amount of fettling and remelting required, with a consequent reduction in both production costs and carbon footprint.

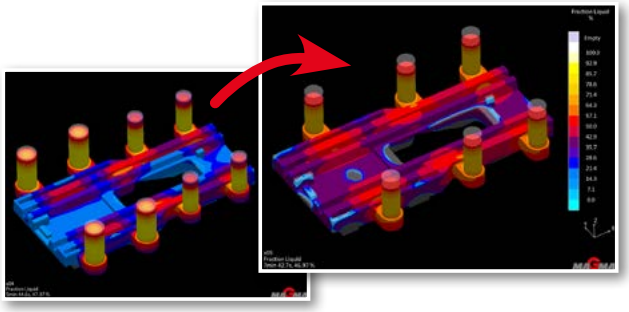

Figure 2: The application of FEEDEX NF1 exothermic sleeves optimised casting of an aluminium machine slide, reducing the number of sleeves required from eight to six, and eliminating the need for exothermic powder.

FEEDEX NF1 IN COPPER CASTING

Although FEEDEX NF1 sleeves were initially formulated for use in the aluminium sector, they have also now been applied to copper casting with excellent results. Due to the higher temperatures of the various copper alloys, the material ignites – and thus the exothermic reaction takes effect – even faster. And due to the higher density of copper compared to aluminium, the absolute saving in materials is even clearer.

These benefits were recently demonstrated at Pleiger, a Witten-based foundry that manufacturers high-quality aluminium and copper castings for almost all applications. When casting in brass (CuZn34Al), the foundry was using eight insulating sleeves to achieve its requirement for zero shrinkage. However, this resulted in high material consumption and fettling costs, as well as negatively impacting productivity.

FEEDEX NF1 sleeves were implemented to improve feeding performance. As at MMG, this allowed the number and volume of feeders to be reduced: in this case to just four FEEDEX NF1 sleeves. The finished casting met all quality requirements, while saving 35kg of metal per casting. This reduces the amount of returns (lowering fettling and remelt). Overall, the solution helped to cut production costs and improve productivity at Pleiger. Carbon footprint was also reduced.

CONCLUSION

The application of FEEDEX NF1 exothermic sleeves brings a range of benefits to non-ferrous casting. These have now been demonstrated not only in the aluminium sector, but also in copper applications. The advantages include:

- High strength (can be used on automatic moulding lines)
- Quick ignition followed by a slow and steady exothermic reaction (significantly delaying solidification)
- No need for exothermic hot topping powders
- Lower emissions to the foundry environment (reducing emissions control requirements)
- Stable process
- Significant savings in molten metal (reducing fettling and remelting)
- Lower carbon footprint

REFERENCES

[1] Development of FEEDEX NF1 sleeves for aluminium is detailed in: Fröscher, A., 'Brand-new innovation for the non-ferrous sector: the exothermic feeder FEEDEX NF1', Foundry Practice No. 268, pp. 21-23.

ABOUT THE AUTHOR

Arndt joined Foseco GmbH in 2002 as a development engineer for Non-Ferrous. Later he moved to application engineering and became European Product Manager for Non Ferrous Methoding in 2012.
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