



PARADIGM SHIFT: AN INDIAN FOUNDRY EXPERIENCE



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Bradken and Foseco are two leading global companies in their respective fields. In India, there has been a close association between these two organisations which is principally based on mutually rewarding partnership and working together on many value creating projects related to improvements in foundry processes and the development of castings.

The objective of this paper is to highlight the outcome of joint efforts between Foseco and Bradken and share the benefits of working together.

INTRODUCTION

Bradken and Foseco are two leading global companies in their respective fields. In India, there has been a close association between these two organisations which is principally based on mutually rewarding partnership and working together on many value creating projects related to improvements in foundry processes and the development of castings.

In the early part of 2019, during one of the joint meetings between Bradken and Foseco Management Teams, while discussing future global trends and casting quality requirements it was pondered how Bradken and Foseco could further work together to meet new challenges. As an outcome of the initial discussions, it was decided to work on the following two broad areas of foundry operations mainly addressing environmental concerns and to be cost competitive.

Coating:

- Overall quality enhancement in surface finish of castings
- Reduction in coating cost while maintaining the existing quality standards.

Feeding Systems:

- Improvement of Inventory Management
- Innovative packing methodology to avoid transit losses
- Development of new products to address special needs

Joint projects as above were specifically initiated since Bradken Management highlighted that in spite of present market situation, they have challenging targets considering improved production at Bradken India site with increased expectation with regards to maintaining high safety standards, delivering excellence in all operations, and continual focus on cost optimisation.

Once these specific requirements were understood a joint effort was invested which lead to many new initiatives. These included new sleeve designs,

new packaging methods and the INSTA concept in coating which delivered significant benefits in overall coating process, achieving all the objectives set in the beginning.

The objective of this paper is to highlight the outcome of joint efforts of Foseco and Bradken and share the benefits of working together.

JOINT WORKING IN THE AREA OF COATINGS

In addition to improvements in surface finish and optimisation of coating cost, Bradken also showed interest to work on enhancement of their HSE norms in their foundry by eliminating or reducing the usage of plastic (packing material) in their foundry process.

Figures 1, 2 and 3 explain in brief the requirement of Bradken i.e. Focus on Safety, sustainable reduction in cost and process time with enhanced casting quality along with equal emphasis on environment aspects of foundry operations.

To summarize, the current challenges being faced by our partner and looking for improvements in areas like,

- Overall cost reduction
- Improve casting surface quality (finish)
- Minimized usage of plastic

Internally teams were formed at Foseco as well as in Bradken to investigate all aspects of coating preparation and application.

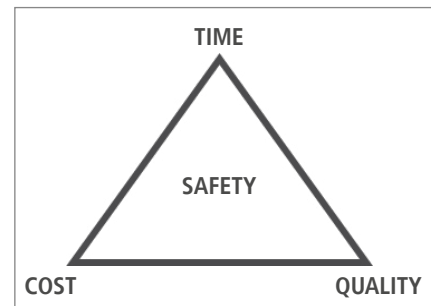


Figure 1. Project Objectives



Figure 2. Need of foundry industry – Go Green



Figure 3. Plastic wastage: a severe threat to society (Source: Study in science advances. The Economic times)

All these areas of improvements were discussed in detail with our R&D Teams and the discussion lead to the development of an innovative coating technology called INSTA*.

A proposal highlighting above benefits of INSTA TECHNOLOGY was presented to Bradken Management in the Month of May 2019.

After joint discussions and exchange of ideas between Foseco and Bradken teams it was decided jointly that INSTA technology should be assessed at Bradken Foundry.



STEPS FOLLOWED FOR INSTA PROJECT EXECUTION

1. Joint process mapping: Understand the existing practice, mould and core making, type of castings being made, metal grades, sand systems, core shop operation and identify location for equipment.
2. Understanding Bradken shop floor requirement with regards to coating operations: Every step was studied, including tests performed on as received coatings, coating preparation, adjusting to final application consistency, coating application, drying of coating, final finishing, closing practice and pouring.
3. Equipment support: New INSTA mixer was designed for high performance coating mixing and provided to Bradken as a part of INSTA TECHNOLOGY



Figure 4. INSTA coating and Mixer for coating preparation at Bradken

WHAT IS INSTA?

