

Simulating castings with real foam filters

By Håkan Fransson

Technical Manager, Simulation

Filtration of the melt during casting is an important part of foundry technology. Filters are used by different types of casting material/methods, but especially for casting material that easily create slag/oxides like aluminum and steel castings. Type of filters are pressed filters, foam filters which have an inner structure like a sponge or a so called woven filter.

[illegible]

The difference between the different filters is quite big:

1. Pressed filters – Advantages: high reproducibility due to the manufacturing method. This means that you have the same characteristics for the whole population. Pressed filters are strong and can withstand high flows. They can be produced large to be able to work with large castings. Disadvantages: There is a risk that the flow is not laminar after the filter (which works better in foam filters). The behavior is like through a mincing machine where the melt is split up in small streams of metal. The slow down effect is though very good.
2. Foam filters – Advantages: filters the melt very good, creates a laminar flow. Disadvantages: reproducibility between manufacturers is low but also within the same manufacturer and also even within the same batch. This depends on the manufacturing method. It is difficult to use for big castings since the filters break or are hard to scale up.
3. Woven filters – Advantages: easy to apply anywhere. Cheap. Disadvantages: Filters only big particles and are not good at reducing speed of the flow.

© NovaCast Systems AB

NOVAFLOW & SOLID

Temperature, °C

1000.00
950.00
900.00
850.00
800.00
750.00
700.00
650.00
600.00
550.00
500.00
450.00
400.00
350.00
300.00
27.00

10MatCf_Steel
Mold_Corona
Mold_Core_Sand#0
dt: 1e-04
Time: 0.00011372
Filler volume, %
Liquid phase, %
Shrinkage, %
XYZ plane, min 05.00 [65]
NovacFlow v2.0.0
Copyright © Novac Flow, Inc., 1998, 1999, 2000, 2001
File: M010101

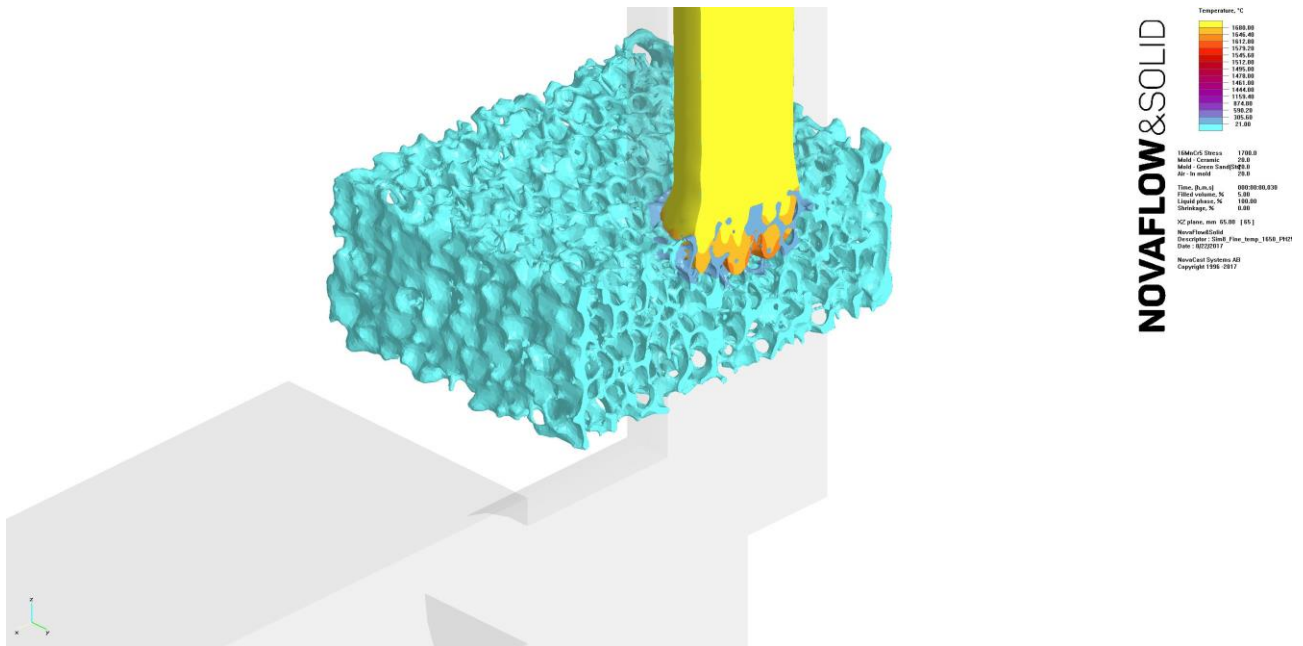
NovacFlow Systems AG
Copyright 1998, 2017

It has been possible to simulate foam filters for a number of years, but the simulations have then taken a month or two which makes it most unpractical. With today's technology, it is possible to create 3D models of filters.

