Getting the right recipe for heating food products

Heat is fundamental to the food and drink industry. From cooking and drying to other treatments such as pasteurisation, heat is widely used in all but the most basic food manufacturing and processing situations, in sectors as varied as dairy, fruit and vegetable processing, meat, prepared foods, brewing, dietary supplements and more.

by Matt Hale, International Sales and Marketing Director, HRS Heat Exchangers. www.hrs-heatexchangers.com

As you would expect, this demand for heating (and cooling) requires a large amount of energy. The Carbon Trust estimates that the UK's food and drink sector is the fourth highest industrial energy user in the country, with a total demand of 37 TWh a year, of which up to 60% is attributed to heat. This includes ovens, boilers and space heating, as well as processes such as drying, sterilisation and concentration.

Many reports which consider the greenhouse gas (GHG) impacts of food production do not fully distinguish between those emissions associated with primary production (both direct and indirect) and those associated with processing and distribution, making detailed analysis difficult. However, based on average statistics, 37 TWh of energy production is enough to power more than 1.8 million homes and could account for up to 11 million tonnes of CO_2e emissions.

Minimising environmental impact, maximising profit

In order to reduce their environmental impact and make best use of their by-products and biomass wastes, many food producers have invested heavily in bioenergy production projects such as anaerobic digestion and biomass combustion in recent years, as well as other forms of renewable energy.

While this has helped to reduce the sector's environmental footprint, maximising process efficiency, and thermal efficiencies in particular, is sometimes overlooked, not only as a way of improving environmental performance, but also generating greater economic returns for the business.

Recapturing and reusing heat from other sources (such as surplus heat from cooling operations or spare boiler capacity) can be an effective way of increasing capacity or adding a new production process without the need for major new heating or energy infrastructure.

Depending on the application, HRS Heat Exchangers' equipment has been shown to recover as much as 50% of previously wasted heat, which can then be used for water, space or process heating, waste treatment or other thermal applications.

Influencing factors

While some processes and materials will require specific equipment, such as ovens or retorts, for others, heat exchangers are an effective and efficient solution, and are also more likely to enable heat regeneration than other systems.

The choice of heat exchanger will depend on many different factors, such as the nature of the process to be carried out (pasteurisation, sterilisation, dehydration, etc); the viscosity of the food or drink being processed; and whether it contains particles or pieces, etc.

Furthermore, Newtonian and non-Newtonian fluids will behave differently under different temperature and pressure regimes, and this will affect the handling necessary during processing.

For example, if subjected to too much pressure, certain sauces may shear, resulting in them failing to meet the end specification – such as pizza sauce not staying on the pizza!

Another challenge is presented by certain fat-free products which become more or less viscous with temperature, and so may be more fluid on the cooling side of the heat exchanger than the heating side.

The HRS R Series can be run in reverse at the end of a batch to reclaim valuable products, effectively emptying the heat exchanger without damaging or affecting quality.

Benefits of corrugation

Such issues can be overcome with the correct type of heat exchanger and careful system design.

Corrugated tube heat exchangers, like the HRS MI and MR Series, are available in various configurations, so that delicate materials such as cream can be processed without damage.

The corrugated design also minimises fouling in the heat exchanger, which increases the thermal efficiency and prolongs operational periods between cleaning.

In addition, corrugated tube heat exchangers have a lower pumping requirement than smooth tubular heat exchangers due to their compact nature, which results in a lower pressure drop. This helps increase operational life while reducing maintenance costs compared with other types of heat exchanger.

Reducing waste

For some materials, such as curd production in the dairy sector, increased turbulence can be beneficial. Alternatively, where low pressures are required, scraped surface heat exchangers, like the HRS Unicus Series, keep things flowing smoothly while handling the product gently: one way to overcome the pizza sauce example above.

Using the right type of heat exchanger can also help to reduce product losses caused by materials remaining in equipment at batch changeovers or when cleaning is required.

Some scraped surface heat exchangers, such as the HRS R Series, can be configured to run in reverse, effectively removing product from the heat exchanger without damaging it or affecting its quality.

When dealing with any food processing machinery, it is critical to check for compliance with the necessary legislation. However, ultimately you need to ensure that the equipment you choose will perform as required. And, as with any capital expenditure, it is important to compare not just the initial capital costs, but also operational and maintenance costs across the life of the machinery. All heat exchangers are not alike, but these differences mean that there is undoubtedly a heat exchanger solution that fits your food processing needs. ■