- HOLCOTE* INSTA (A combination of refractory fillers, rheological conditioners & binder system)
- HOLCOTE INSTA, a single part refractory coating premix which delivers highly consistent coating when mixed with water.
- INSTA Mixer: Specifically developed for Bradken

1. A highly accurate, consistent, efficient machine for preparation of INSTA coating.
2. Designed by Foseco with all safety features considering Bradken's Safety requirement.
3. Timer-controlled mixing with auto stop, RPM regulator and emergency control.



The benefits of INSTA coatings are:

1. reduced overall coating cost in use
2. elimination of plastic buckets
3. improved application consistency due to introduction of INSTA MIXER
4. consistent casting finish.

INSTA COATING: TRIALS

- HOLCOTE INSTA Coating
- Initial trial was conducted with preparation of a batch of 205 kg INSTA coating.
- Mixing ratio:
 - INSTA Coating: 125 kg
 - Water Addition: 80 Kg
 - Total outcome: 205 kg coatings ready for use
 - Coating Baume: 95 to 100 unit
 - % Dilution: 64 %
- Coating layer applied on mould: 3 layers
- Wet film thickness: 800 to 900 microns
- Coating drying: torching (Individual layer)
- Coating appearance: coverage and bond was found satisfactory.
- Trial casting weight: 4MT
- Mould and Core: Furan binder systems
- Pouring Temperature: 1560 Deg. C

Bradken management supported in joint evaluation of Trials, supported all the development work and provided their valuable inputs for executing INSTA project in "First Time Right" manner.

Through INSTA technology we could achieve much higher dilution (up to 65%) for INSTA coating and delivered superior casting quality compared to conventional coatings.

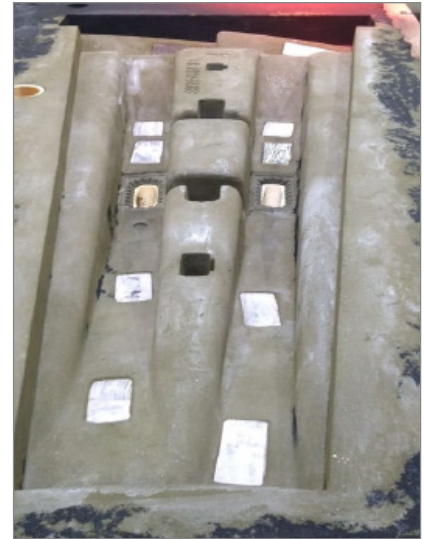


Figure 4a and b. Shows the mould/core before coating with INSTA coating.



Figure 5a and b. Mould/core coated with INSTA coating



Figure 6a and b. Casting results with HOLCOTE INSTA

BULK EVALUATION OF INSTA TECHNOLOGY

Based on Initial encouraging results, Bradken team decided to adopt INSTA technology on the shop floor.

At the time of publishing this paper, 30MT of INSTA coating used over a 6-month period has been successfully tested by Bradken.

BENEFITS TO BRADKEN THROUGH JOINT PROJECT OF INSTA TECHNOLOGY:

INSTA project aimed to deliver

- Savings in the coating cost as per initial estimation up to 15 %
- Consistent surface finish
- Elimination of HDPE buckets: which was one of the major SHE initiatives for Bradken

OUTCOME

Based on 6 months extended run with INSTA technology, this project delivered following benefits

- Eliminate usage and generation of plastic buckets.
- Improved application consistency due to introduction of equipment and consistent casting finish
- Delivered Cost saving up to 23% on existing coating consumptions- which is higher than the saving proposed to Bradken before commencement of project. Higher percent savings were mainly possible due to coating process optimization at Bradken.
- Going Forward: Introduction of palatized packing of INSTA coating for easy transportation and handling.



Figure 7. Palletised packing of INSTA coatings for easy handling at Foundry

JOINT WORKING IN AREA OF FEEDING SYSTEMS

Since 2018, Bradken India started ramping up its manufacturing, nearly doubling production volume. However, increased production also brought challenges with respect to Bradken casting metal grades which are non-repairable and large casting sizes.

