MEGGITT HEATRIC

PRINTED CIRCUIT HEAT EXCHANGER BULLETIN
COOLANT CONTROL STABILITY

Inter-stream leakage, caused by unstable coolant control, has occurred on several Printed Circuit Heat Exchangers (PCHEs) in gas compression cooling service. In all cases the leakage was detected by observing hydrocarbons within the coolant system. There have been no reports of pressure relief valves lifting, over-pressurisation of the coolant, or of hydrocarbon release to atmosphere.

Background

PCHEs, in common with other compact heat exchangers, have a very small thermal mass so that the internal metal temperature responds very rapidly to changes in process conditions, particularly flows. In contrast, devices for measuring gas outlet temperature respond more slowly, thus the measured temperature will lag behind the actual temperature. A rapidly responding coolant control system can therefore introduce unwanted and damaging instability.

Unstable coolant flow controllers have been found to permit continued large amplitude, high frequency coolant flow variation - with flow switching by a factor of two or more every few minutes - typically giving 100,000 severe thermal cycles within 6 months. These instabilities have been generated entirely by the control systems, even when the process inputs - gas flows and inlet temperatures - were not varying.

Such instability can give severe cyclic thermal stress within the core, leading to fatigue cracking and inter-stream leakage, within months, or sometimes only weeks of start up. Whilst the fatigue cracking gives no immediate danger of external hydrocarbon release, the PCHE will need to be taken out of service for rectification.

Temporary repair is often possible, but this will have a limited life, so a new core is the only permanent option.

Note that thermal fatigue damage is caused by flow instability. PCHEs are fully suitable for all normal and expected operating conditions.

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Recommended actions

- **T** During commissioning ensure that the coolant flow controller is set to 'manual' mode.
- **T** Install physical minimum stops on the coolant control valve, so that flow cannot be shut off inadvertently.
- **T** After commissioning or changing process conditions check tuning of the controller to ensure that it is not unstable. Coolant flow variability should be well within ±5%.
- **T** Monitor the coolant controller output trends to ensure that the valve position is stable. Use un-averaged readings taken every 15 seconds over a 2 hour period. Do not average.
- **T** Physically check the valve linkages to ensure they are acting correctly.
- **T** Monitor exchanger pressure drop or flow trends to verify stability.

Once set up correctly there should be no need for continuous monitoring of coolant control stability. However should any operation changes, or retuning, which might affect system stability, be made, recheck the coolant controller output trend data. Consider routine checking of coolant flow stability every few months.

It is essential to view coolant controller output and flow (or dP) trend data. Note that the extent of instability may not necessarily be evident in other data such as gas outlet temperature.

If you would like any further information or have any queries or concerns, please contact Heatric at:

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