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Operating Thermal Oil Plants Safely and Reliably

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Heat transfer oil systems provide heating and cooling for production systems and processes in numerous industries. As the operation of these systems usually takes place above the flash point of the heat transfer medium and therefore carries certain risks, it is important to always keep an eye on all safety-relevant parameters – also with respect to high availability, if possible without downtimes. But what exactly does the operator need to pay attention to? Or to put it another way: What is often overlooked when dealing with such plants? These questions were discussed by a group of experts who met at the end of last year at the invitation of the thermal oil manufacturer Eastman and its German distribution company KRAHN Chemie.

The meeting place was at Heat 11 in Löhne, a leading manufacturer of heat transfer plants such as electric and fired heaters, heating/cooling systems or secondary circuits.

As guests of the panel of experts, Heat 11 Managing Director Dietmar Hunold welcomed the risk engineer Marcus Thiem of HDI Risk Consulting GmbH, Matthias Schopf, Manager of Global Technical Services HTF (Heat Transfer Fluids) from Eastman, Uwe Herberger-Rosin, Sales of industrial KSB Pumps, together with his product manager Stephan Dohmen and Jürgen Kröger, independent consultant for thermal oil systems. Thorsten Stahlberg from KRAHN Chemie, who is responsible for the distribution of Eastman thermal oils in DACH and southern and central Europe, acted as the moderator.

*Heat 11 thermal oil boiler with
2,000 kW air pre-heater for
heating a reaction column.
Flow temperature 370°*



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„Seals must be compatible with the filled oil,“ confirmed Schopf. Nevertheless, spare gaskets that do not meet the requirements for material stability are installed time and again. Monitoring is therefore essential, especially for pumps with a single seal. Double seals, on the other hand, are significantly less affected by this issue. „And for the operator, the advice is to have spare parts available for the pump in order to be able to react quickly in the event of a breakdown.“



Double seal for the Etanorm SYT pump

The supply of spare parts is also eminently important for Hunold as a plant manufacturer. „In the operating instructions, we refer to which spare parts should definitely be stocked,“ explained the Heat 11 boss. Nevertheless, it would of course be difficult to talk about the supply of spare parts when selling or planning new plants. It is essential that the plant be operated within the scope of the manufacturer's design data on temperature and output. You can't run a 6 MW boiler with a 9 MW burner – and yet that still happens. „It would have helped a lot if the operators simply and easily complied with the plant manufacturer's specifications and the legally prescribed annual maintenance, including oil analysis.“

In summary, thermal oil systems are, in principle, an uncomplicated and safe way of supplying process heat (or cooling). But only if some basic rules are observed. The pump pressure and flow in the plant should be monitored daily. This allows problems such as contamination to be detected early on. Another important point is the annual oil analysis to detect dangerous flash point reductions

But what needs to be taken into account when selecting the heat transfer oil for a new plant in order to ensure or even increase operating safety and availability in particular?

Manufacturers of heat transfer plants generally establish the basic conditions for this. „The analysis of the temperature requirements for the respective plant is absolutely essential,“ explains Dietmar Hunold from Heat 11. „With a required continuous temperature of 300 degrees Celsius, for example, we will always use a thermal oil that is approved for at least 320 degrees. This margin of safety should be standard, regardless of whether heating or

freezing plants are involved. The margin of safety also increases the service life of the oil, and it can be assumed that the operator will not have any problems even after several years of operation.“

This margin of safety is also an issue for Eastman. „As a heat transfer media manufacturer, we also take this operational safety into account by selecting our recommended flow temperatures in such a way that they enable several years of plant operation. Simply put, we have already taken these 20 Kelvin into account,“ Schopf added. Jürgen Kröger pointed out in connection with the aforementioned margins of safety that a doubling effect occurs for every 10 Kelvin plus for the service life of the thermal oil. „At 20 Kelvin plus, the oil will last for about four years, and at 30 Kelvin it will last eight years.“ The safety margin therefore has a direct positive effect on the operating costs of the thermal oil plant.