In the area of Feeding systems, the challenges are:

- Inventory management considering of higher volumes of sleeves, varying in size and large numbers of sleeves being used.
- Consistent feeding performance leading to consistent casting quality.
- Easy removal of risers with minimum contact area, facilitating faster casting throughput with minimum fettling.

INVENTORY MANAGEMENT

At Bradken, with increased production volumes, it was a major challenge to maintain the optimum inventory of feeding system products. The issues faced were:

- Complex requirements of sleeves due to a higher number of sleeves in different sizes and types.
- Longer supply chain from the Fosco Plant to Bradken stores.
- Often leading to possible stock out situations causing production disruption.
- Also, at the same time we wanted to avoid excess inventory levels to avoid blocking space and capital.

In order to address the above points, a joint team was formed between Bradken and Fosco in order to understand the entire supply chain.

This team extensively studied all Feeding System process points including:

- Consumption pattern of each SKU
- Full process of stock movement & placing orders.
- Processing of orders and manufacturing planning at Fosco
- Actual manufacturing, testing and packaging
- Pattern of dispatch considering the way sleeves are loaded and unloaded in the trucks.

The above analysis helped in understanding importance of planning and execution of orders at Fosco based on Bradkens priorities and necessary actions were put in place. Improvements were required with regards to packing which would help to reduce transport losses.

Additionally, for improving overall efficiency a need was seen to develop customized shapes meeting Bradken's enhanced requirements.

IMPROVEMENT IN PACKING

Before this joint work, Foseco supplied sleeves in loose trays stacked one above each other. This, coupled with distances involved, occasionally resulted in considerable transit damage. In addition to the material loss involved in the transit, additional issues were caused by not having the right material available as per production schedules at Bradken which caused disruption and non-value-added work at both ends.

To overcome the problem, several options of packing were considered before focussing on a palletized packing method. This suggestion was immediately supported by Bradken and after initial assessment for effectiveness, it was employed as a permanent measure. This is shown in figure 8.

BENEFITS INVOLVED WITH PALLETISING

- About 5% reduction in transit losses due to breakage.
- Availability of right material on time. No production loss or need of last-minute changes.
- Overall reduction of non-value-added work on both sides avoiding any emergency management of the situation.

