A world designed to last

WATT: Winding Annulus T.EN Tube®

A novel high flux radiant coil inlet tube to significantly increase cracking furnace capacity



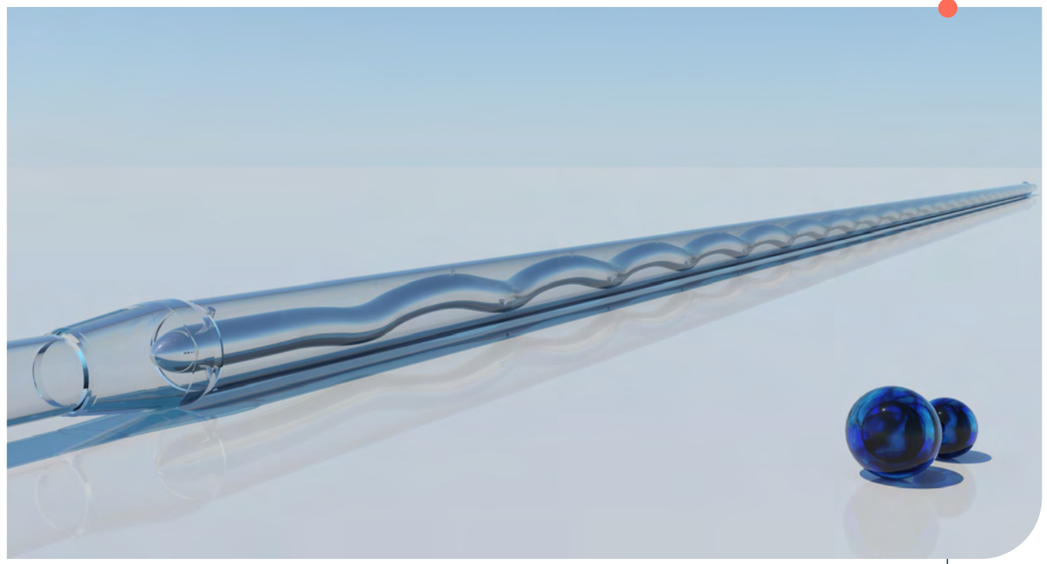
T.EN TECHNIP ENERGIES

The latest addition to Technip Energies' extensive portfolio of radiant coil technologies is the WATT Winding Annulus T.EN Tube®, or WATT tube. This proprietary design employs a helically shaped body positioned inside a radiant tube to boost its performance.

WATT tube principle

The process medium is flowing around a helical inner body positioned inside a tube. This improves radiant tube performance in three manners:

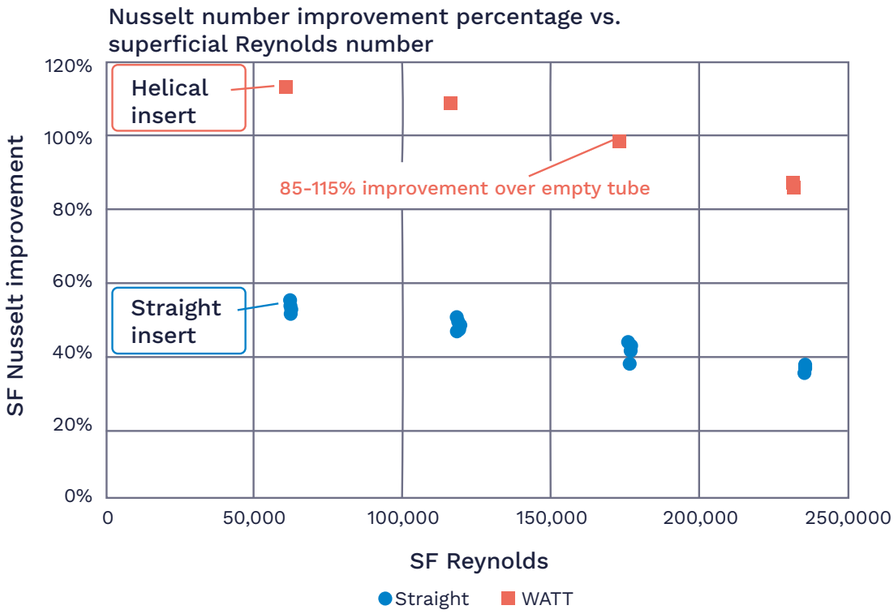
- Placing a body in a tube with a certain volume and outside area, reduces its volume while maintaining its surface area, resulting in a relatively high surface-to-volume ratio, which enhances heat transfer.
- As the process medium is forced along the helically shaped inner body, annular swirl flow is produced. This annular swirl flow practically doubles the convective heat transfer coefficient.
- Since in this high-temperature application, the helically shaped inner body is substantially lower in operating temperature than the outer body, thermal radiation between the hot outer tube and the relatively colder inner tube adds to the heat transfer.



WATT Winding Annulus T.EN Tube®

Superior performance

A cold flow test was performed showing that, depending on the extent of the formation of turbulence, indicated by the superficial Reynolds number, the WATT tube has an 85 to 115 percent better performance than an empty tube, in terms of convective heat transfer, allowing tube capacity to be doubled. This performance improvement is practically twice that of a straight tube insert with the same diameter as the WATT, which was also tested as benchmark.



Easy retrofitting

The WATT tube is the radiant tube of choice for furnace capacity expansions. Depending on the available pitch between the inlet tubes, the surface area can be increased from 40 to 100 percent, by simply replacing the existing inlet tubes. This, without the need for making modifications to the roof of the firebox. This can increase coil capacity by at least 15 percent.

