

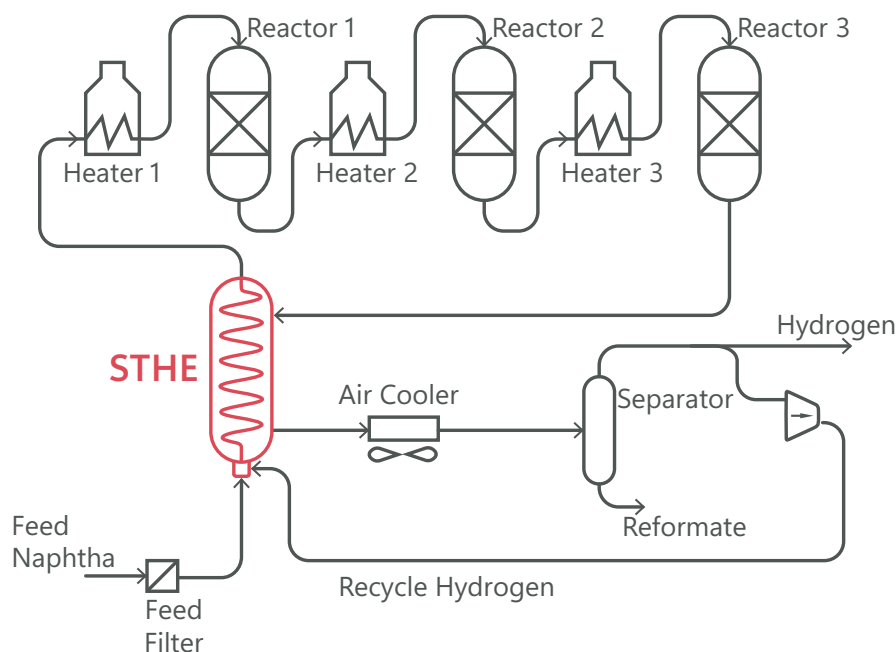
REPLACING WELDED PLATE HEAT EXCHANGER WITH SPIRAL TUBE EXCHANGER IN CATALYTIC REFORMING

Exchanger Solutions for Catalytic Reforming

While welded plate heat exchangers (WPHE) are widely recognized for their superior thermal and hydraulic performance in feed/effluent heat recovery compared to traditional shell-and-tube designs, their inherent limitations—such as sensitivity to temperature gradients, reverse pressure, and fouling—can significantly impact unit reliability and operability. These constraints often limit the operability of the units, especially during unavoidable refinery upsets.

Zhenhai Petrochemical Jianan Engineering Co., Ltd. (ZPJE) has more than 700 employees specialised in spiral tube exchangers (STHE) manufacturing, thermal and hydraulic calculation, R&D, and project management. For more than 30 years, ZPJE has developed a unique knowledge of heat exchange calculation, hydraulic simulation, and mechanical modelling of spiral tubes design to enable this technology to become the mainstream solution for reforming units in refineries in China.

This brochure presents why STHE represents a reliable, effective and affordable alternative for replacing existing WPHE in catalytic reforming units.



Performance and Reliability

Over the past decades, shell-and-tube heat exchanger (S&T) technology has evolved significantly to address its traditionally low thermal efficiency. Despite its mechanical robustness and proven ability to withstand the high pressures and temperatures typical of catalytic reforming processes, S&T exchangers are inherently limited in heat transfer performance—often restricting the achievable hot approach temperature to 50–60°C (120–140°F).

To improve efficiency, manufacturers have developed advanced S&T designs, such as replacing multiple horizontal units with large vertical «Texas Tower» exchangers to reduce the unit pressure drop. Additional enhancements—including helical and rod baffles on the shell side and twisted tubes on the tube side—have been implemented in an effort to boost thermal recovery. However, these modifications have still fallen short of matching the thermal performance of WPHE.

ZPJE's spiral tube heat exchanger technology closes this performance gap. It delivers thermal and hydraulic efficiency comparable to WPHE while maintaining the mechanical strength and reliability that characterize traditional shell-and-tube designs—offering a robust, high-performance solution for catalytic reforming applications.

A Seamless and Safer Replacement

Spiral Tubes Heat Exchanger has a similar compact design and high heat transfer efficiency as the Welded Plate Heat Exchanger, but its inherent robustness will eliminate the risks of leakage and will ensure reliable, long-term operation. The main advantages of STHE technology can be found in the following table :

	STHE
Design	Thermal expansion allowed by flexible tubes. Fully symmetrical design for perfect fluid distribution
Pressure resistance	No limitation on pressure difference or reverse pressure
Thermal resistance	No limitation on temperature increase or decrease rate
Fouling resistance	Specific flow pattern added to the very low surface roughness, gives an anti-fouling and self-cleaning design.
Cleanability	Chemical cleaning for shell side. On tube side, chemical and mechanical cleaning by high-pressure water jet.
Key characteristics	High performance, very low fouling, robustness to upset conditions.

When replacing existing WPHE, ZPJE's spiral tube heat exchanger offers a reliable, safer, and straightforward alternative. Following a thorough study either through review of existing drawings or on-site measurements, ZPJE can, in most cases, deliver a true "plug-and-play" solution for any existing Welded Plate Heat Exchanger technology. This means the replacement unit is designed to match existing foundations characteristics (Bolt Circle Diameter, maximum Hydrotest Weight, elevation, etc.) and offers the same process interfaces (size, projection, elevation and orientation).

When it is not feasible to match all process interfaces, the design will at least propose the same hot interfaces (Combined feed outlet nozzle, Effluent inlet nozzle) to minimize the overall retrofit costs.

This approach significantly reduces project complexity, cost, and downtime. Based on experience from over 30 successful WPHE replacements, ZPJE typically completes on-site replacement installation in just 5 to 7 days.

Case Study

In November 2023, STHE by ZPJE was installed to replace a WPHE originally commissioned in 2014 on a 2.0 MMTA CCR unit while retaining the existing foundations. The hot-end nozzles were designed to be fully compatible with the existing piping connections, requiring only minor orientation adjustments to the cold-end piping. The entire on-site modification was completed within one week.

Following commissioning, the STHE achieved the performances of the original WPHE design. At 100% operating load, the design hot approach temperature (HAT) was 38 °C, whereas the measured operating value was 31 °C. In addition, the startup pressure drop was measured at 85 kPa, closely matching the design value of 86 kPa.

Conclusion

In catalytic reforming applications where heat exchanger performance, durability, and reliability are critical, ZPJE's spiral tube heat exchanger technology offers a compelling alternative to welded plate heat exchangers. By combining comparable thermal and hydraulic efficiency with superior mechanical robustness, STHE addresses the operational vulnerabilities of WPHE—particularly in demanding refinery conditions prone to high temperature differences, fouling materials, and pressure fluctuations.

With over 30 years of expertise and a proven track record of more than 30 successful WPHE replacements, ZPJE delivers customized, plug-and-play STHE solutions that minimize installation time, reduce shutdown duration, and significantly lower overall project costs.

Whether upgrading existing systems or seeking a more robust design for future units, STHE stands out as a high-performance, low-risk solution engineered for long-term reliability in catalytic reforming operations.

