CONSISTENT COATING APPLICATION THROUGH AUTOMATED PREPARATION

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ABSTRACT

The paper introduces a new way of process control for a usually underestimated quality influence to casting. Coatings and the correct way to apply them have a significant and influential importance to casting quality. By maintaining a consistent coating at its application state a lot of defects can be avoided, but also considering the complete foundry process some so called bottle necks can be eliminated. The paper shall incentivize foundries to look closer to a consistent coating application in general and will show ways of proper controls as well as the state of the art tool to automate coating handling.

Keywords: Coatings, Consistent coating application, Process control, Automate coating handling

1. INTRODUCTION

Assuming the average delegate has more than 10 years in a foundry environment, in this conference room, there is most likely more than 500 years of foundry experience sitting here.
Coating application and the consistency control is still one of the most neglected practices in a foundries day to day operation. With an attempt to adapt what is done in other industries ref. coating control M.Joyce, M.Rebros and S.Ramrattan published an article in AFS 2008 looking into paper coating industries and concluded surface tension, levelling indexes etc. could be applied as foundry coating control tests1. Ok with all respect and fairness this is a very scientific approach to a problem that is pretty common in all foundries around the globe:

2. HOW CAN WE MONITOR/CONTROL/ADJUST COATING

Application where it is most critical at the application state in other words, which is the ultimate parameter that should be kept as consistent as possible?
Let’s take a moment and look into various parameters of a coating that provide influence to the end performance:
Table 1: Coating Parameter and Influences
Parameter Influence

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Influence</th>
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<tbody>
<tr>
<td>Viscosity (Flow Cup, sec.)</td>
<td>→ Flow characteristics and fine part absorption</td>
</tr>
<tr>
<td>Solid Content (%)</td>
<td>→ Real protective layer</td>
</tr>
<tr>
<td>Baume (°Be)</td>
<td>→ Coating Body/Stiffness</td>
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<tr>
<td>Density (g/cm³)</td>
<td>→ Best applicable measure to relate to WLT</td>
</tr>
<tr>
<td>WLT Sedimentation (%/24h)</td>
<td>→ Coating (suspension) stability</td>
</tr>
<tr>
<td>Flow Properties</td>
<td>→ Result of RB + wetting time</td>
</tr>
<tr>
<td>Wetting Time (sec.)</td>
<td>→ Important ref. Core handling</td>
</tr>
<tr>
<td>Ring Test (sec.)</td>
<td>→ Carrier liquid penetration – levelling</td>
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</table>

The layer thickness applied on a sand surface determines the efficiency of a coating, how much coating actually is consumed and the quality of the casting. Hence this parameter consequently should be kept as constant as possible. There are numerous control methods existing that indirectly and via a kind of detour check what is assumed to represent layer thickness, e.g. Viscosity (Ford or DIN cup), Baume, pick up etc. Beside the fact that all above measures are dependent of environmental influences like temperature, they can also be influenced by the skill level of the person who does the test.

Figure 1: Viscosity change on temp. Variation (pg. 40, PPCJ. – November 2011( www.coatingsgroup.com)
Figure 2: Signal Toothpaste softening (viscosity drop) on temperature differences (Temperature dependence of viscosity of non-Newtonian materials Internship 2012 (May 21st to July 29th)

Figure 3: – Wet layer difference due to Baume (± 1Be) and Visc. (±1 sec.) Differences

So the ultimate target is to exclude all influences and still have a measure that represents the applied wet and dry layer of coating and is sensitive enough to be used as a control and adjustment measure.
Well to keep a long story short, Baume and Viscosity is common practise in foundry context as coating process.

Control measures.

It has been found however that the best correlation of an indirect process control is specific gravity (SG) or Density. In fact if you think about it, it appears to be a logical consequence of a solid content responsible for a layer build up that also determines the density of a suspension – called coating:

Figure 4: – Viscosity and Density Dependence of Water

Figure 5: Relation between wet and dry coating layer vs. applied density.
Another complication that should be not forgotten are the methods of controls. Baume and Viscosity are batch controls that monitor a snap shot of the coating at a special point in time. Ideally an online and continuous control can be applied that enables a direct influence to the applied dilution, in other words layer thickness. As mentioned above coating performance in general changes due to various influences. Hence a large number of various tests and development stages are leading the way to an end product applied in the foundry. E.g. we are enabled today with all the modern equipment like Rheometers to finger print a coating product to an extent of even point out tiny product differences. In case this online measurement would be available the hassle with coating consistency and coating related defects could be minimized. In fact since Foseco has launched the so called Coating Preparation Plant, short CPP, a lot of European foundries have installed this new technology for quite various motivations:

1. Quality, consistency and recording options that did not exist before
2. Value of castings and appreciation of importance of coating application
3. Maintaining core shop- and foundry-processes at an optimized balance
4. Reducing environmental stresses
5. Cost saving

The range of foundries that run this kind of Coating monitoring covers windmill-, steel- and automotive foundries. The measuring principle is rather simple. A pressure difference determines the corresponding coating density by resistance to a fixed and constant pressure. This type of control enables us to 1st adjust the coating that is supplied in say paste form 2nd controls the coating in the tank ready for being applied 3rd re-adjusts the coating returned from the end user, e.g. Dip tank, flow coating catch tray or even pressure vessel of a spray system.
3. CONCLUSION

Considering the importance of a consistent coating application a re-thinking process should start leading to at least an acknowledgement of coating influences to casting quality and a greater effort to control. With the CPP-way of maintaining coating performance a long desired variable in the foundry process can now be considered constant.

REFERENCES

2) Foseco internal investigation
3) Source: Density/Viscosity - Wikipedia, the free encyclopaedia. mht
4) Foseco internal study