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Hyflon® PFA for Heat Exchanger Tubing in Thermal Coal-Powered Plants

Flue Gas Heat Exchanger

In large, thermal coal-powered plants, flue gas desulphurization (FGD) units are used to abate SO_2 gas emissions. This is in adherence to environmental regulations that many countries have adopted, beginning in the 1980s.

Since FGD units operate at saturation temperatures they need heat exchanger systems to cool and reheat the flue gases. Because heat exchangers are operated at tube-wall temperatures below the acid dew point, they need to be corrosion resistant.

Composition of these flue gasses includes SO_2/SO_3, HCl and HF. The effect of such harsh chemicals is magnified by the presence of dust and slurry deposits, which accumulate on wetted heat exchanger surfaces. These deposits are likely to coalesce so that as cooling acids are formed they can concentrate under the deposits.

The technical issues mentioned necessitate construction materials for the heat exchangers which have the following properties:

- Very high service temperature
- Broadest possible chemical resistance
- Outstanding creep resistance and mechanical properties during use
- Excellent surface smoothness and anti-stick properties

Figure 1: Chemical resistance of Hyflon® PFA

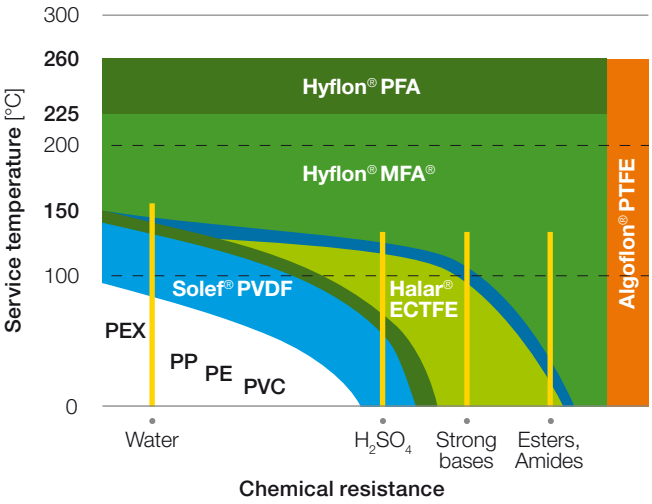
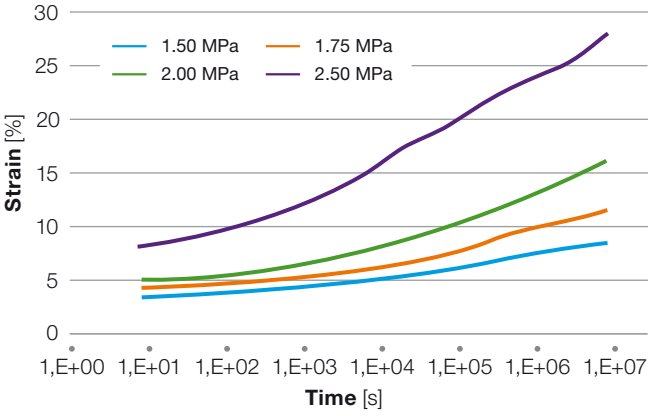
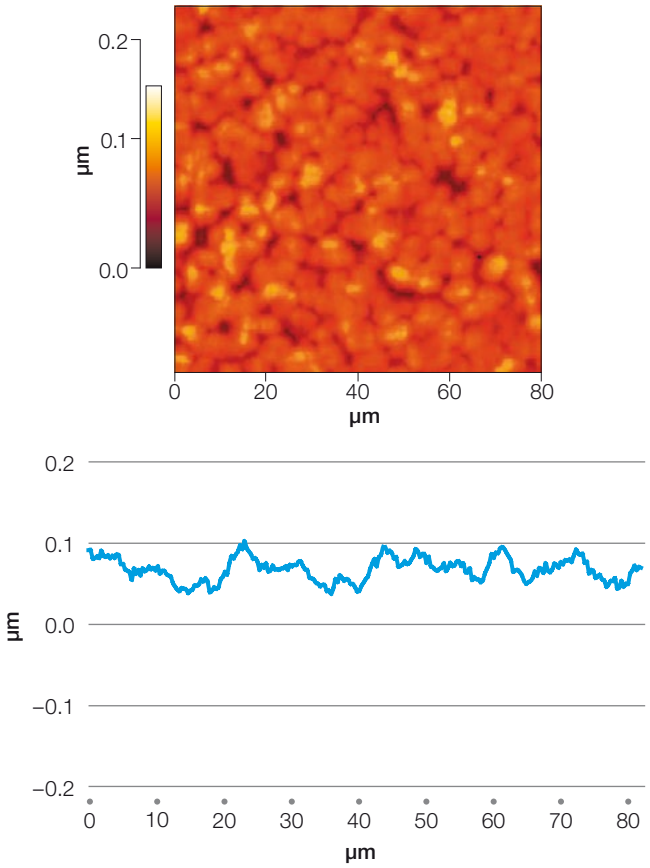


