Unique antifouling technology for refinery key process units, fired heater and heat exchanger tubes

In most refining conversion units, such as delayed coker and others, unscheduled shutdowns, high maintenance, higher fuel consumption and throughput reduction are common problems. This is mostly due to furnace tube coking, fouling and corrosion. Ceramic coating technology minimizes formation, deposition and plugging due to coke/carbon in addition to reduction in fouling, corrosion and fuel usage. Use of ceramic coating in these applications leads to longer runs, incremental life cycle for equipment, reliable operations, reduced fuel consumptions and hence significant savings in OPEX and CAPEX.

By Sanjay Lodha, Global Business Director - Tubacoat

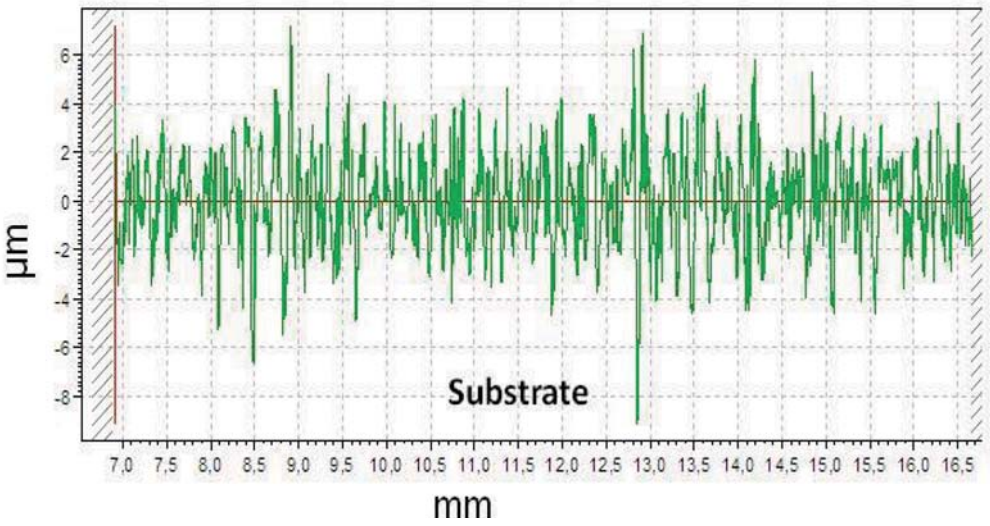
Tubacoat tubes (advanced ceramic coated tubes) are a disruptive innovation technology from Tubacex Group. This new technology of silica ceramic coating has an excellent resistance to coking, erosion and corrosion at extreme conditions and high temperatures up to 800°C (1472°F) in critical refinery and petrochemical process equipment. Tubacoat tubes also minimize coke formation, deposition and plugging due to their chemical inertness in delayed coker, visbraker, vacuum distillation unit, resid hydrocracker and other refinery unit furnaces. These benefits improve unit run lengths, unit reliability, heat transfer efficiency, and tubes life cycle without the same level of need for decoking, and they increase throughput and reduce carbon footprint for both new and aging plant equipment.

Key properties

The coating is a continuous, homogeneous layer. Tubacex is able to control the thickness of the layer across the pipe in a very unique way, based on suspension parameters and rheological properties.

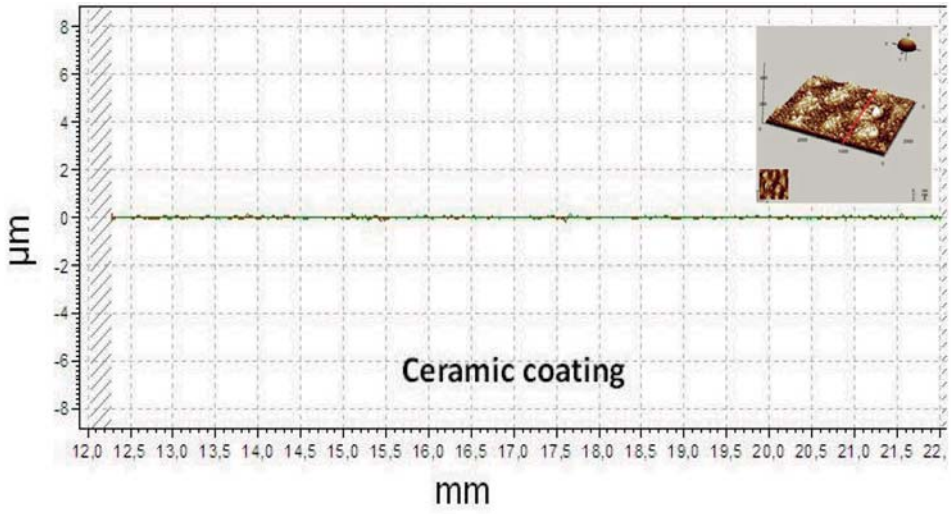
There is a 97% drop in roughness from the uncoated to the coated tube, minimizing particle adhesion. As we know, the smoother the surface, the less resistance there is to the flow.

After 10,000 cycles there is a 94% decrease in mass loss between the uncoated and coated tubes. The hardness and elasticity properties of the tubes can be improved by modifying the structure and composition of the ceramic compounds and process conditions. The hardness of Tubacex's coated tubes is four times higher, while allowing for more elongation (up to 1.5%).



