NATUREWORKS CASE STUDY

Large Format 3D Printing Grade Ingeo PLA 3D700 Delivers Improved Performance in Metal Casting Manufacturing for Shanghai TuoZhuo

Situation: Wood Molds for Metal Casting Manufacturing are Expensive and Require Regular Maintenance

Metal casting, the process of filling negative impression molds with liquid metal to create metal parts, is a manufacturing process primarily used to create unique or irregular pieces that would be expensive to make by other methods like machining, forging, or stamping.

In the past, wood has typically been used for foundry molds, but as a material, it has limitations. Wooden molds are easily affected by weather, expanding in hot weather, contracting in cold weather, and warping over time due to moisture. These molds therefore require regular maintenance for size accuracy.

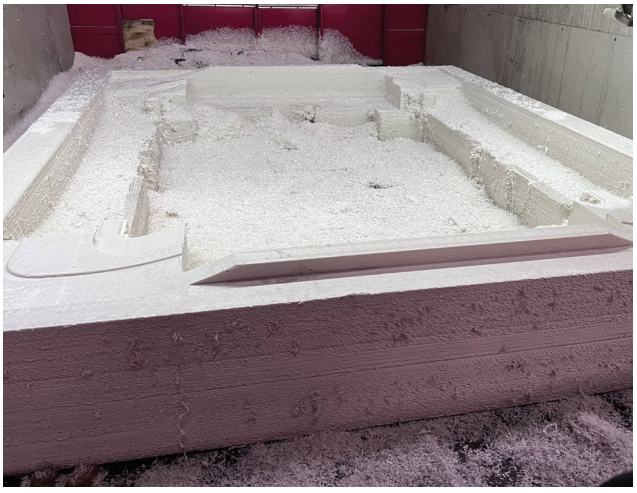

Photo courtesy of TuoZhuo

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Solution: Ingeo PLA 3D Printed Molds Offer Time and Cost Savings and Sustainability Benefits

3D printed molds, by contrast, are faster to produce, more cost efficient, and easier to maintain. They have higher strength and smoother surface than wooden molds, which causes cleaner and more accurate mold prints. Furthermore, they have a longer life cycle. Wooden molds can be used generally around 200 times, but 3D printed molds made with Ingeo PLA can be used up to 500 times. The processing lead time of a 3D printed mold is much shorter and thus more cost efficient than using wood molds. Molds made from Ingeo PLA specifically also offer sustainability benefits over molds made from other plastic materials. Because Ingeo is a plant-derived polymer, it has a carbon footprint 84% lower than petrochemical-based plastic such as ABS.

There is, however, one major challenge in creating 3D printed molds for large format metal casting applications. When printing significantly large pieces, certain materials are prone to warping, causing the print to pull away from the print bed or separate between print layers. These are costly errors in prints of a large size—both in the cost of wasted material and in the hours or days of wasted print time.

Outcome: Ingeo 3D700 Delivers Low Warpage Accurate Parts for Shanghai TuoZhuo Large Format Metal Casting Application

The benefits of Ingeo in large format metal casting can be seen in recent work from Shanghai TuoZhuo, a 3D printing material R&D company. Large format prints made from Ingeo 3D700 were used to create sand casting molds for metal bumpers and forklift counterweights. Using a direct resin-to-print process, Shanghai TuoZhuo's customer printed the molds out of Ingeo 3D700 with no support structures.

Shanghai Tuoz observed notable improvements when printing with Ingeo over other petrochemical-based plastics common in additive manufacturing. "There is no warping or deformation when printing with an amorphous PLA grade like Ingeo 3D700," said Gabino Chen, Project Manager at Shanghai TuoZhuo New Materials Technology Co., Ltd. "Using ABS, PETG, or PA in prints of this size is difficult, which is why it's important to use PLA and useful to have a PLA grade specifically designed for large format printing." Shanghai Tuoz observed that Ingeo 3D700 outperformed not only other fossil-based materials but also improved upon the performance of generic PLA grades that were not designed for this specific printing format. No support structures were needed for these prints, and Shanghai Tuoz was able to print at a low temperature of 170–175˚C. For each part, the time to print was between 10–24 hours.

Strategic Objectives

- Find an alternative to wood foundry sand casting molds that is cost efficient, time efficient, and resistant to moisture warpage.
- Utilize the strengths of additive manufacturing to deliver molds for sand casting up to 2 meters tall
- Reduce the rate of print failures due to part warping and loss of inter-layer adhesion in large format prints

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