Figure 2: Tensile creep curves at 200 °C, Hyflon® PFA M620



For more information, please contact your Solvay representative.

Figure 3: Hyflon® PFA M series surface smoothness by AFM



Optimize performance with Hyflon® PFA

All of the above-mentioned requirements call for special materials, namely fully-fluorinated fluoropolymers.

In terms of performance, the best among these is Hyflon® PFA. For heat exchanger tubing applications, Hyflon® PFA materials are unprecedented in regard to the combination of chemical and thermal resistance, as well as creep resistance – all leading to a much longer service life in comparison to other fluoropolymers.

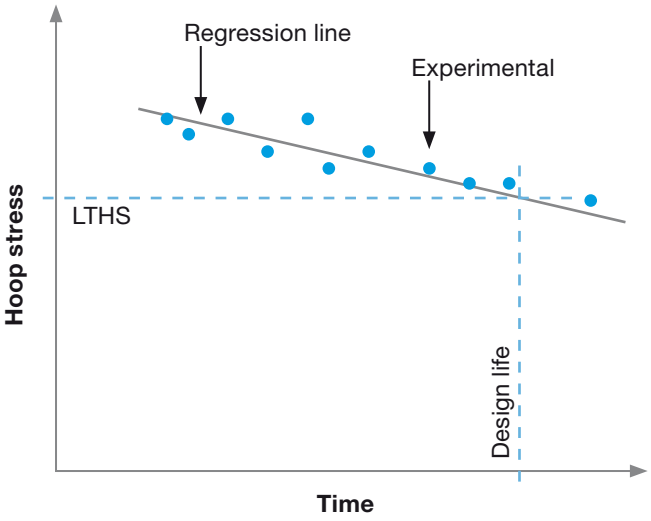
Heat exchanger modules which use Hyflon® PFA tubes have shown that they remain physically and chemically unaffected by continuous operation after more than 60,000 hours in service.

Hyflon® PFA surface smoothness and anti-stick properties also dramatically decrease clogging and build-up of condensates and slurries on the tube surface, leading to a highly effective heat exchange performance.

Heat Exchanger Tube Design

An overall benefit for plastic materials used for tubing applications is their long-term resistance to internal pressure. As shown in the Figure 4, such performance is determined by conducting a series of stress rupture tests performed at constant temperature and under constant hoop stress. The test results are used to calculate a regression line from which the Long-Term Hydrostatic Strength (LTHS) can be estimated. For a given temperature, the LTHS is the point of interception between the regression line and that of the time coordinate (design life).

Figure 4: Regression line for LTHS estimation



Experimental value in the regression curve is determined according to ISO/TR 9080 and ASTM D2837 standards. It is thus possible to calculate hoop stress of Hyflon® PFA-based tubes by applying the following formula:

$$\sigma = \frac{p(d_{em} - e_{y,min})}{20e_{y,min}}$$

where:

σ = the hoop stress of the tubing

p = the inner pressure, in bars

d_{em} = the mean outside diameter of the pipe, in millimeters

$e_{y,min}$ = the minimum measured wall thickness of the pipe, in millimeters

Hyflon® PFA Heat Exchanger Typical Applications

- Thermal coal-powered plants
- Waste incineration power plants
- Petro chemical plants

Figure 5: Heat exchanger modules

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