Advantages through Sustainable Temperature-Control Technology

Even in Difficult Economic Times, It Is Worthwhile Investing in Energy-Efficient Temperature Control

Climate protection is still on the global agenda, even if its relative importance has changed recently in the public perception. Many so-called "low carbon footprint technologies" are already available and could be utilized immediately in plastics processing. But what carbon reduction measures are not only environmentally effective? Using practical examples, gwk shows how the use of efficient temperature-control technology rapidly pays off economically, too.

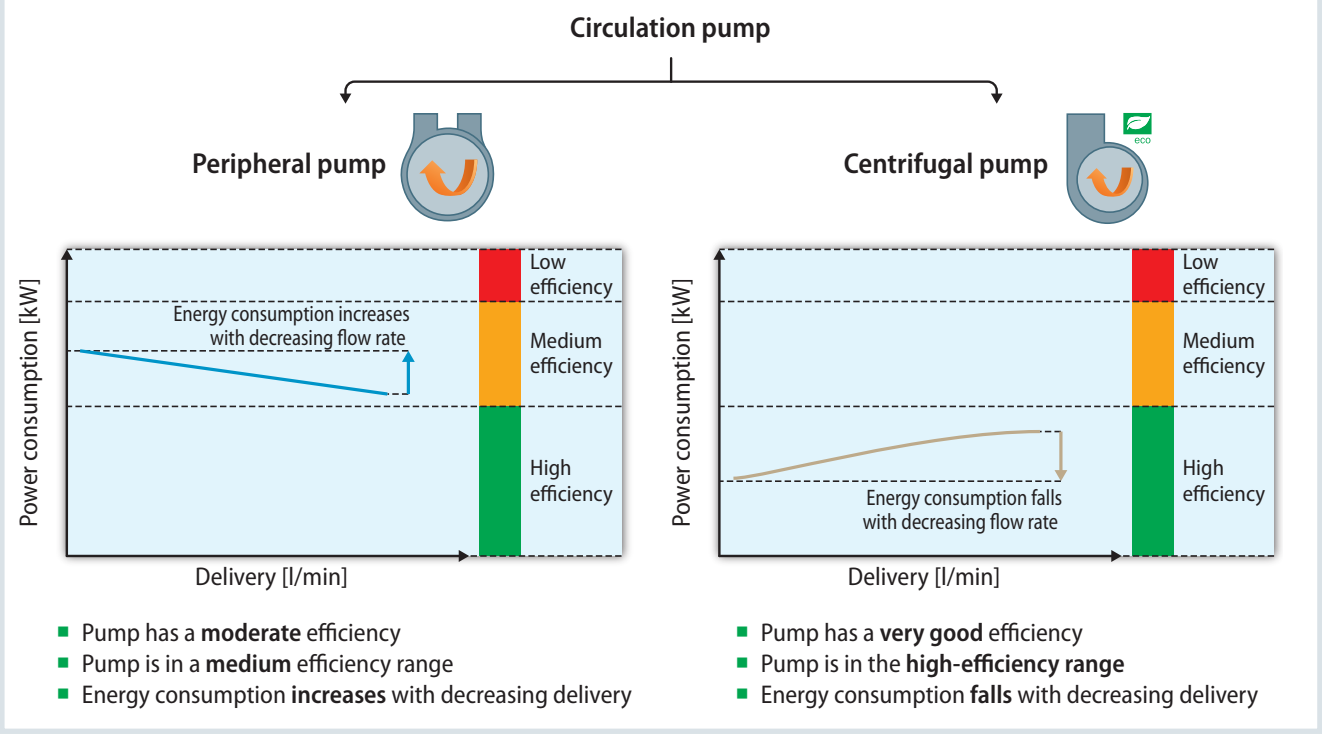

Fig. 1. Differences in power consumption and quantity ratio Source: gwk, graphic: © Hanser

The Covid-19 pandemic has pushed the climate crisis out of the spotlight. But temperatures on Earth continue to rise, and global industrial development makes a significant contribution to increased carbon emissions. Among scientists, there is agreement that the goal of the Paris Climate Conference, of limiting global warming to less than 2 °C, cannot be achieved with the measures that have been implemented so far. Only with the intermeshing of effective offsetting measures – for example reforestation, foregoing domestic flights, and rethinking our trading and consumer behavior – and decarbonized industrial processes, can climate change be slowed or stopped. In a time of the Corona virus and the resulting global economic consequences, it has become more urgent than ever to implement carbon-reducing measures right now and with economic gains.

gwk Gesellschaft Wärme Kältetechnik mbH, Meinerzhagen, Germany, is using new technologies to put efficiency advantages and climate protection on a

common denominator with economic purchasing interests. The following practical examples show the potential of gwk technologies with the aid of comparative calculations and payback times. They also consider the effects of incentive measures on the use of energy-efficient technologies, since they can help to offset the extra costs in some cases.