that can result from the multiplication of low boilers, for example. An excessively high proportion of low boilers can even lead to the termination of the operating permit and also jeopardize virtually all plant parts. Also extremely important: Wherever possible, always use the heat transfer medium designed for the plant. If you wish to operate the system with another heat transfer medium or with an added heat transfer medium, we recommend prior clarification with the heater and pump manufacturer and, if necessary, with the authorities, TÜV and your insurance company. Finally, stocking spare parts for essential wear parts such as pumps, valves and other components in the safety chain is highly recommended in order to be able to react quickly in the event of breakdowns and to keep downtimes as low as possible.

(Recorded and edited by Carsten Krüger, freelance journalist)

**What doesn't apply?
Which operator data leads
to these deviations? And
who can provide information
about this?**

Sample temperature: „We know that an operating temperature 10 degrees higher doubles the rate of decomposition,“ says Schopf. „Has the temperature been increased over time? Or was the heat transfer medium replaced? And if yes: When? Or was mixed or even mixed several times?“ In the worst case scenario, the operator has purchased their thermal oil more and more cheaply over time and has therefore now mixed three or four different products in their system, making an analysis almost impossible – especially if there are not even reference values for the initial product.

All parameters to be measured are equally important for the oil analysis. From individual values, such as viscosity or flash point, it is not yet possible to draw conclusions about the entire product – just as little as with the proportion of high and low boilers or acid values. „It is advisable to measure all parameters, because only the combination of all physical parameters together with gas chromatography allows a correct assessment,“ says Schopf. It is also true that deviations from a reference can have several causes. Is this the reason for decomposition or is it an admixture that causes changes in the expected measured values? It is the famous stumbling around in the fog when no output data is available.

„At Eastman, we analyze around 5,000 heat transfer samples worldwide every year,“ says Schopf. „Around 1000 of these come from Europe, 500 of which come from Germany. This shows how well operators in Germany are already aware of this issue, while in other parts of the world less attention is paid to oil testing.“ By the way, Heat 11 also sends samples taken from the customer during a service visit to Eastman. Schopf adds: „We need to raise operators' awareness of the oil issue and remind them time and again how important the maintenance service of the system manufacturer is and subsequently also of the oil supplier.“



Parameter	Value	Unit
Flash point	270	°C
Viscosity	100	cSt
Density	0.85	g/cm³
Specific heat	2.0	kJ/kg·K
Thermal stability	1000	h
Corrosion	0	mg

However, it happens time and again that after delivery of the plant, the customer fills using another heat transfer oil than the one specified by the system manufacturer. For example, the customer fills the plant with a mineral oil instead of a synthetic one. This can or must necessarily lead to a new check of the neuralgic system components, such as heaters, heat exchangers, pumps, etc. Ideally, all process parameters are then recalculated, a new type plate and a new plant plate are created, and the documentation and the operating instructions are updated so that subsequent inspections test for the correct oil. After changing the heat transfer oil, a new

TÜV approval may even be indicated so that the operating permit does not expire. The use of another heat transfer medium alone therefore theoretically results in a real re-engineering, which of course entails costs. However, only if the other heat transfer medium used is actually officially „certified“. „Unfortunately, however, only a few operators adhere to it,“ complained Jürgen Kröger. „The result is that neither the operator nor the inspector knows exactly what they are dealing with.“



Jürgen Kröger: „Operator trainings for operating personnel on site at the user's premises are highly recommended.“

From the pump manufacturer's point of view, the evaluation plays out on two levels. „As far as the relationship with the manufacturer of thermal oil plants is concerned, there are no problems at all. Uwe Herberger-Rosin from KSB Pumps confirmed the competence of the plant manufacturers. They know what they are doing and what requirements must be met – also with regard to pump selection. „On the user side, this looks quite different. Nobody really knows what is important. In many cases, we would like a more intensive training level for the employees on site.“