Crude fouling in heat exchanger and the influence of microsized particle

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Fouling in heat exchanger is ubiquitous in refinery, which caused economical loss was estimated (for 2006) at 4.68 billion dollars in china [1]. A lab-scale bench reactor was design and constructed to simulated crude fouling process in CDU heat exchanger train. Influence of microsized particle on fouling process was also investigated.

Fouling acts as a thermal insulator, thereby reducing the heat transfer rate. So, heat transfer rate probe was used in this study. Probe equipped with precision thermocouple was installed in a bench scale reactor, as shown in Fig. 1.

Fig. 1. Experimental apparatus sketch

Constant heat quantity was supplied by electric heating in the center of the reactor. Increase of temperature on the probe surface could be detected by thermocouple and recorded by SCADA system. Fouling rate of certain crude could be concluded from data record.

Hot surface temperature was recognized as the most significant influence factor. Averaged fouling rate as well as fouling induce period were influenced by surface temperature. As shown in Table 1, much higher fouling rate and shorter fouling induce period could be raised from higher surface temperature.

Table.1 Influence of surface temperature on averaged fouling rate

Ts	K m2K/kw	Fouling Rate m2K/kwh	Induce Period
310	0.16	0.0031	17
330	0.35	0.0073	15
360	0.80	0.014	10
380	1.4	0.021	8

Fig.2 demonstrated the influence of surface temperature on detailed fouling process. Almost linear increase of heat resistance could be found after short induce period.

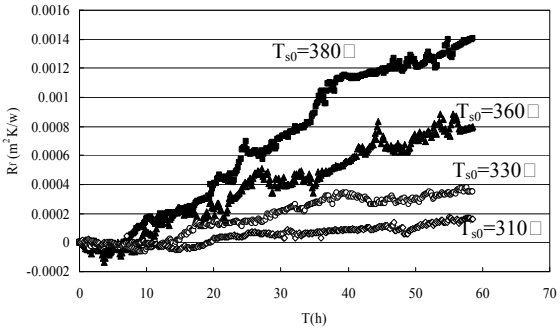

Fig. 2. Influence of surface temperature on fouling process

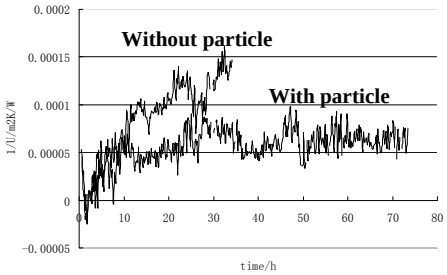

Fig. 3. Influence of microsized particle on fouling process

Fig 3 shows the influence of microsized particle added in bench scale reactor. Total different fouling trend could be observed. Heat resistance in experiment run with particles remains on much lower level after induced period, while heat resistance in experimental run without particles increase continuously. Effectiveness of microsized particle as an anti-fouling agent could be concluded.

Conclusion

(1) Fouling of crude in heat exchanger is a complex chemical reaction process which was mostly influenced by temperature;

(2) Microsized particle could be an effective agent to reduce crude fouling.

References

[1] Xu Zhi-Ming, ZHANG Zhong-Bin, and YANG Shan-Rang, "Costs due to utility fouling in China", ECI Engineering Conferences International Symposium Series, Heat Exchanger Fouling and Cleaning VII, July 1-6, 2007 - Tomar, Portugal