Potential in Temperature-Control with Centrifugal Pumps

Temperature-control devices are used in many plastics processing operations. The design of the rotary pump has an impact on both the performance and energy efficiency of the units. Besides the conventional peripheral pump, the centrifugal (radial) pump has therefore been gaining in importance in recent years (**Fig. 1**).

Centrifugal pumps provide a higher available flow rate with the pressure loss that is normal in the process and require significantly less energy than peripheral pumps at the operating point (**Fig. 2**). The greater the pump performance, the greater the energy advantage in favor of the centrifugal pump.

Another difference lies in the power consumption behavior: while, with a centrifugal pump, the power consumption falls with decreasing flow rate, the energy consumption of a peripheral pump increases (**Fig. 1**). The centrifugal pump is thus to be preferred from an energy point of view, for example, even when used on controlled water distributors, with deliberately throttled deliveries.

A Comparison of Investment and Energy Costs

If two small circulation pumps in the performance range up to max. 40 l/min flow rate are compared, a centrifugal pump yields a 3.5 times higher flow rate for the same pressure than a peripheral pump with the same drive power. It can thus be used to replace three units of a less efficient type. The cost comparison shows clear advantages in the investment and energy costs in favor of the units that are equipped with a centrifugal pump (**Table 1**).

In so far as a higher flow rate is not necessary for process optimization, the use of a pump speed regulator alternatively also offers a high potential for reducing energy consumption. The available flow rate and the pressure would then be identical. However, the energy consumption would be clearly reduced from 0.48 kW for the peripheral pump to only 0.17 kW for the centrifugal pump.

In this practical example, the investment in a temperature-control unit with centrifugal pump can be subsidized by up to EUR 1104 via the funding program of the German Federal Ministry of Economics and Technology (BMWi). The payback time for the extra investment in temperature-control units with centrifugal pumps is thus significantly reduced. In addition, it can be assumed that low-carbon production results in reduced payments for carbon taxes.

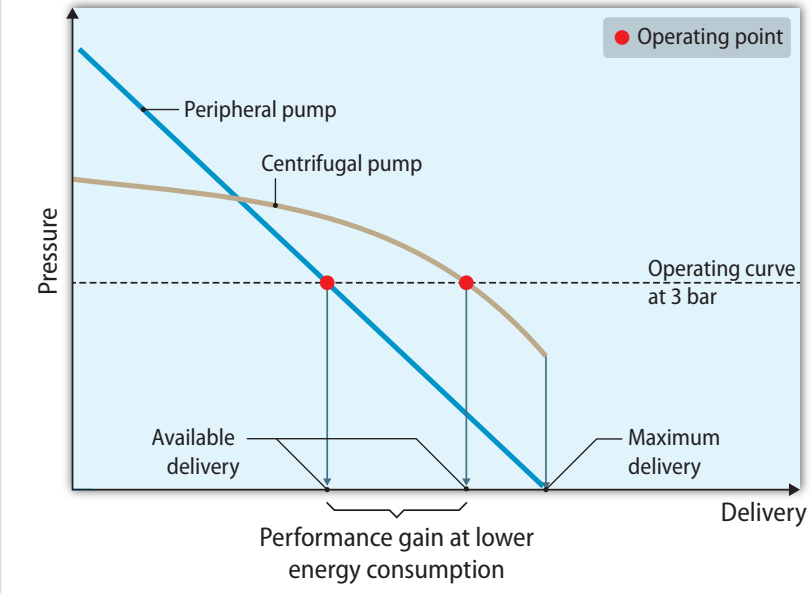

Fig. 2. Comparison of the characteristics of the pump types (pressure/delivery). The greater the pump performance, the greater the energy advantage in favor of the centrifugal pump Source: gwk, graphic: © Hanser

The Bigger the Pump, the Bigger the Potential Savings

A comparison of two medium-sized circulation pumps in the performance range up to max. 120 l/min flow rate reveals an ever larger saving potential, because the centrifugal pump for the same operating flow rate requires almost 62 % less electricity than the peripheral pump. In addition, the profitability calculation shows that a centrifugal pump not only pays off because of the energy cost saving, but also in the investment costs (**Table 2**).

