Ceramic Foam Filters -

How to Achieve Higher Flow Rates?
Are Elements released by the Filter?
Filter Preheating – often underestimated
Content

1. HF Filters – overview, benefits and usage
2. Potential releases of elements from the filter
3. Filter preheating
HF Filters
HF Filters

What is a “HF-Filter”?

“HF” stands for “High Flow“. HF-filters by Drache are standard-sized ceramic foam filters, which have a higher open porosity than regular CFFs.

Due to that, higher filter efficiencies and / or higher throughputs can be achieved.
HF Filters – LIMCA Results (1)

Average efficiency of HF50 much higher than standard 50ppi CFF
HF Filters – LIMCA Results (2)

No minimum of efficiency at 40-60 µm particle size
- Complete overlap of depth filtration (fine particles) and bridge/cake filtration (large particles)?
HF Filters – Flow Rates

<table>
<thead>
<tr>
<th></th>
<th>9”</th>
<th>12”</th>
<th>15”</th>
<th>17”</th>
<th>20”</th>
<th>23”</th>
</tr>
</thead>
<tbody>
<tr>
<td>PPI 40 HF (reg)</td>
<td>130 (50)</td>
<td>226 (87)</td>
<td>326 (117)</td>
<td>419 (175)</td>
<td>580 (267)</td>
<td>767 (384)</td>
</tr>
<tr>
<td>PPI 50 HF (reg)</td>
<td>88 (34)</td>
<td>174 (67)</td>
<td>239 (100)</td>
<td>307 (134)</td>
<td>424 (200)</td>
<td>561 (267)</td>
</tr>
<tr>
<td>PPI 60 HF (reg)</td>
<td>73 (28)</td>
<td>140 (54)</td>
<td>188 (80)</td>
<td>242 (107)</td>
<td>335 (160)</td>
<td>443 (214)</td>
</tr>
</tbody>
</table>

Flow rates in kg/min for various HF Filter. The data given in brackets is for regular CFFs.
HF Filters – Benefits & Drawbacks

Benefits of HF Filters:

• Significant higher filtration efficiency
• Higher throughputs possible compared to standard CFFs
• Allows application of finer CFFs without changing the filter size
  (=without changing the filter box)

Drawbacks:

• More fragile, more careful handling required (especially for 23”)
• Large difference in metal level before and after the filter
Element Releases
Elements Releases

It is not secret that a reaction between the melt and the CFF occurs…

… but what happens?
Element Releases – Test Set-Up (1)

The release of Elements from a standard, Phosphate-bonded CFF as well as a Phosphate-free CFF was tested together with Hydro Aluminium, Germany, in their R+D facility in Bonn.

Test set-up:
• Pieces of about 100 g are cut out of CFF filters to be tested
• About 2500 g of AlMg4.5 with low Na-content is melted and kept at about 750°C
• The preheated (~10min) CFF pieces are submerged into the melt
• After 0, 30, 60, 90 and 120min analytical sampling is done
• Parallel one crucible without a CFF (just coated with a painting) is used as a reference sample
Element Releases – Test Set-Up (2)
Element Releases – Sodium

Legend: X – reference, E+F: Drache standard, G+H: Drache P-free, I: others
Element Releases - Silicon

Legend: X – reference, E+F: Drache standard, G+H: Drache P-free, I: others
Element Releases - Conclusions

• Standard, Phosphate-bonded filters show a very little, for most alloys negligible release of Na and Si
• In contrast to that, the Phosphate-free filters show significant release.
• Based on the test data, the release seems to be higher for finer filters.

• Although it was not tested within these trials, it is reported that Ca may also be released from Phosphate-free filters.
Filter Preheating
Filter Preheating

… is known to be necessary, nevertheless often underestimated and occasionally done wrong.

Potential mistakes:

• Filter too cold
• Filter too hot
• Uneven preheating
• Filter cools down too much after preheating stops
Filter Preheating

Wrong filter preheating can result in:

• Filter floating up (while priming)
• Reduced filter efficiency
• Rapid oxidation of the first metal touching the filter surface
• Cracked / collapsing filter
• Reduced filter efficiency
• Significant drop of metal level after filter
• Aborted casts
Preheating Curves – Good vs. Bad
Preheating Trials – Set-Up

Colors used as for run-charts

Melt inflow

Melt outflow
Preheating Trials - Results

Note: Trials were performed on a “real”, fully functional installation in a casthouse.
How can proper preheating be achieved (1) ?

E.g. by the use of high-velocity or swirl burners, running was a controlled gas-air mixture.
How can proper preheating be achieved (2)?

E.g. by the use of high-velocity or swirl burners, running was a controlled gas-air mixture.
Filterbox Design for proper preheating

- Very good insulation
- Tightly closing, well insulated lid
- Proper burner set-up, in order to achieve fast preheating times, without overheating the filter.
- Continues, touchless temperature monitoring of the filter
Filterbox Examples
Filterbox Examples
Filterbox Examples