

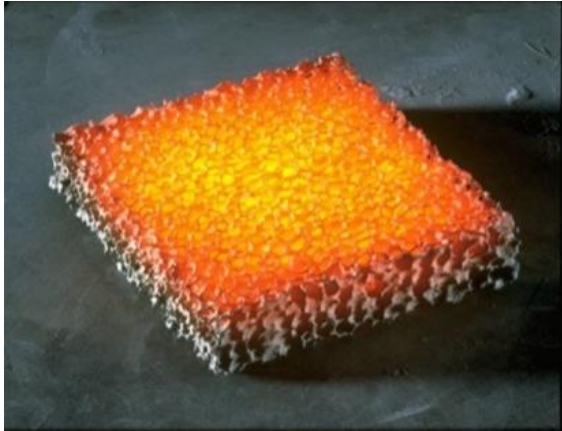


Additive Manufacturing Technology in Casting Filtration

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Introduction and Background



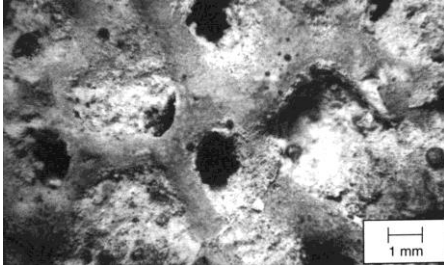
- Ceramic foam filters are now the leading type of metal filtration system used to produce castings in most alloys and casting technologies
- However, ceramic foam filters have restrictions including, inability to produce exceptionally large pore filters (>10 ppi) and flexibility in design
- Other filter types are commercially available but not extensively used as they provide a reduced level of filtration efficiency and turbulence control

Filter Function

Inclusion Removal

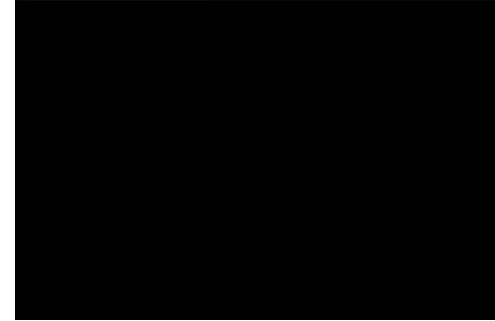
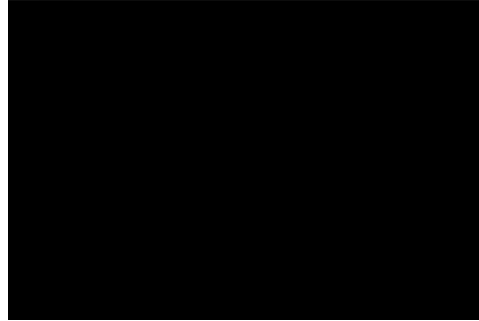


Refractory and slag



Alumina Powder from de-oxidation

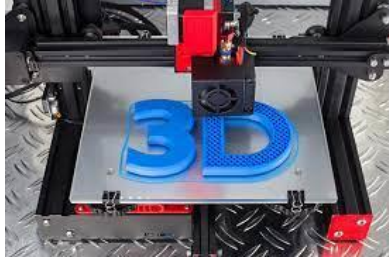
Turbulence Control



Introduction to Additive Manufacture



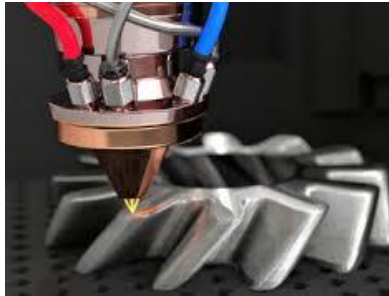
Stereolithography



Material deposition

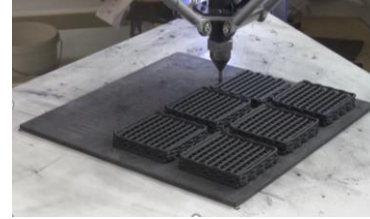


Pattern printing



Metal printing

Initial focus for molten metal filters



Extrusion



Binder Jetting

3D printed filters



Features

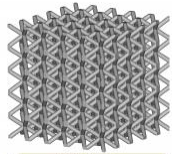
- Alternative structures to foam
- The potential for bigger than 10 ppi pores
- Product and performance consistency (the filters will be very consistent)
- Exact definition of pore size (e.g. 4mm)
- Multiple structures in one filter

