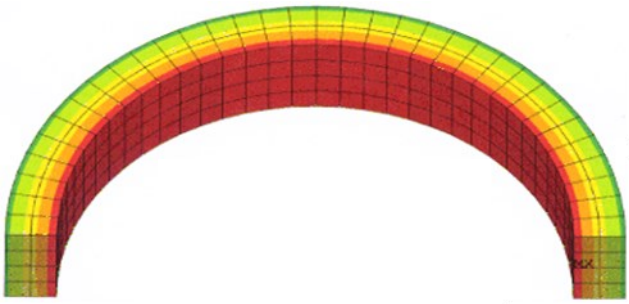
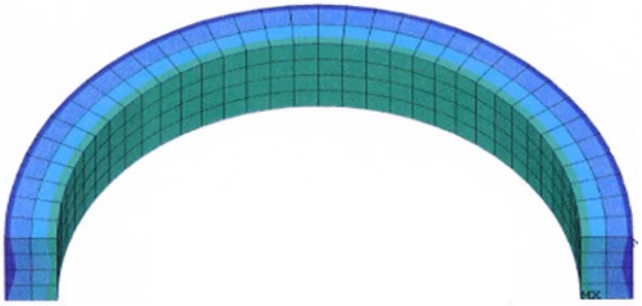
Carbon Fiber Reinforcement for Annular Groove Heat Exchangers

Technical Information

The application limits for graphite annular groove heat exchangers can be extended by external reinforcement with pre-stressed carbon fiber. The following figures show the maximum tension and stress distribution in a cylindrical wall of 300 mm outside diameter under an internal pressure of 12.5 bar g (tension determined by finite element method FEM).



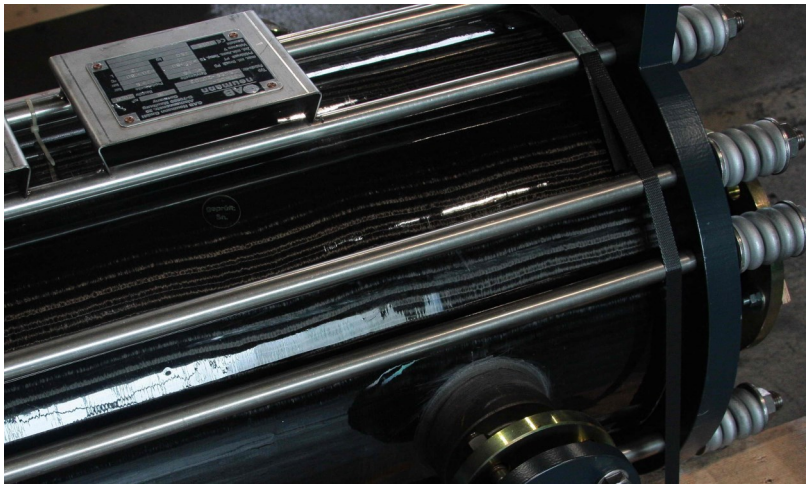
FEM Analysis graphite wall without C-Fiber reinforcement
Tension between 5.8 und 7.9 N/mm²



FEM Analysis graphite wall with C-Fiber reinforcement
Tension between 3.7 und 5.4 N/mm²

An additional benefit reinforcing annular groove heat exchangers with carbon fiber is clear when considering their cylindrical, concentrically arranged walls. Reinforcement of the outer wall strengthens the whole structure.

The other main advantages are:
C-Fiber prevents cracking in the outer graphite wall, even in the event of major pressure shocks such as the „Joukowsky-shock“. The personnel and local environment are therefore protected. The heat exchanger’s heat transfer area is approximately 15 % larger for a given unit size due to reduced external wall thickness and improved structural integrity linked to C-Fiber reinforcement.
The additional cost for C-Fiber reinforcement of annular groove heat exchangers (see figure below) is approximately 20 % on smaller units and 15 % on larger units. The thickness of the C-Fiber reinforcement is generally 2 mm.



Detail view on C-Fiber reinforced annular groove condenser

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