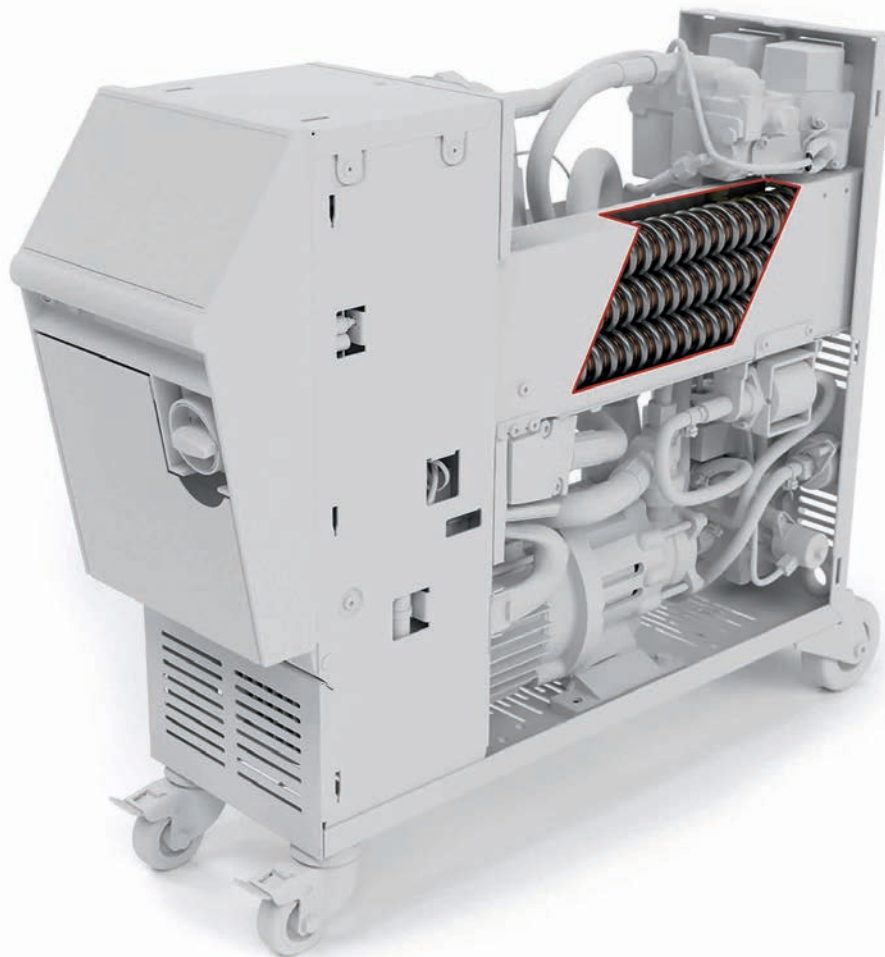


Correctly Assessing the Energy Efficiency of Heating Systems

Indirect Heating without Contact between Heating Element and Water Has Many Advantages

It is often claimed that temperature control units featuring heaters with no direct contact to the heat transfer medium are at a disadvantage in terms of energy efficiency. While this may seem correct at first glance, a different picture emerges when the whole system is taken into consideration.



Installation location of the indirect heating system in Series 5 temperature control units

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A lifetime warranty on the heater – this promise, which was made by HB-Therm AG, a St.Gallen/Switzerland-based manufacturer of temperature control units and which is unique within the in-

dustry, recently cast doubt on the energy efficiency of indirect heating. What is not in doubt is that direct contact of heat registers with the heat transfer medium is more efficient than indirect contact, be-

cause all the electrical energy is transferred straight into the medium. Nevertheless, the heat emitted during indirect heating is not “lost”, provided that it remains in the heater package.

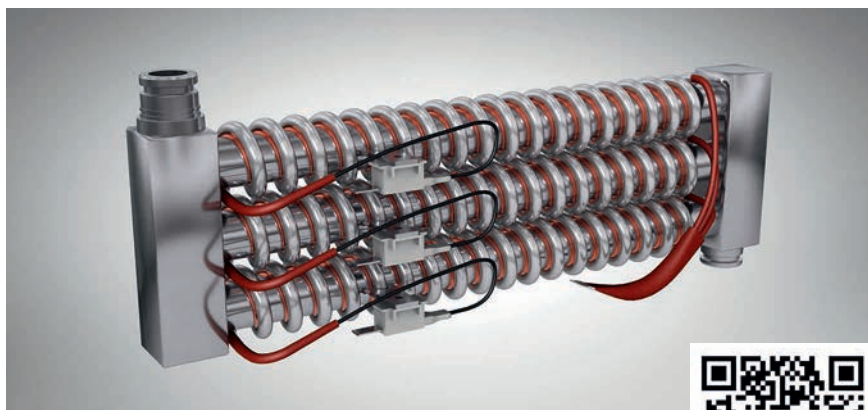
An essential advantage of indirect heating is that it does not require a tank and so much less energy is needed for heating. For, it is often forgotten that, in addition to the volume of water in the temperature control unit, the entire surface, material thickness and insulation on the unit have to be heated as well. This confers a further advantage on tank-less systems, namely they respond much faster to set-point changes. HB-Therm knows from experience with its Series3 units that the advantages of indirect heating outweigh the disadvantages in many respects, especially as regards their vulnerability to failures and the outlay on maintenance.

The Decisive Question: How Much Heat Is Lost?