Benefits

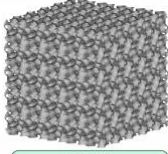
- Very consistent filter performance
- High-capacity filters facilitating application to large castings
- Optimising filter design to provide improved performance
 - Different structures may be optimum for different castings or alloys



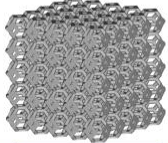
Potential structures include



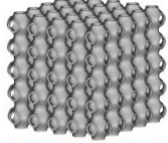
BCC Lattice



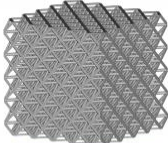
Split P



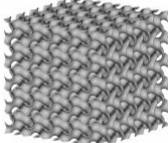
Kelvin Cell Lattice



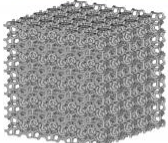
Schwarz P



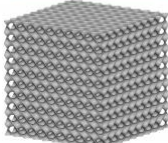
Octet Lattice



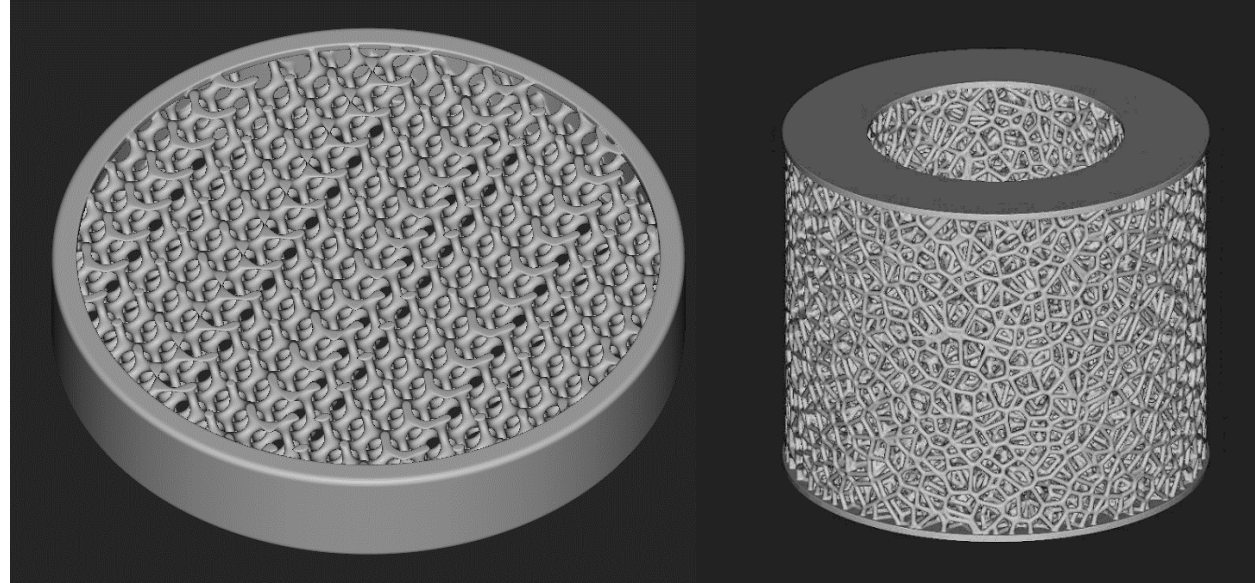
Gyroid



Weaire Phelan Lattice



Diamond



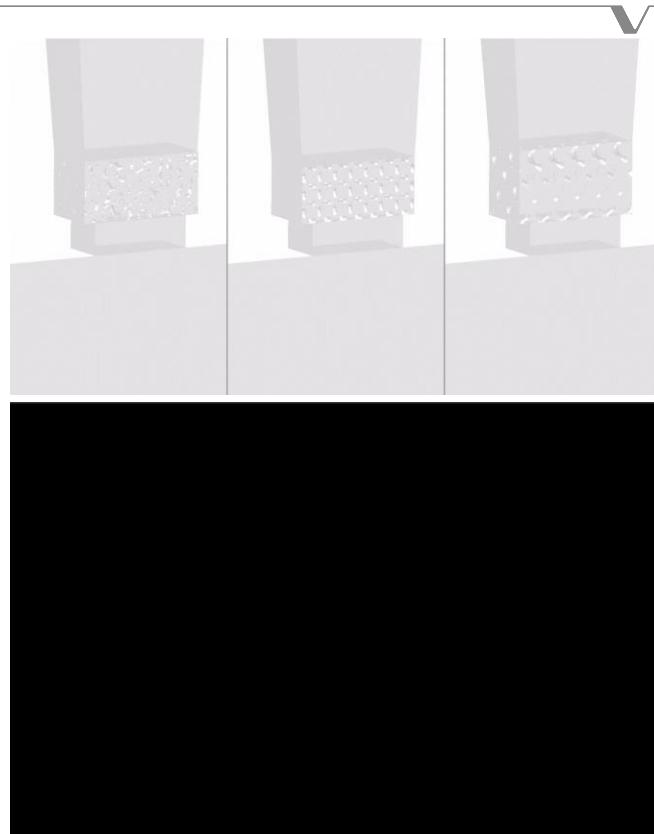
Gyroid

Voronoi

Defining the optimum filter structure

Depends on the objective

- Inclusion removal
 - Scrap / rework reduction
- Turbulence control
 - Direct Pour
 - Process simplification
 - Runner removal
- Increased capacity
