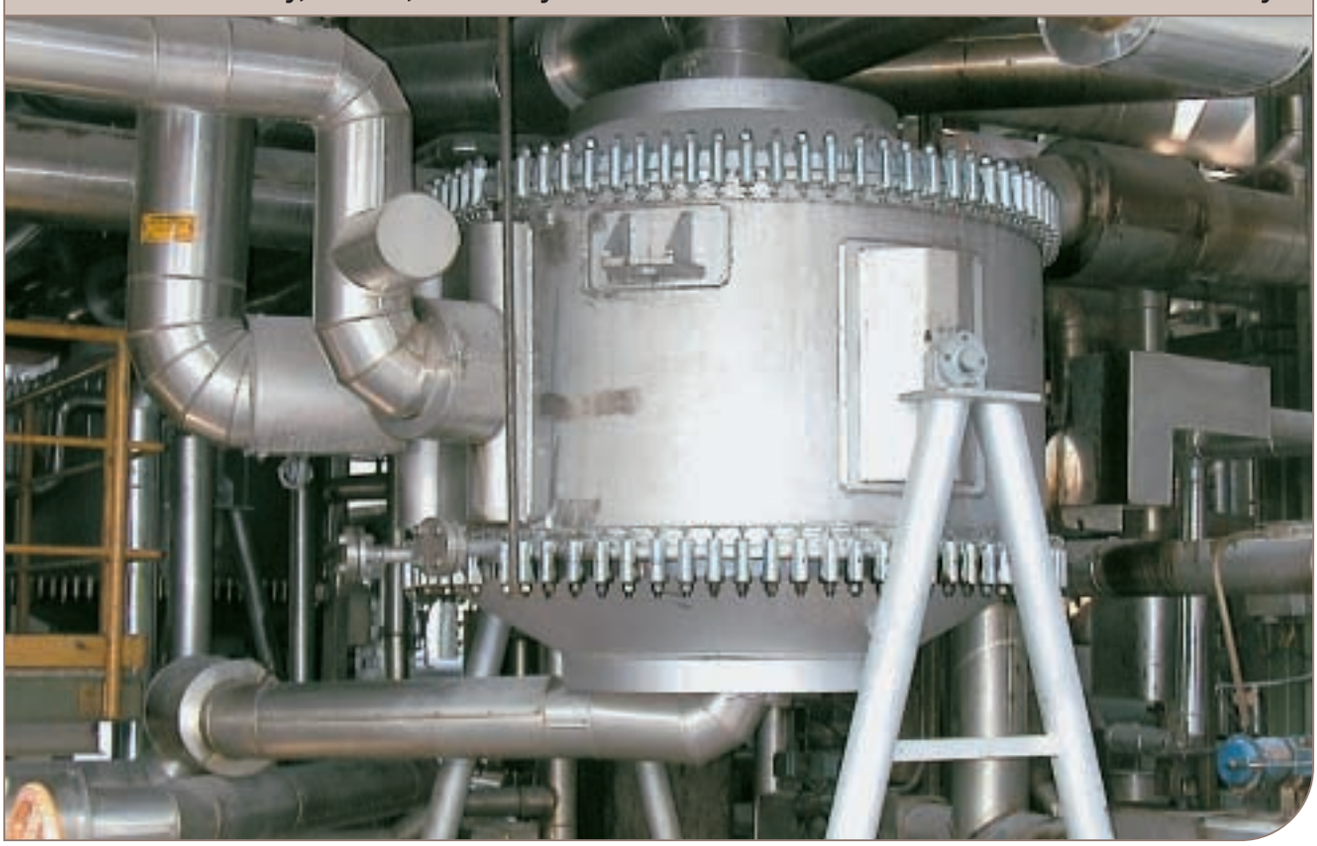
The spiral heat exchanger solves a difficult fouling problem

MIDER refinery, Leuna, Germany **Case story**



One of the two spiral heat exchangers installed for cooling of the bottoms product from the FCC fractionator.

One of the great features of the Spiral heat exchanger (SHE) is its ability to handle media containing suspended solids without clogging. Mitteldeutsche Erdoel-Raffinerie GmbH (MIDER) in Leuna, Germany took advantage of this feature when they replaced their existing bottoms product coolers in the fluid catalytic cracking (FCC) unit with spiral heat exchangers, and in this way drastically reduced the down-time and maintenance cost.