When it comes to evaluating the two systems, Dipl.-Ing. (FH) Jürgen Rottach, an engineer in the Technology & Engineering section at HB-Therm, is wholly familiar with the pros and cons. "We know all about the benefits and drawbacks of heating registers in direct contact with the heat transfer medium, because all HB-Therm units employed the same concept up to the Series3 temperature control units 20 years ago. We concluded after extensive testing that indirect heating of the temperature control medium is more efficient than direct heating in most cases because, although the surface temperatures may be similar, a 5-liter tank has a roughly 50% larger surface area and that sends energy consumption soaring."

Plus, direct contact with the heat transfer medium means that sooner or later, depending on the water quality, lime-scale will develop, impairing heat transfer and necessitating maintenance of the heating system. Furthermore, the efficiency of the heating system is not the sole determinant of overall efficiency. In fact, it is not how the heat gets into the heating medium, but how much of it is released into the environment and thus is lost that is crucial.

The external temperature of the heating component in direct and indirect systems is very similar by virtue of the insulation. Thus, the size of the heating registers is the decisive factor. The corollary of this is that more-compact assemblies have an energy advantage.



View of HB-Therm's proprietary heating system without direct contact to the heat transfer medium. The QR code links to a video clip with more detailed information © HB-Therm



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This applies to each of the various components, and ultimately also to the energy balance of the overall unit. The temperature control units supplied by HB-Therm achieve a high level of energy efficiency because they are well insulated, their smaller surfaces have better ventilation designs and the number of ventilation slots has been kept to a minimum. "Users have confirmed this efficiency to us," says Rottach.

Insulation and Heat Balance Are Key Factors

The technology expert makes a vivid analogy with the construction industry: "We know that insulation and ventilation in houses have a much greater impact on heating cost than does the efficiency of the heating system. The insulation in new houses is now so good that, even when the temperature is 15°C outdoors, there is no need to turn on the heating. Enough heat is emitted by the inhabitants and appliances to maintain the room temperature. The same applies to temperature control units. The insulation and the heat balance of the overall temperature control unit are key to minimizing energy losses. The heating system does not have to compensate for them, and that translates to genuine energy savings."

And then there are the other aspects of insulation. The connection fittings (hoses, manifolds, etc) as well as the mold itself release heat to the environment, especially at high temperatures. Insulating the hot parts can eliminate a great deal of unnecessary waste heat. Yet these possibilities are not being exploited systemati-

cally. For example, a non-insulated DN13 hose transporting a medium at a temperature of 130°C emits about 100W per meter to the environment. Simple insulation measures can reduce this value to about 60W.

In view of the many meters of hoses normally used on an injection molding machine, the savings potential is not hard to see. Just analyzing the single system components alone yields a distorted overall picture. The overall system must always be looked at.

Direct Heating: Effective, but More Maintenance-Intensive

The shorter lifetime of direct-acting Series3 heating registers is easily explained. When the water at the heating register reaches boiling point, bubbles start to form due to the change in »

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physical state of the water. Wherever the heating register is in contact with the bubbles, it will partially overheat. This then gives rise to stress cracks. The medium now penetrates through these cracks into the heating register, ultimately causing it to fail. In addition, lime-scale is deposited at these points, acting as an insulating layer which impairs heat transfer. The heater therefore needs to be descaled at specific intervals. Indirect heating completely eliminates this maintenance outlay.

Rottach adds, "The failures that occurred in the Series 3 units as a result of direct heating of the temperature control medium were at odds with our own concept of quality and provided the motivation to develop a proprietary heating register. We succeeded in developing a system that combines the many advantages and minimizes the disadvantages of temperature control unit heating.

In the meantime, the technology behind the heating registers has stood the test of time and the figures speak for themselves: of the approx. 80,000 heating registers in operation, the annual failure rate is less than 0.3%. "These figures prove

that the proprietary HB-Therm heating register with no direct contact to the heat transfer medium offers clear-cut advantages over conventional heating concepts," says Rottach. Spare parts produce gray energy and thus CO₂ as well.

Indirect Heating: Intelligent, Energy-Efficient Solution Found

The solution is well designed down to the last detail. As the heating registers are not in direct contact with the heat transfer medium, stress cracks cannot develop. A superimposed system pressure prevents the water from evaporating and effectively suppresses bubble formation. The electrical energy is transferred efficiently to the heat transfer medium in the heating register, and solid state relays ensure an even load distribution across all heating stages. Three integrated bi-metal elements provide emergency protection in the unlikely event of overheating. The insulated heater package reliably prevents uncontrolled radiation of heat, while the compact design also prevents wasteful release of heat to the environment.

Leading-edge energy efficiency is achieved through the interaction of all the components that make up the temperature control unit. The tank-less heat-transfer circuit minimizes circulation volumes such that temperature control of the heat transfer medium is restricted to the bare minimum. The forced flow in the heating register transfers the electrical energy directly to the heat transfer medium and thus into the mold. The high energy efficiency is ultimately reflected in the low level of waste heat emitted by the overall system. A sophisticated cooling concept and a heating register with a small surface area reduce heat losses to an absolute minimum.

Consequently, even modern indirect heating systems have a high degree of efficiency, a small carbon footprint and low energy losses. And they generally have a longer lifetime than any heating register in direct contact with heat transfer medium. HB-Therm is so convinced of this concept that it is the only manufacturer of temperature control equipment to issue a lifetime warranty on its heating registers. ■