It is even worthwhile compared to low-cost equipment. The possibility of state support here speaks clearly in »

Small pumps	Peripheral pump	Centrifugal pump*	Cost saving
Investment	3 x 3485 = 10,455 EUR	5430 EUR	5025 EUR
Pump energy consumption	8640 kWh p.a. (3 x 0.48 kW x 6000 h)	2880 kWh p.a. (0.48 kW x 6000 h)	
Corresponds to an emission of	4.6 t CO_2 p.a.	1.5 t CO_2 p.a.	
Pump energy costs (at EUR 0,16/kWh)	1382.40 EUR p.a.	460.80 EUR p.a.	921.60 EUR p.a.
Lifecycle costs 10 years	24,279 EUR	10,038 EUR	

** Higher quality equipment, e.g. with stainless steel pump and IE5 motor, frequency converter, pump energy consumption display, larger cross-sections, air separator …*

Table 1. Comparison of the investment and energy costs of temperature-control equipment with small pumps in the performance range up to max. 40 l/min flow rate Source: gwk

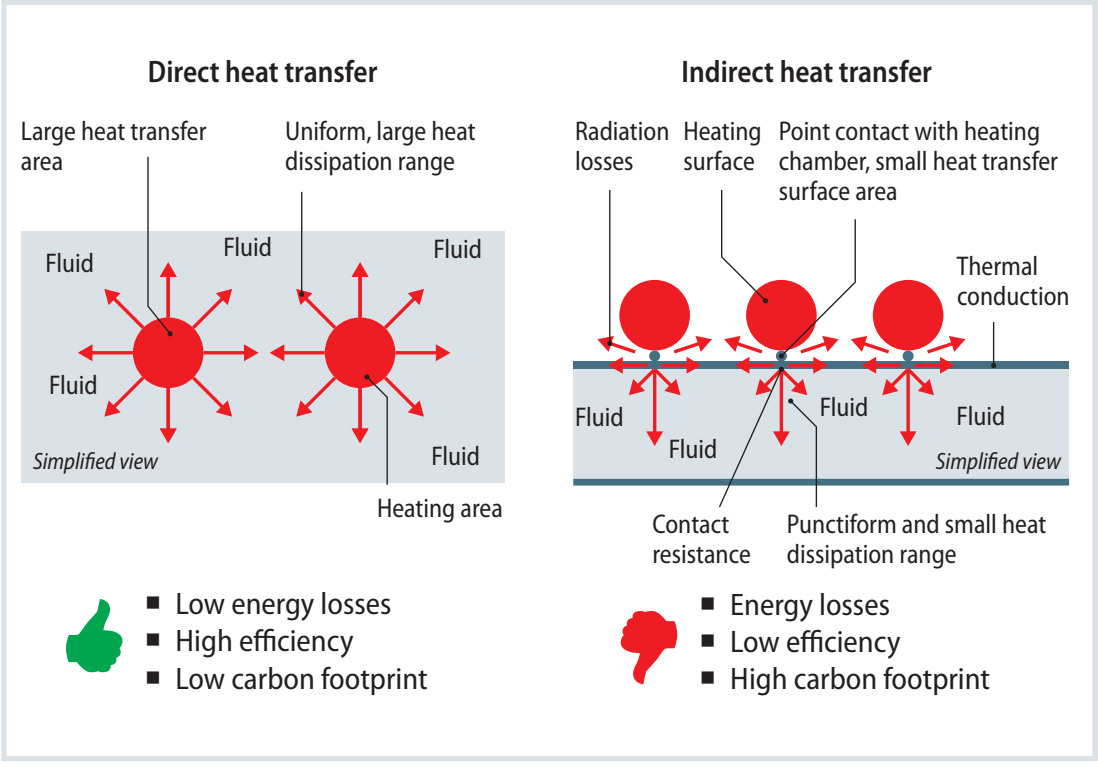

Fig. 3. Comparison of heating strategies: direct heat transfer wins out thanks to high heating rates in a small space, a sustained high efficiency, a low weight and a modest insulation requirement, as well as the possibility of small heating performance gradations and easy mechanical cleaning Source: gwk, graphic: © Hanser

favor of greater market penetration of temperature-control units with centrifugal pumps (**Table 3**). If the payback time without considering state support is over two years, corresponding funds for realizing the carbon reduction measures can be applied for from the BMWi's support fund. In the illustrated example, with state support, the payback time is thus reduced from 2.53 years to only 0.2 years. In this case, a possible carbon tax leads to savings in the operating costs.

