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CHEMICAL & MECHANICAL CLEANING OF SPIRAL TUBE EXCHANGERS IN HYDROPROCESSING.

Presentation

Maintaining heat exchanger efficiency between two turnarounds is a critical factor in ensuring the long-term optimized yield of a unit. Variations in operating conditions and feedstock fluctuations can accelerate fouling, significantly affecting product quality. To mitigate this, heat exchangers should be designed to minimize fouling and allow for efficient cleaning of both the tube side and shell side. ZPJE Spiral Tubes Heat Exchangers (STHE) are engineered to address these challenges. Their unique design—characterized by high turbulence, the absence of dead zones, and low surface roughness—substantially reduces fouling tendencies compared to conventional technologies. Additionally, the tube side can be cleaned using both chemical and mechanical methods, while the shell side supports chemical cleaning.

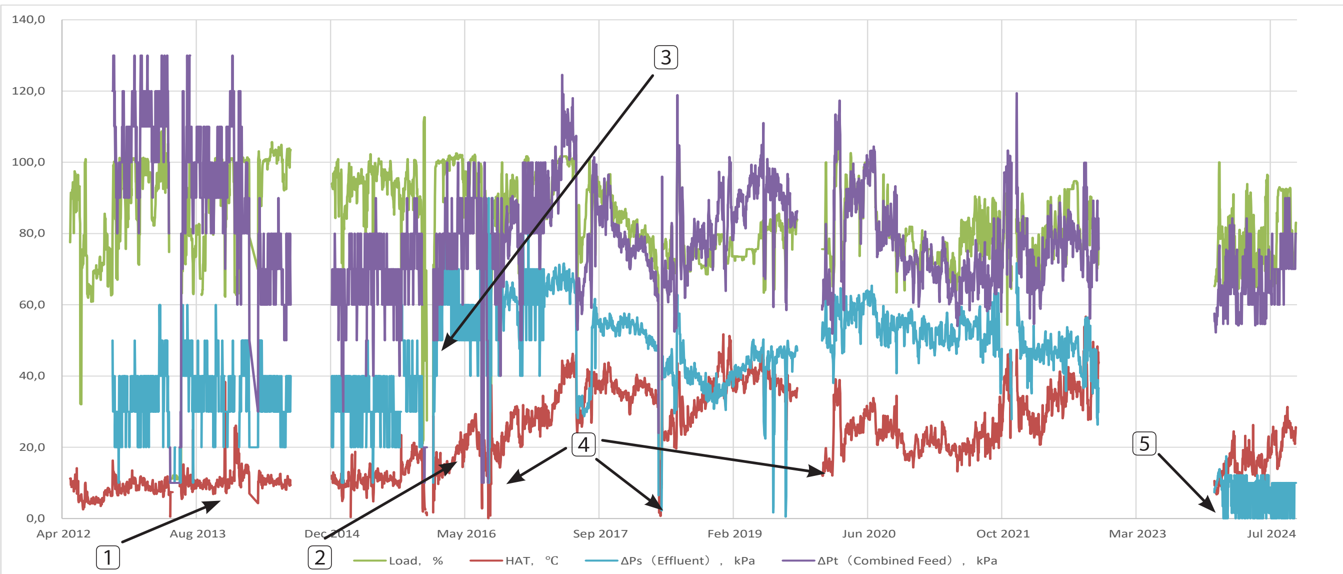
On-site maintenance for STHE can be performed by a standard local maintenance provider, following ZPJE's maintenance procedures and, if required, under the supervision of ZPJE service specialists. The maintenance duration depends on the exchanger size; however, typical cleaning times are as follows:

- Chemical and mechanical cleaning: Approximately 10 to 20 days
- Chemical cleaning only: Less than 7 days

Case Study

In this 2.0 MMTA diesel hydrotreating unit, the process feedstock is composed of 45% coking diesel, 39% catalytic diesel, and 16% straight-run diesel. A total of 3 of STHE were installed in May 2012. The design parameters of the Hot Combined Feed/Effluent Exchanger are given in the following table :

Service		Fluid	Operation Temperature (°C)	Operation Pressure (MPa g)
Hot Combined Feed/Effluent Exchanger(E-9101)	Tube Side	Hot Combined Feed	154/358	12.59
	Shell Side	Reactor Effluent	405/240	11.71



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Since its startup, the three units meet the design requirements without any mechanical problems. The operating parameters of the exchanger E-9101 can be seen on the Graph 1 with the following details :

① Before 2016, operating with a good catalyst activity, the exchanger by-pass is open to control the inlet temperature of the heater.

② From 2016, with the normal deactivation of the catalyst and the upgade of product quality, the by-pass is gradually closed to increase the feed inlet temperature to the reactor. This can be seen on the HAT graph which is continuously increasing.

③ In January 2016, a rapid increase of the pressure drop on the shell side is observed. This is most probably due to catalyst powders migration after a regeneration. After this event, the pressure drop remains stable

④ Catalyst regeneration/replacement.

⑤ Cleaning of the exchanger

The cleaning process, which included mechanical and chemical cleaning of the tube side and chemical cleaning of the shell side, was completed in 16 days. Following the cleaning, both thermal and hydraulic performance were restored to levels close to those observed at the initial startup, despite 12 years of continuous operation. These performance levels have remained stable since the cleaning.

The following table resents the operational data recorded before and after the cleaning, while Figures 1 and 2 provide images of the tube side and shell side.

	HAT (°C)	Tube Side ΔP (kPa)	Shell Side ΔP (kPa)
Start-up	**12.5**	**70**	**10**
Before cleaning (SOR)	20	85	65
Before cleaning (EOR)	55	100	65
After Cleaning (SOR)	**13**	**75**	**13**

Figure 1 : Before and after cleaning pictures tube side

Figure 2 : Before and after cleaning pictures shell side

Conclusion

The long-term efficiency of heat exchangers is crucial for maintaining optimized unit performance between turnarounds. As demonstrated in the above applications, ZPJE STHE offer a reliable solution for mitigating fouling and ensuring stable operation over extended periods. Their innovative design, which enhances turbulence and minimizes dead zones, significantly reduces fouling while enabling effective cleaning through chemical and mechanical methods.

The successful maintenance and cleaning of STHE in this case study highlight the ability to restore thermal and hydraulic performance even after years of continuous operation. These results reinforce STHE's effectiveness in optimizing heat exchanger reliability, minimizing downtime, and sustaining process efficiency in demanding industrial applications.

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