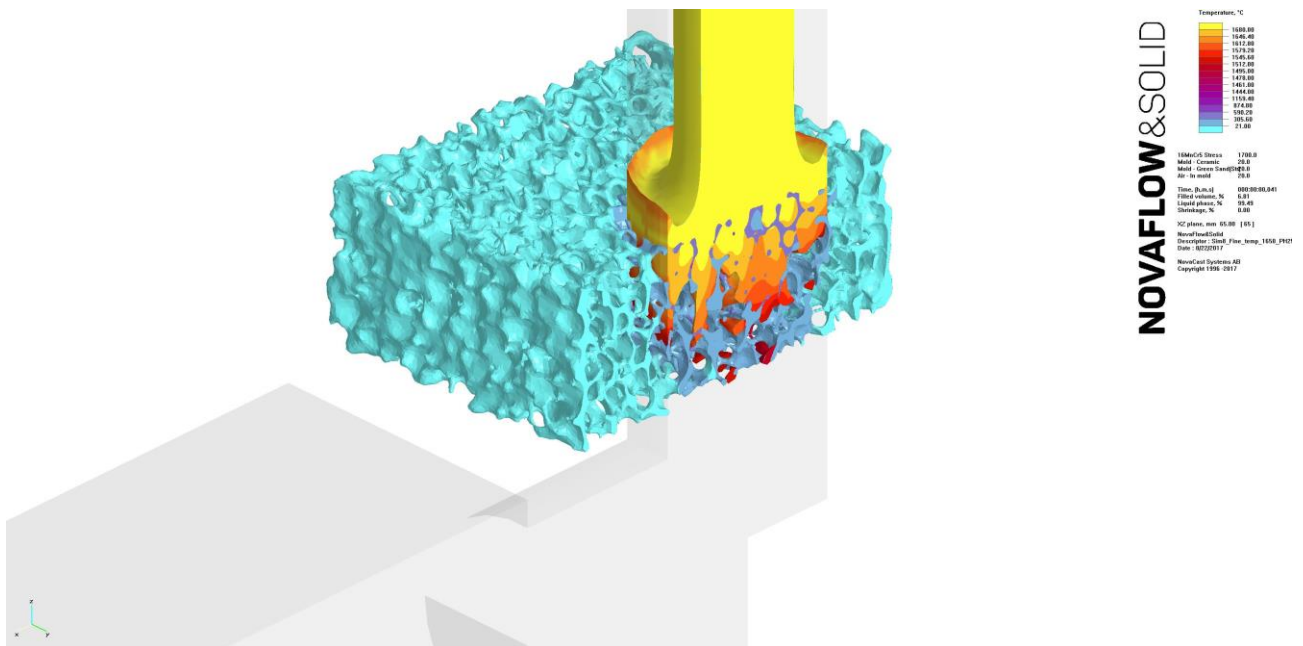
NovaFlow&Solid can simulate both pressed and foam filters thanks to the special meshing technique: Finite Volume Method (FVM) which combines cubic elements with fully flexible elements which adapts to the geometry. This gives an exact description of the geometry with a high accuracy. NovaFlow&Solid can also have more than one material in each cell. The calculation time does not necessarily increase significantly when simulating filters, which is fantastic! As a bonus, the meshing is automatic and takes only a few seconds.

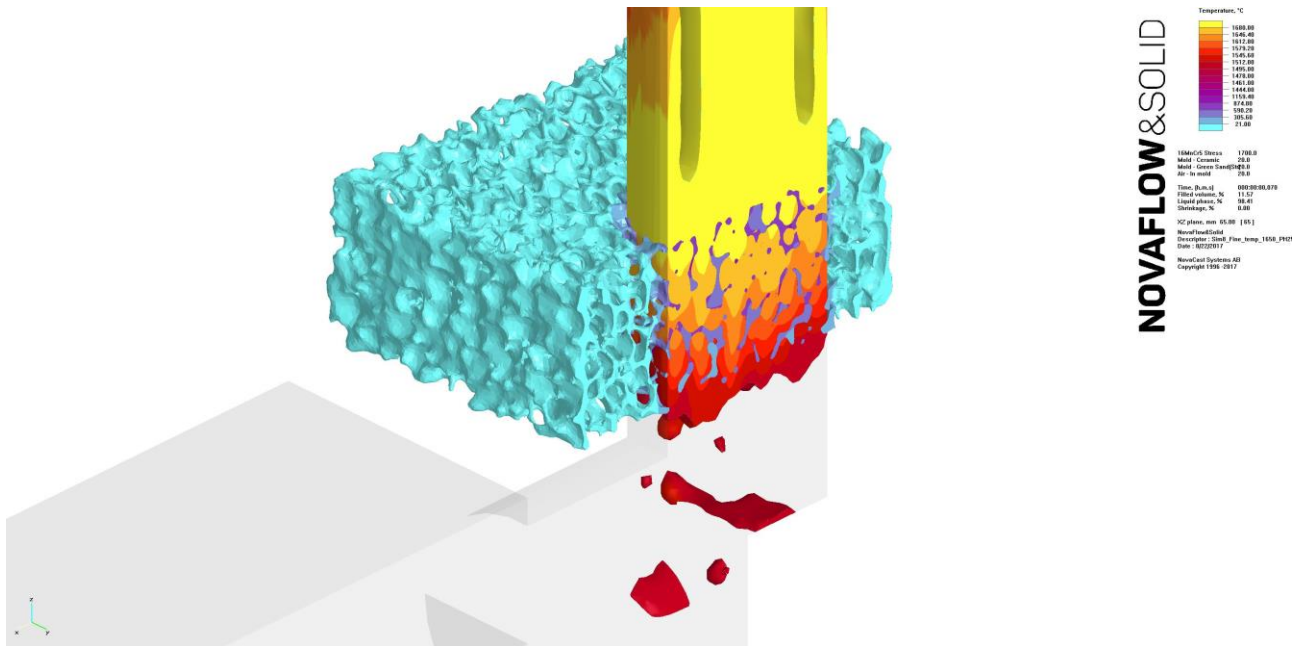
By using real dimensions in the filters there is no need to find values for pressure drop through the filters or which friction to use, the simulation shows how it will work in reality when adding the actual filter in the ingate system. It is however important to use correct dimensions and choose correct filter material. By doing this it will give correct speed, loss of pressure and temperature drop through the filter. The loss of temperature is important since it thereby is possible to simulate if the initial melt can get through the filter, which sometimes is a problem.