Main application area

The WATT tube is very advantageous for short residence time radiant coils, such as the U-coil, GK5 and the GK6 radiant coil. These types of coils have relatively small diameters, that can be increased in size without a significant increase in wall thickness, such that additional surface area for heat transfer can be made available without a disproportional increase in radiant coil material.



GK5 type radiant coil with WATT inlets

Successful industrial scale WATT introduction

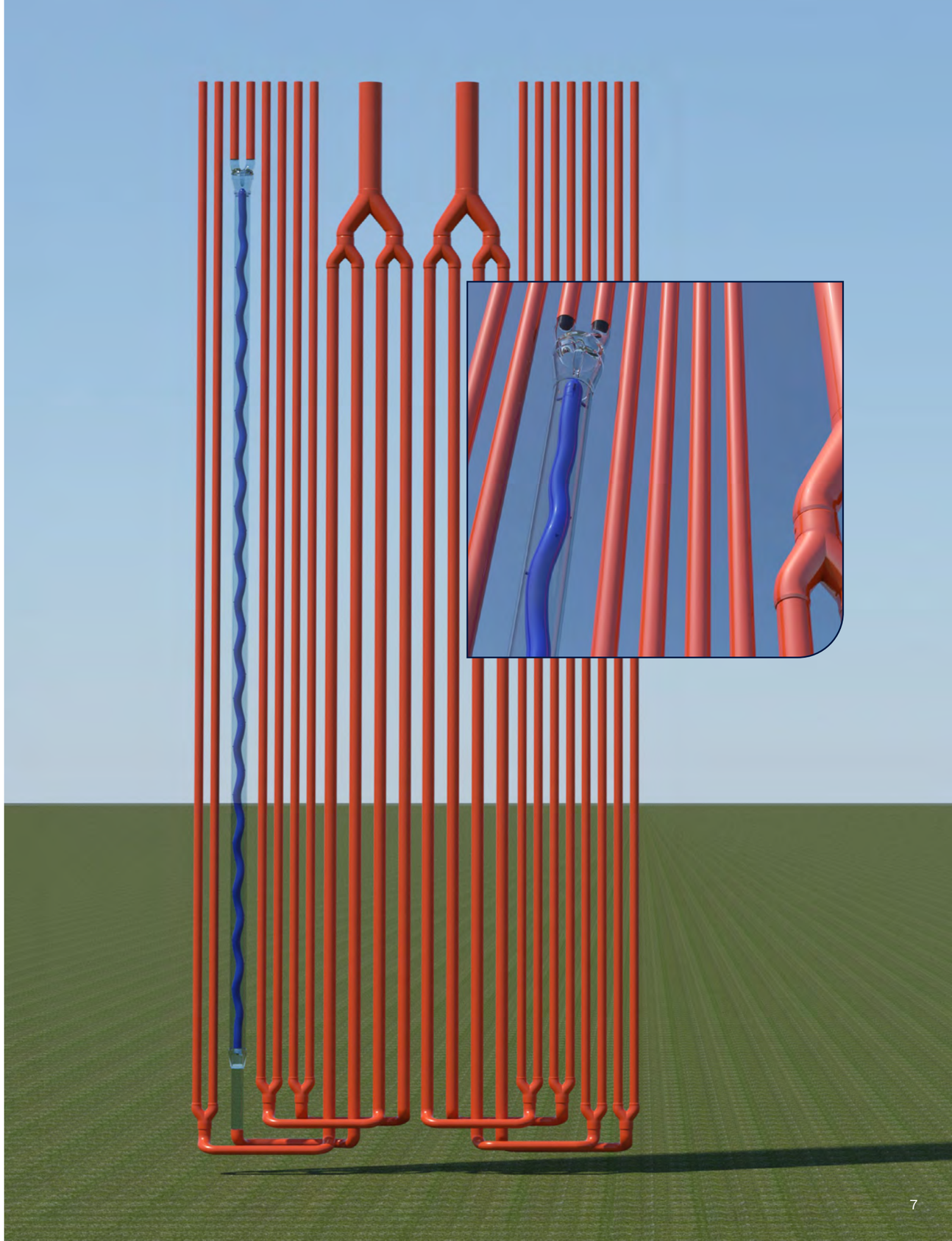
The first WATT tube prototype has been successfully in operation since February 2020 in an industrial cracking furnace at PKN ORLEN SA in Płock, Poland. This first full scale performance test has been set up to demonstrate the WATT tube's ability to extend radiant tube capacity by a mere 100 percent. For this purpose, two conventional GK5 type radiant coil inlet tubes were replaced by a single WATT tube.



Collected field data on the radiant coil tube skin temperature and the radiant coil pressure drop proved that the radiant tube capacity could be doubled, while maintaining the same pressure drop and tube skin temperature level as the neighboring, conventional inlet tubes. It also demonstrated that the mechanical design is suitable for prolonged operation under industrial conditions.

Full compliance on quality control

The prototype was assembled by a well-known and worldwide industry recognized high alloy tubes manufacturer, Paralloy Ltd. This specialized radiant coil vendor has manufactured the high-grade radiant coil castings, performed the final assembly of the prototype and arranged the quality control required to obtain authority approval for the field installation. All the Quality Control results were fully inspected and approved by the Lloyds Inspection Agency. Production was accomplished without compromising on Safety, Integrity, Quality, Respect and Sustainability.



Bruno Destour
Ethylene Market Lead
+33 1 4778 2458
bruno.destour@ten.com

Jelle-Gerard Wijnja
Product Manager Ethylene Furnace
+31 79 3293 621
jelle-gerard.wijnja@ten.com

Peter Oud
Product Development Manager Ethylene
+31 79 3293 592
peter.oud@ten.com

www.ten.com

© Technip Energies 11-2026