MIDER's Leuna-refinery is a totally new grass-roots facility replacing an older refinery that was located on the same site. The new refinery which is owned by Totalfina Elf, started up in 1997. The engineering and construction was carried out by TLT (Thyssen, Lurgi, Technip). The FCC unit is based on a process licence from UOP.

Originally the installation included two double-pipe exchangers in carbon steel - one in operation and one as stand-by - to cool the bottoms product from the main fractionation column. The cooling water was running inside the tube with the product on the outside. The bottoms product is cooled from 163 to 65C by means of a fresh water loop of 50C.

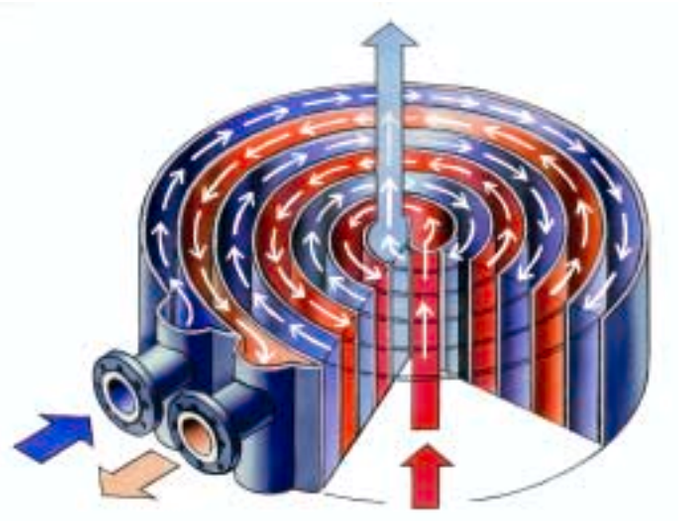
The bottoms product, containing up to 1% catalyst in the form of fine grains, constituted a major problem from a fouling point of view. Only two weeks after start up of the FCC-unit the double-pipe exchanger plugged up on the product side and had to taken out of operation for cleaning. The fouling consisted of suspended catalyst particles as well as cracked by-products from the FCC process. The cleaning of the

exchanger, which was done by means of a high pressure water jet of 1 000 bar, took three to four days to carry out. During subsequent operation this cleaning procedure had to be repeated about every 10 days at a considerable cost. It is estimated that during the 15 months that the double-pipe exchangers were in operation they had to be cleaned about forty times.

Spiral heat exchangers installed
At the end of 1998 the two double-pipe exchangers were replaced by two spiral heat exchangers in stainless steel.

The Spiral heat exchanger is constructed with one channel per medium only, which eliminates the possibility of the media channelling. This design makes it particularly suitable for heating and cooling of slurries and other process streams containing solids and fibres. Cooling of media containing fibres and particles was in fact the main target application at the time when the SHE was originally developed.

Another important factor in the suppression of fouling deposits is the turbulence, which is considerably higher in the spiral channel than in the double-pipe exchanger. Increased turbulence keeps the solids in suspension, which counteracts clogging of the channel. These features have ensured that no cleaning has been necessary during the three years that spiral heat exchangers have been in operation.



The single channel concept eliminates the risk of the medium channelling and diminishes fouling tendencies.

The installation in the spiral heat exchangers has turned out to be a very good investment. The saved service cost during their first year of operation alone, amounts to the whole capital cost for the two spiral exchangers. A very good pay-back time, indeed!

Key facts about spiral heat exchangers
The spiral heat exchanger is an extremely compact assembly where two long strips of plate are wound around a centre to form a spiral body containing two concentric channels. Each channel is welded closed at alternate sides, leaving the opposite side open. Covers are fitted to each side of the spiral body to complete the unit. By removing the covers all of the heat transfer area is available for manual cleaning. The spiral heat exchanger can be built in sizes ranging between 0.5 m2 and 500 m^2. The versatility of the spiral concept allows it to be designed for a wide range of applications. E.g. by closing one of the channels on both sides and leaving the other channel open the spiral heat exchanger becomes especially suitable in vacuum condensing duties when very low pressure drops are required or as a column mounted top condenser.

Material of construction
All materials that can be cold-formed and welded such as:
- Carbon steel,
- Stainless steels
- High nickel alloys
- Titanium

Specifications

Design pressure min/max:	Vacuum/30 barg (430 psig)
Design temperature min/max:	-40/400ºC (-40/750 ºF)
Codes of construction:	ASME (with or without U-stamp), D-Merkblätter, Stoomwezen, CODAP, SPVC

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