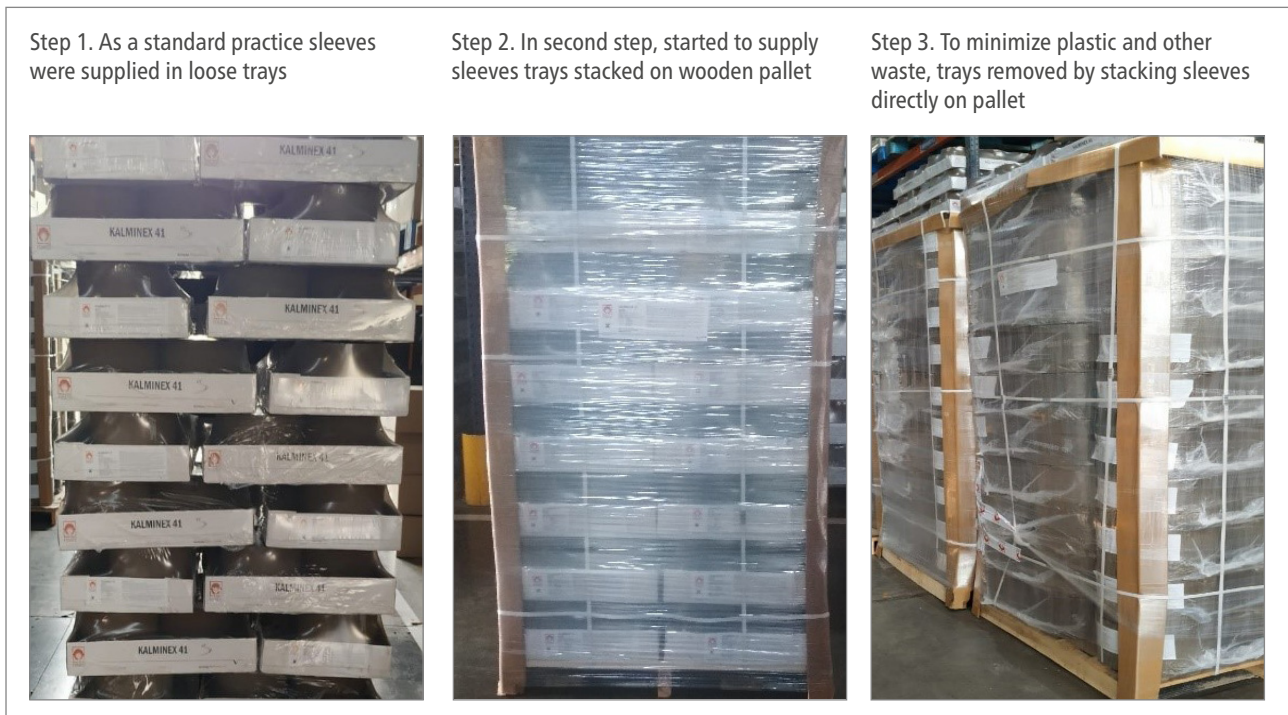


Figure 8. The progress of packing improvement initiative

DEVELOPMENT OF NEW PRODUCTS FOR BRADKEN'S REQUIREMENT

A. Slotted Neck Down sleeves

Application of standard Neck Down (ND) sleeves has been very common at Bradken resulting in many benefits:

- Ease of riser removal due to smaller contact area
- Substantially reduced riser neck grinding work.
- Ease of sleeve application where the casting contact area is limited.
- It helps to avoid sleeve projecting out and the need for a metal pad.
- Benefits of the ND sleeves were further extended by introducing "Slotted ND sleeves". Slotted ND sleeves facilitate application in specific casting geometries with minimum fettling work. (Figure 9)

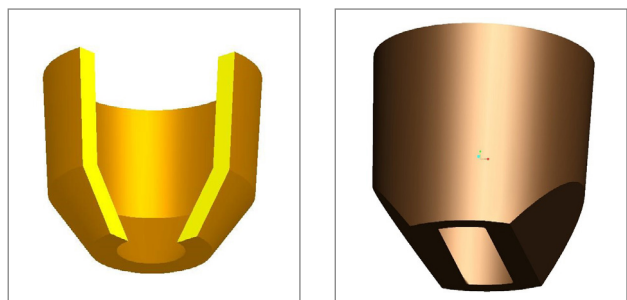


Figure 9. Standard (left) and Slotted (right) ND Sleeve design

B. Neck Down sleeves with Larger Neck Opening.

ND sleeves are designed with a neck opening as small as possible in order to gain the benefits associated with lower feeder contact area.

However, feeding behaviour of the casting metal during solidification is the main decisive factor to limit the opening of the neck.

To balance the sound feeding of casting during solidification and minimum neck opening, ND sleeves with different neck openings were designed specifically for Bradken. ND sleeves with 60% and 72% neck openings were introduced in addition to the 50% standard neck opening (figure 10).

The benefits of ND sleeves were further extended by introducing "Higher Neck opening ND sleeves" which facilitated effective feeding of metal grades that were typically difficult to feed through standard 50% neck opening ND Sleeves.

C. Kapex For Higher Size Sleeves

All ND sleeves and cylindrical sleeves above a 6" diameter are open sleeves. However, it is very common practice to make many open sleeves to perform like blind based on location of the sleeves by covering top face of open sleeves. Foundries normally cover the top sleeve face by sand cores, but this method certainly compromises the performance of blind feeders.

Foseco has a unique offering to such problems which are typically solved by using Foseco's innovative development named KAPEX* (figure 11). This helps to make open sleeves perform like a blind sleeve and ensure consistent performance of bigger feeders.

However, in the case at Bradken, the existing range of KAPEX was not enough and it required development of specific customized sizes. The KAPEX product range was expanded to cover additional sleeve sizes as per Bradkens requirement.

D. Sleeves With Customised Height

It is common practice in making heavier castings to build the required sleeve height by stacking another sleeve or cut piece of another sleeve on top.