 - Process simplification for inline filters

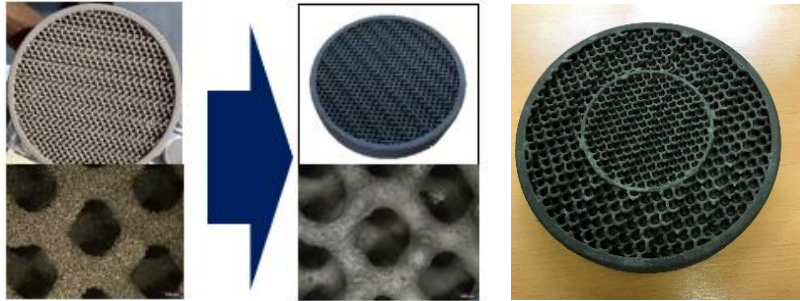


STELEX Optiflow3D manufacture



Based on combining two existing technologies

- Binder jetting
- Carbonisation



STELEX Optiflow3D

Target casting types

- Large iron castings
 - Energy generation, machinery, engines
- Steel
 - Large castings, nuclear, valves, wheel axles

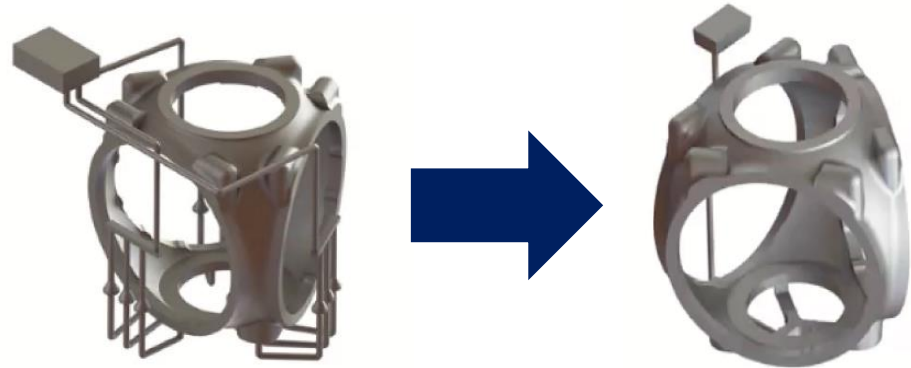
Foundry benefit

- Flexibility with structures
- Filtration efficiency
- Application performance
- Consistent / predictable
- Large castings

Process simplification

Process optimisation and simplification

- Hollowware reduction
- Yield improvement
- Scrap / rework reduction
- Filter reduction
- Extension of Direct Pour potentials



First external foundry trial

Ø200x35 mm Gyroid

- Alloy - SG Iron
- Filter applied in Feeder - Ceramic Holder
- Lip Pour Ladle

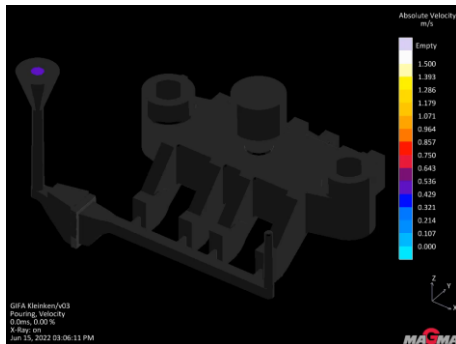
Metal Pouring

- Pouring Temperature 1400 °C
- Poured weight 2 t
- Pour Time 30 s
- Flow Rate 66 kg/s