Substrate

Ra ≈ 1,5 µm and Rz ≈ 7,8 µm



Ceramic coating

Ra < 0,04 µm and Rz ≈ 0,2 µm

» Figure 1: Roughness. Ra and Rz decrease > 97% minimizing particle adhesion

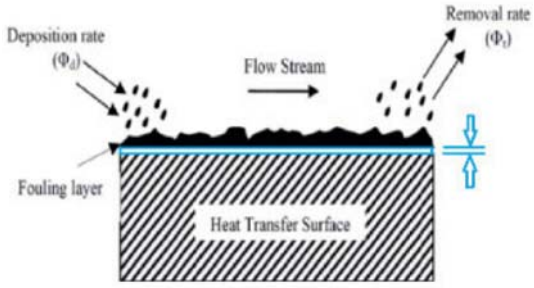


Figure 2

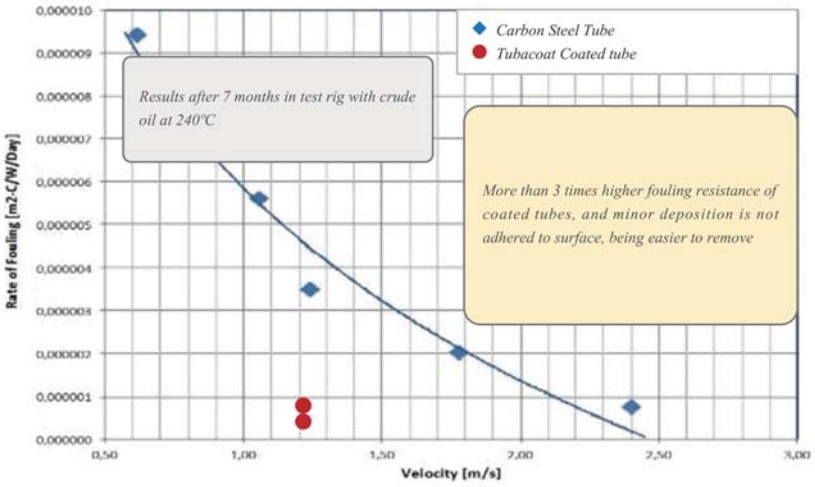


Figure 3: Fouling tests performed by major Oil&Gas companies

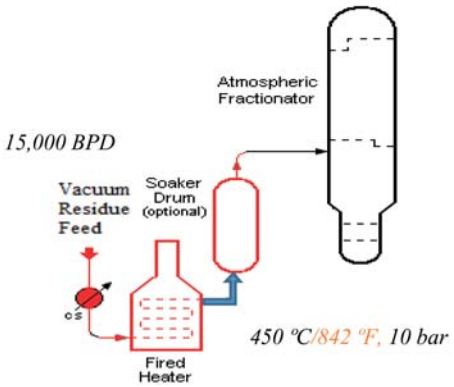


Figure 4: ID coated tubes, bends and flanges installed at the furnace outlet line to prove anti-fouling properties.

Subheading

In any refinery or petrochemical process, there are startups and shutdowns – rapid heating and rapid cooling. The coated tubes perform well under thermal cycling, with no delamination and no cracking. The Tubacoat glass-finished layer will protect the inner and outer surface of the tubes, minimizing any fouling. The deposition rate will decrease because the tubes are chemically inert and as smooth as glass. The removal rate will increase because it will not stick to the surface of the tube, and because of that, heat transfer loss will reduce significantly. And since there won't be any fouling or heat transfer loss, the fluid flow will maintain at a steady state. There is significantly higher fouling avoidance with the coated tubes, as proven in a study conducted at one major U.S. refinery over a period of seven months (see figure 4). The eventual deposition is not adhered to the surface and is more easily removed with pressurized water.

Case study

Visbreaker Unit, European Refinery

Problem: Coke deposition inside the tubes was causing frequent shutdown in the fired heaters for pigging. This resulted in a huge loss of production. The preheat exchangers were constantly being taken out of service because of coke accumulation. There was tube deformation related to hot spots. The unit had poor heat transfer efficiency and resulted in high fuel consumption in the furnace.

Solution: Tubacex installed ID coated tubes, bends, and flanges at the furnace outlet lines.

Results: After nine months, there was a 75% reduction in coke deposition. What little coke was there was much easier to remove and required three times less the amount of pressurized water for removal. Future cleaning will be less frequent and softer pigs may be used.

The run lengths without decoking/online spalling was increased between three and four times. It saved this refinery $1.5 million per year.

Conclusion

In conclusion, applying an inner coating in DCU/VU/VDU and RHC tubes results in longer run lengths, improving overall throughput, and requires less frequent cleaning. It increases safety by reducing the number of shutdowns and startup operations and avoidance of hot spots. It is much cleaner, with a reduced fuel consumption due to increased heat transfer efficiency and CO2 reduction. And it is extremely reliable, with an ad-hoc formula designed for specific applications. The ceramic coating can be applied to carbon steel, stainless steel, and steel and nickel alloy materials.

About the author

Sanjay Lodha is a Global Business Director for TUBACOAT, a subsidiary of Tubacex Group, Spain.

Sanjay has over 26 years of experience across various roles in the international refining and chemical industry.

He has a MS in chemical engineering from University of Idaho, and Executive Management from MIT. He is currently based in Dubai, United Arab Emirates.