Thus, often the sleeve height build up requires manual operation of sleeve cutting. To avoid this manual sleeve cutting operation required for additional height build up was analysed by Bradken and Foseco. A sleeve range (three customized sizes) with additional height was introduced to avoid manual cutting of sleeves resulting in improved productivity and ease of operations.

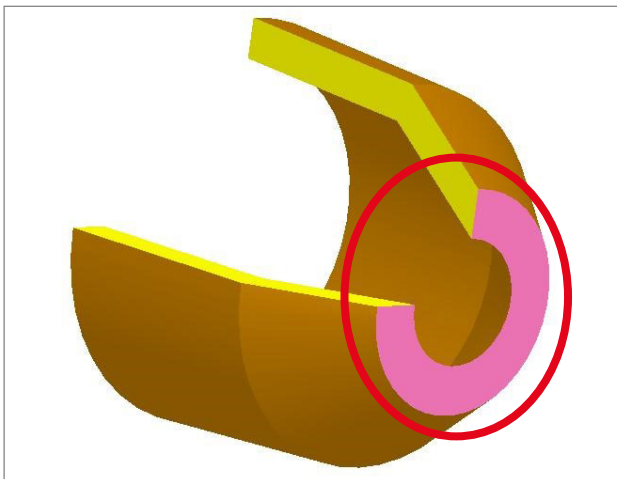


Figure 10. ND Sleeves with higher neck opening



Figure 11 . showing Typical "KAPEX"

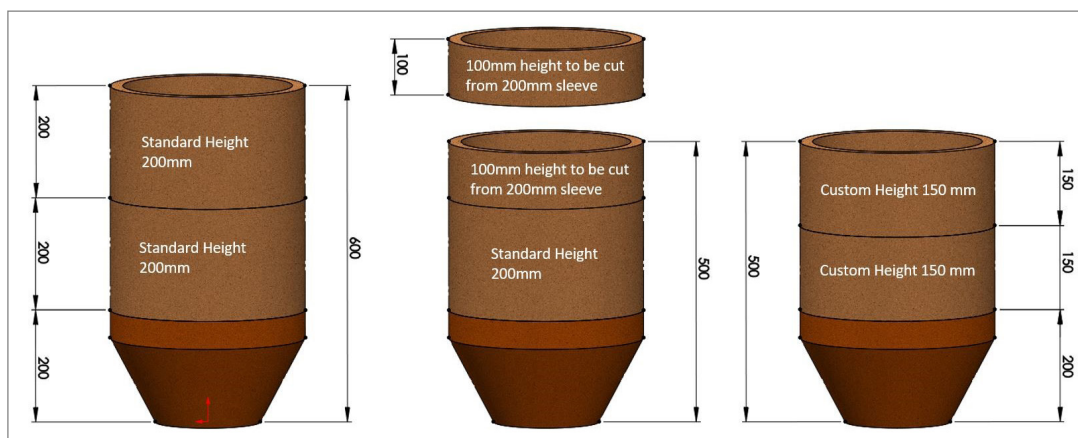


Figure 12. Sleeve with Customized height in Moulding

CONCLUSIONS

Foseco India and Bradken believe that working together in partnership is key to address current and future challenges.

The experience of working together on numerous initiatives ultimately lead to the following benefits through which enhanced foundry performance:

- Significant reduction in coating cost through implementation of INSTA.
- Introduction of process control equipment like the INSTA mixer helps to improve process consistency and deliver consistent coating application.
- Reduced transportation cost, reduced handling, and improved space availability at stores optimised inventory costs.
- Joint working and better understanding of each other's needs and capabilities, lead to the development of customised sleeves – which once implemented reduces rework, improves casting soundness and thus enabling faster casting throughput from fettling shops.
- Innovative approach like INSTA and improvement in packaging not only helps in achieving primary goals such as cost optimisation and inventory management but also helps in achieving environmental benefits by reducing the use of plastic from the process significantly.

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ACKNOWLEDGEMENTS

The authors, gratefully acknowledge the collaboration and permission given from the management of Foseco India Limited and Bradken India Private Limited to present this paper.

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