Experimental Calibration of Heat Transfer and Thermal Losses in a Shell-and-Tube Heat Exchanger

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Many factors such as, environmental issues, concern about sustainability and rising cost of fossil fuels are presently encouraging research and investment into renewable resources. Renewable energy power plants face the main problem of dispatchability of demand due to the variability of their power sources. Nevertheless, solar thermal power plants are appropriate for large-scale energy production since they efficiently store heat in Thermal Energy Storage (TES) systems. Thus, many commercial solar thermal power plants rely on this technology (Herrmann and Kearney, 2002).

The performance of solar thermal power plants with TES systems is highly influenced by the heat exchanger control strategies applied in the charging and discharging processes (Zaversky et al., 2013). Therefore, advanced control strategies may improve the performance of the whole plant. For this reason, a dynamic heat exchanger model is being developed. This heat exchanger is part of the CIEMAT-PSA molten salt testing facility. This multipurpose molten salt testing facility is devoted to evaluate and control the heat exchanged between molten salt and different kinds of heat transfer fluids.

Figure 1. Shell-and-tube heat exchanger

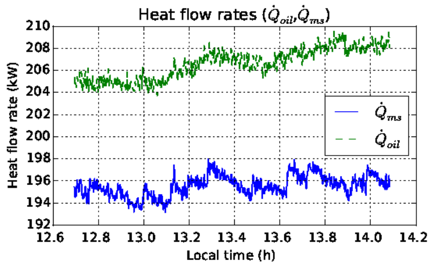

Figure 2. Heat flow rates

During experimental campaigns, it was noticed a performance loss in the heat exchanger (see figure 1) with respect to design performance. A dynamic heat exchanger model is being developed in order to evaluate this performance loss. This paper shows the followed procedure to calibrate heat exchanger thermal losses, which are shown in figure 2, as well as heat transfer correlations for both fluid sides.

References

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