For energy-efficient temperature control, gwk recommends its units of the protemp eco line. These are characterized by ready-to-connect heating and cooling units with speed-regulated centrifugal pump technology and direct heat transfer from the heating cartridge to the medium. The water circuits designed as a closed system without oxygen contact permit service temperatures from 95 to 140 °C. In comparison with standard units with peripheral pumps, the energy consumption with protemp temperature-control units can generally be reduced by 62 % up to as much as 92 %

Potential for Heating with High-Efficiency Heating Cartridges

For compact temperature control units, two competing heating strategies have emerged in past years:

- Heat transfer from the heating cartridge directly in the medium and
- indirect heat transfer from the heating cartridge to the medium via a heating jacket.

Indirect heat transfer is characterized by the fact that the heating surface area is wound in a spiral around a tube – through which the medium flows – and thereby emits the heat to the medium through the pipe wall. With this method, the small heat-transfer area and the resulting radiation losses result in low efficiency and high energy losses. To achieve greater energy efficiency and a higher effectiveness, it is therefore advisable to use direct heat transfer in the medium (**Fig. 3**).

Medium-sized pumps	Peripheral pump	Centrifugal pump	Cost saving
Investment	9950 EUR	7430 EUR	2520 EUR
Pump energy consumption	12,900 kWh p.a. (2.15 kW x 6000 h)	4920 kWh p.a. (0.82 kW x 6000 h)	
Corresponds to an emission of	6.9 t CO_2 p.a.	2.6 t CO_2 p.a.	
Pump energy costs (at EUR/kWh 0.16)	2064.00 EUR p.a.	787.20 EUR p.a.	1276.80 EUR
Lifecycle costs 10 years	30,590 EUR	15,302 EUR	

Table 2. Comparison of the investment and energy costs of temperature-control equipment with medium-sized circulation pumps in the performance range up to max. 120 l/min flow rate Source: gwk

In comparison to indirect heating, direct heat transfer with heating of the type gwk "longlife" offers a larger heat transfer area as well as a more uniform heat dissipation range.

Another advantage is the long lifetime of the gwk heating cartridge. Thanks to the high quality of the stainless steel materials and special design solutions, such as optimized heating surface load, semiconductor relays, multiple safety circuits and guided flow, the failure rate of heating cartridges is considerably reduced with direct heat transfer.

In numerous temperature-control series, gwk therefore offers a long-term warranty on its "longlife" heating.

Summary: Climate Protection and Efficiency Can Be Reconciled

Many offsetting projects for achieving a neutral carbon balance are worthwhile, but generally require time to have an impact. Wherever possible and economically feasible, carbon reduction measures that are immediately accessible should be preferred. With the continuous expansion and modernization of its product range, gwk presents temperature-control units that combine environmental and economic advantages. The use of such efficient devices and systems can help the plastics processing industry to speed up its efforts to achieve the necessary climate protection goals. ■

Low-cost unit	Peripheral pump	Centrifugal pump	Differences
Investment	4200 EUR (assumption)	7430 EUR	Additional costs: 3230 EUR
Pump energy consumption	12,900 kWh p.a. (2.15 kW x 6000 h)	4920 kWh p.a. (0.82 kW x 6000 h)	
Corresponds to an emission of	6.9 t CO_2 p.a.	2.6 t CO_2 p.a.	
Pump energy costs (at 0.16 EUR/kWh)	2064.00 EUR p.a.	787.20 EUR p.a.	Energy saving: 1276.80 EUR
Lifecycle costs 10 years	24,840 EUR	15,302 EUR	Payback time: 2.53 years
With public funds	0 EUR	2972 EUR*	
Net investment	4200 EUR	4458 EUR	Additional costs: 258 EUR
Pump energy consumption (at 0.16 EUR/kWh)	2064.00 EUR p.a.	787.20 EUR p.a.	Energy saving: 1276.80 EUR
Plus carbon surcharge	??? EUR	??? EUR	
Lifecycle costs 10 years	24,840 EUR	12,330 EUR	Payback time: 0.20 years

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Table 3. Comparison of the investment and energy costs for the low-cost unit. In the illustrated example, the payback time of 2.5 years is reduced to only 0.2 years with support from public funds. In this case, too, a possible carbon tax leads to savings in the operating costs Source: gwk

Company Profile

gwk Gesellschaft Wärme Kältetechnik mbH based in Meinerzhagen, Germany, is a system supplier of cooling, temperature-control and water technology for the plastics processing industry. The manufacturer offers solutions that cover the entire production process, from the cooling system, through temperature control, to water treatment. The product portfolio includes, among other things, temperature-control systems, temperature-control equipment and refrigeration machines. gwk solutions further offers solutions for the field of dynamic temperature control of tool inserts and tool cleaning. The company employs around 400 staff and is a member of the technotrans Group.

↘ www.gwk.com

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