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Intellimold Update and RRIM Case Study

As the products that we make become more varied, so must our process capabilities. RIM and RRIM processes were very much in demand a couple of decades ago and have died down in the past decade. As the automotive (and non-automotive) industries expand their part and product requirements, RIM and RRIM have gained popularity and research again in the last few years.

The benefits of RRIM are significant in our industry due to the relatively inexpensive tooling and lower processing pressures required, allowing for cost-effective prototype runs and low volume production. Additionally, more complex, larger parts can be made because flow is not limited directly by part geometry, but by injection time. Therefore designers can be free to create parts that could not be made using conventional injection molding processes.

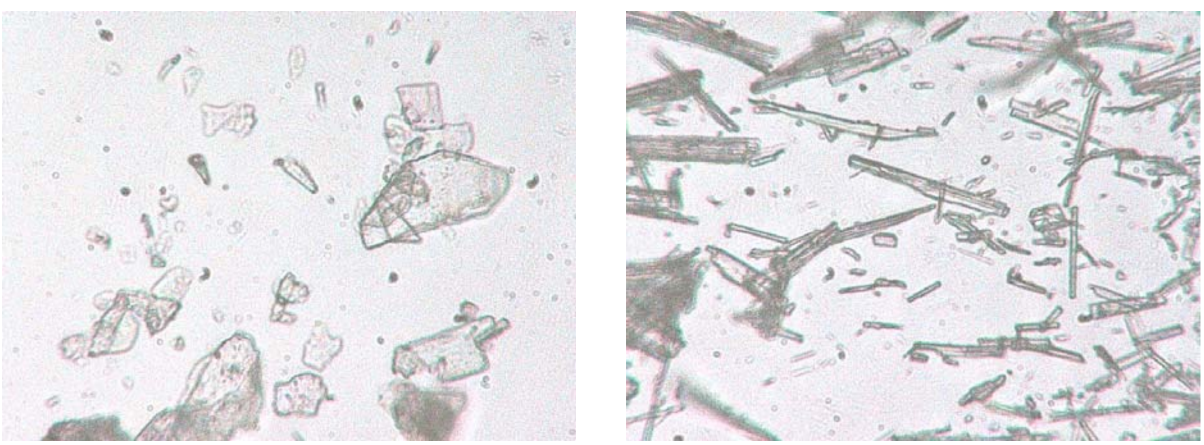
RRIM also has some inherent problems associated with it that may deter many molders from investing in it. These are problems that can be reduced or eliminated by using the Intellimold process.

RRIM CASE STUDY

The following is a case study created from an integration with a RRIM machine, making a luxury sports car body panel with high appearance and structural requirements.

Problems: poor mixing, high porosity at end-of-fill, wide porosity variance, pitting, uneven filler distribution, waves, blisters, extensive flash

Background: The parts being produced are large body panels. The press tonnage is just barely enough to keep the mold closed during injection due to the projected area of the part. In short, the press is operating at its upper limit. When the end-of-fill is reached, the tool flashes every time because of the press limitation and the viscosity of the material. Because of the high injection speeds, the mix of the material is very poor as well as the filler distribution. The fillers break down extensively as well as the material and cause a variety of appearance and structural issues.



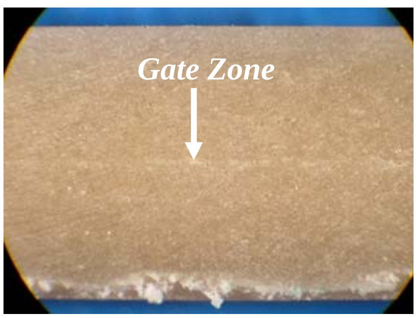
Broken-Down RRIM Fillers (Mica and Wollastonite)

Approach: Our first step was to collect a series of random samples and take them to our laboratory for physical and chemical analysis. We started with light microscopy and high magnification to see, physically, what was happening at the problem locations.

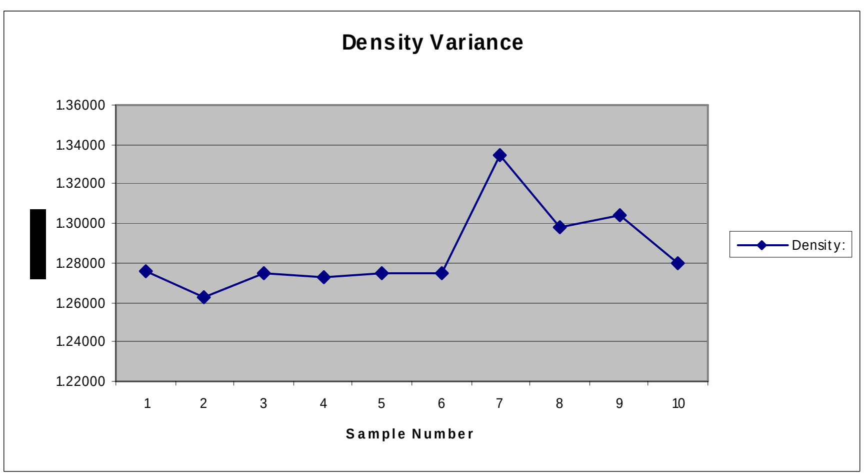
Our next step was to analyze the fenders with FTIR using a grid pattern to evaluate the compositional variance across the outside and inside surfaces of the part. This accomplishes two main things: first, we can determine if there is a varying level of cure from the gate area to the end-of-fill, and second, we can pick up filler types and their distributions on the same comparison.

