Considering 3D Sand Printing: Large Size Impellers with Nickel Aluminum Bronze (NAB) Alloy

3D printing has proven to be a revolutionary invention to the industry and although frequently relied upon, some challenges persist. Not all alloys are suitable for direct part-making using 3D printing, particularly components that have copper-based alloys and aluminum bronze grades. 3D sand printing could be a solution for this obstacle; yet challenges can remain when considering additional factors such as size, weight, and cost.

To relieve these challenges, engineers tend to look at two alternate options for 3D sand printing: Monobloc Printing and Segmented Printing.

By Olivier Gouriou, Mechanical Engineer & Technical Sales Manager

The 3D sand printing method is a solution for components that have a Nickel Aluminum Bronze (NAB) Alloy (ex. CuAl10Fe5Ni5 according to EN 1982-CC333G or ASTM B148 C95800) and is mainly used for 2 reasons: to remanufacture a component when the original drawings and patterns are no longer available and for when a hydraulic component requires an improved accuracy and surface finish.

When looking at factors such as the size, weight, and cost of 3D sand printing, end users can benefit from capitalizing on alternate methods like Monobloc Printing and Segmented Printing. Each of these methods can bring success when working with the aluminum bronze casting of the large impellers. These methods can be used for the mould itself or the core of the component.

Monobloc Printing

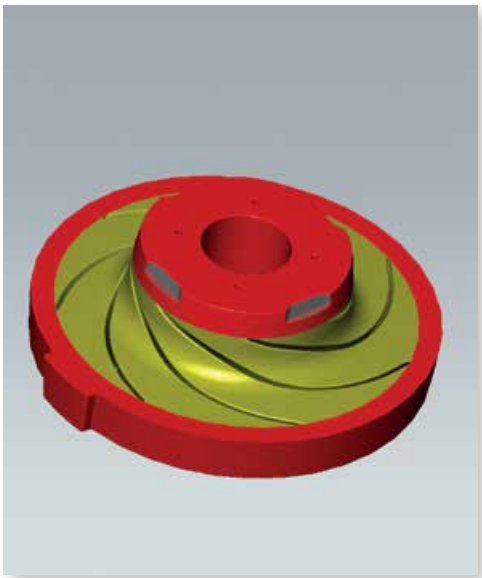
Printing a core monobloc is currently possible with the help of a large printer. New technology enables Monobloc printers to reach dimensions of 4m x 2m x 1m, but this type of equipment and dimensions remain scarce on the market. Investing in the printer can become expensive and as a result, combining both new 3D sand printing and traditional foundry is common. As new technology becomes available, the investment costs of the printer will decrease making it more accessible for end users.

Large size impeller at control stage.

Large size 3D sand printed cores (VoxelJet VX4000).

Segmented Printing

The alternative approach for remanufacturing large-size impellers with NAB alloys is to use the same process as an in-convention sand-casting. This is usually done by printing each vane of the pump and assembling it according to the requested pattern. This process is similar to a retrofit project; first, the pump manufacturer scans the existing impeller and reworks the hydraulics. The second step is completed by personnel in the foundry, as many factors depend on the mould design and pouring technique. This step is completed to ensure is the 3D file is modified to factor in the machine's availability and casting shrink ratios. Lastly, a highly skilled foundry operator will print and assemble all segments to ensure the product achieves proper geometry. Segmented printing is a complex but efficient solution when an accurately sized printer is not available for the project.



3D file (Inoxyda).

Pouring 6To of alloy in 3D sand printed mould @ 1 250°c (Inoxyda).

Considering 3D Sand Printing

3D sand printing is still a scarce manufacturing technology despite its innovation being around for quite some time. The cost factor of the technology is what mainly makes it rare in foundries. The main threshold lies in its capital investment which can cost upwards of 1,500,000 € for larger-sized printers.

3D sand printing guarantees the same metallurgy as the original design, whereas not all alloys are compatible with direct part-making using 3D printing. The chemical analysis and mechanical properties remain the same. Another reason why the same metallurgy is possible is because the melting and pouring of the metal is done with approved partner foundries; this avoids possible requalification costs.

Although alternative methods exist, it is important to understand the advantages linked to 3D sand printing that goes beyond its ability to work 24 hours a day, seven days a week. 3D sand printing allows for the ability to create pattern-less technology that leads to reduced pattern inventory costs. This method saves costs in the long run for manufacturing, storage, transferring between foundries, and maintenance over the years. It also creates the ability to review design hydraulics based on project requirements, specifically the performance of retrofit projects.

6 segments fully assembled hydraulic core (Inoxyda).

Segment 1 of pump hydraulic (Inoxyda).

In Summary

Industrial components that are needed to manufacture reliable valves and pumps must follow a crucial dimensional tolerance and the need for compatibility with all metallurgies. Foundries are proven, historical manufacturing processes that change rapidly; upcoming innovations and several existing technologies have made concepts such as casting simulation and 3D sand printing, a reality. As 3D sand printers become more widespread throughout metallurgical industries, this technology can be a solution for tomorrow's projects.

About the Author

Olivier Gouriou is a Mechanical Engineer and has worked in technical sales for more than 30 years. He has been working with Inoxyda for 8 years and specializes in promoting applications of aluminum-bronze alloys and specializes in the challenges of corrosion. Gouriou takes pride in sharing his technical expertise to help application engineers make informed decisions.