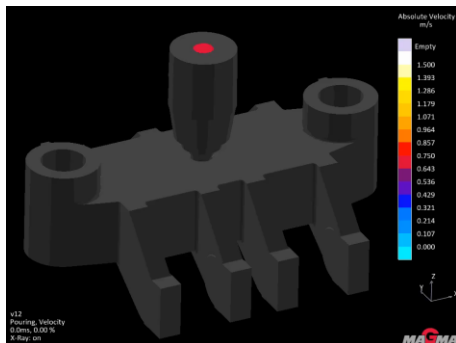
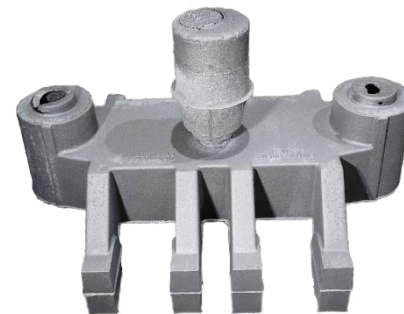


STELEX Optiflow3D
Ø200x35 at
6.3 kg/cm²

Case Study



- Description Cross Head
- Alloy EN GJS 400-18
- Casting weight 800 kg
- Pouring temperature 1350 °C



Pouring weight
Pouring time
Yield

Initial gating
system

959 kg

50 s

83,4 %

Revised gating
system

865 kg

40 s

93,4 %

STELEX Optiflow3D
Ø125x30 at
7,0 kg/cm² in SCK
direct pour feeder

Case Study



Description

Planet carrier

Alloy

GS 17 CrNiMo 6 V

Casting weight

230 kg

Pouring temperature

1610 °C

Initial gating system

Revised gating system

Pouring weight

317 kg

309 kg

Pouring time

21 s

24 s

Yield

72,5 %

74,4 %



STELEX Optiflow3D
Ø100x25 at
3,9 kg/cm²

Hollotex EG Runner ST

Novel holloware system for steel casting



- 10 years' experience with iron castings
- Recently developed for application to steel castings
- Process simplification and casting cleanliness



Benefits

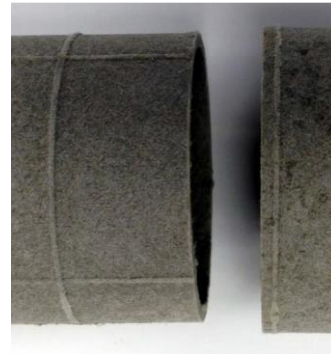
Low Weight

- Typically, 85% lower weight than conventional Holloware running systems
- Lower metal chilling than convention running systems



Push Fit

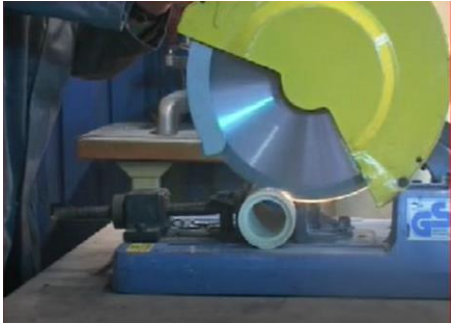
- Each section has a male and female end for easy push fit connection by hand, no extra sealing is required



Benefits

Easy to Cut

- The use of cutting wheels is eliminated providing a safer and quieter working environment.



Low Residues

- Hollotex EG runner comprised of highly refractory minerals and organic binding system with a protective refractory coating. The remanets will not contaminate the foundry sand system



Benefits

Chemically and Thermally Stable

- Hollotex EG runner comprises of highly refractory minerals with an organic binding system and a protective refractory coating.
- There is no reaction between the Hollotex EG Runner and the molten metal resulting in clean castings



Integration with filter holders and ingates

- Hollotex C5-FH filter folders are recommended for application with Hollotex EG Runner ST
- Specifically designed ingates can be applied with the system



Conclusion

Additive Manufactured Filters

- New structures for high value castings
- Alternative to foam
- Excellent performance consistency
- Availability of a variety of structures, shapes and sizes
- Enabling technology for filtration of large casting
- Optimum filter structure and sizes for specific applications

Novel Steel Running Systems

- Process simplification
- Health and Safety
- Environmental and Disposal
- Casting Quality