Once we had our "clean sample" needs taken care of, we performed density studies across the part as well as burn tests to determine filler concentrations.

Findings: Initially, we noticed a thin line of concentrated porosity in the center of the wall thickness across the entire length of the part. The thickness or amount of porosity increased from the gate area to the end of fill. This is caused by the partial cure along the length of flow during injection. As the material enters the mold, the "skin" cures inward much like in conventional injection molding. This sends the majority of porosity through the beginning of the part and traps it toward the end.



We noticed a significant variance in the level of cure from the gate area to the end-of-fill as well as a significant increase in filler concentration from the gate area to the end-of-fill. The density showed no specific trends other than the fact that the variance across the part was as high as 10%.

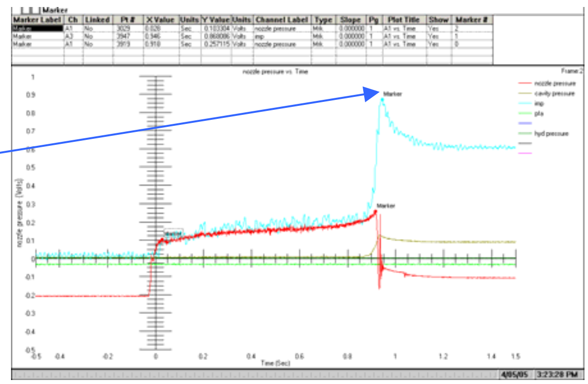


Density variance Table

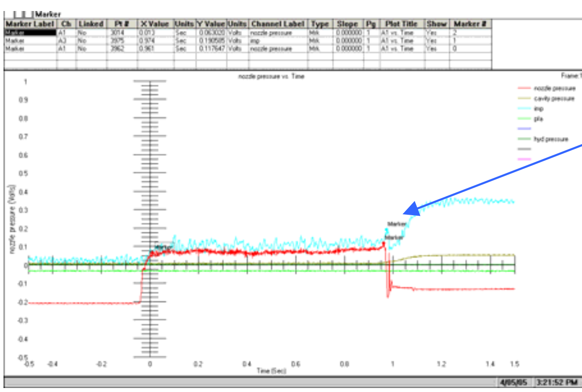
Solution: Intellimold! By installing Intellimold on the RRIM press, we introduced a closed-loop system to the highly sensitive material and the limited process. As you know, Intellimold eliminates the use of opinion and judgment in the molding process by simply allowing the operator to enter the desired material pressure. In RRIM, however, the material viscosity is so low that there is no rule of thumb for material pressure, so in order the maintain a consistent part, while adhering to the automotive specifications imposed, we needed to run a processing DOE to determine what variables had a major affect on the part. More importantly, however, the DOE allowed us to experiment with that particular material to determine the absolute perfect processing pressure, while keeping all of the fillers intact and allowing 100% cure. Once this pressure was realized, we simply input that number in the desired IMP setting (Internal Melt Pressure) and the controls took care of the rest. Now, instead of needing velocity profiling, or simply living with the results of an imperfect tool, we were now able to have the material itself control the process. For Example: if our controls sensed an increase in pressure due to factors such as a cool spot in the tool, or a constriction in the flow, the proportional valve simply adjusts itself to compensate for the variance. All of this takes place in only 1 millisecond, depending on the machine.

End Result: After Intellimold was installed on the RRIM press, we were able to reduce the flash by over 80%, reduce the density variance by 32%, decrease the porosity by 25% and nearly eliminate the porosity variance across the part by providing a uniform fill. In addition to the reduction in defects, we were able to allow our client a more consistent part shot-to-shot and shift-to-shift.

Internal Melt Pressure spike at the end of fill contributes significantly to flash and porosity, leading to decreased paint-ability as well as other part issues



____ Gate Pressure
____ IMP



By controlling the Internal Melt Pressure through the entire "injection phase," we were able to all-but eliminate the end of fill pressure spike and the issues associated

If you have any questions about Intellimold™ or our materials and analysis capabilities, feel free to contact us!

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