Below the gradual penetration of melt through the filter is described:

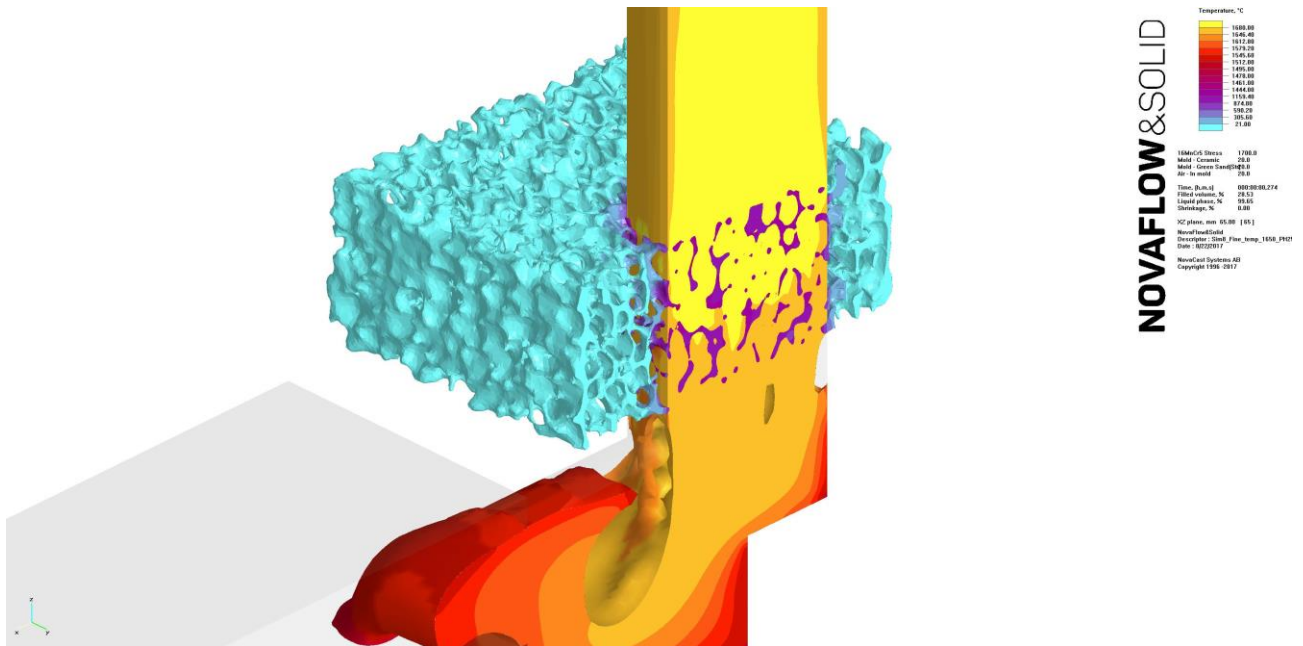


The melt meets the filter and the front of the melt is losing some temperature. At the same time the filter starts to heat up.





This is exactly on the boundary for the melt to break through.



The melt has now penetrated and the filtration has begun. The temperature is now rising in the filter since the melt has heated it up which means that there is no longer a problem with risk for freezing. Note also that when placing the filter like this there is a loss in pressure below the filter which makes the simulation lack melt there and there is a zone instead with basically almost vacuum. This is not good and to avoid this the filter should be placed vertical instead if possible.

The conclusion is that it is now possible to simulate all type of filters and that the new technique with cast simulation connected to advanced 3D scanning and usage of 3D printing for manufacturing of filters opens up to new possibilities in the foundry industry. One can say with a good conscience that another area of the formerly mysterious foundry industry has now been opened as knowledge instead.