

Handle with care

People love chocolate but behind the delicious, sweet treats many of us will receive this Christmas lies a complex manufacturing process. World Pumps looks at how pumps play a key role in successful chocolate production

Think of a chocolate factory and many people will conjure up an image of Roald Dahl's Willy Wonka and his Oompa Loompa workers presiding over a chocolate river mixed by a waterfall. The reality is very different – chocolate production varies enormously, from the bespoke handmade delicacies of small firms to the mass-produced big names we see on our supermarket shelves.

The common denominator is demand with consumers in the United States eating nine kilograms per year on average, while residents of world-famous chocolate centre Switzerland devour 11.8 kilograms, the highest in the world. However, chocolate is not the easiest product to make, especially when it comes to the essential pumping operation. It is shear sensitive, viscous, solidifies when cool and, being food, must adhere to strict hygiene regulations.

Extra ingredients

An extra difficulty is also created with the addition of extra ingredients such as fruit, nuts, fondants or flavoured crystals which provide an additional challenge for the pumps involved. One of the keys to successful chocolate production is temperature. Dark chocolate should be melted between 120°F and 130°F (50°C and 55°C), while milk and white chocolate should melt at around 105°F–115°F (40–45°C).

Critically, this temperature must be maintained to prevent the chocolate becoming congealed. If that happens, friction and heat will increase and ultimately the pump can be blocked or damaged. The chocolate needs to be in a molten state before the pumping operation is started and the consistency needs to be maintained throughout the pumping process.

“We have a special clearance between the rotating assemblies and the casings that allow us to pump the higher viscosity chocolate and avoid the separation of the sugar.”

Andrew Nash, vice president, Desmi

One way of doing this is to use a heating jacket which allows hot water or steam to flow through cavities within the pump without coming into contact with the product.

Shear sensitive

The other major factor that affects how chocolate is pumped is shear. It is extremely shear sensitive meaning that if it is pumped too quickly, the ingredients can begin to separate causing the chocolate to appear dull with it lacking its desirable snap. To avoid this happening, it is recommended that pumps operate at a maximum of 101 psi and often much lower depending on the type of product required.

Perhaps surprisingly, given the nature of the product, there are several types of pumps suitable for use in chocolate production. A positive displacement pump is designed to operate at low speeds and pressures ensuring a reliable flow. Lobe pumps are also ideal for handling high-viscosity fluids and shear-sensitive products such as thick chocolate or chocolate with ingredients such as nuts giving a smooth, pulse-free flow while being compatible with clean in place (CIP) systems which can be very important in chocolate production. Hygienic progressive cavity pumps also provide a steady, non-pulsating flow at varied pressures making them ideal for use in production lines where the product is done into moulds or filling lines.

Adjustable heating

For example, the Nemo BH hygienic pump manufactured by Netsch features a compact block design with an adjustable heating jacket. The technology is based on the coordinated geometries of a helical rotor and its surrounding stator.

Due to the size of the chambers and the low

sliding speeds of the rotor, even larger solids such as nuts or brittle can be conveyed without damage. A heating jacket surrounds the pump from the mechanical seals over the entire length to the discharge nozzle to prevent critical temperature fluctuations.

Another useful feature of this type of pump is the ability to carry out cleaning and sterilisation in place without having to remove the pump, saving time and money as well as efficiently reducing the risk of contamination from residues.

One pump designed specifically for the chocolate industry by specialist manufacturer Desmi is the CHD internal gear pump, a variety of its Rotan positive displacement series. It can specifically handle highly viscous media such as cacao mass and white chocolate with its content made up entirely of sugar and cocoa butter.

Equipped with a heating jacket on the front and rear end, components like rotors, idlers and idler bushings are designed with special clearances, enabling them to handle higher pressures. It is available in multiple sizes with each variation rotating at a different speed.



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1. Hygienic progressive cavity pumps such as the Nemo BH from Netsch provide a steady, non-pulsating flow at varied pressures (Netsch)

2.1 The CHD internal gear pump is available in multiple sizes with each variation rotating at a different speed (Desmi)

Hot water

Andrew Nash, vice president of Desmi, explains, “It is normally jacketed, so we use hot water or steam or even electrically trace the pump and the pipework to keep the chocolate liquid. We have a special clearance between the rotating assemblies and the casings that allow us to pump the higher viscosity chocolate and avoid the separation of the sugar.

“With the cavities we can accommodate suspended solids in any sort of production. There is almost a natural separation by the internal forces of the fluid. We can also remove the whole rotating assembly without disturbing the pipework or the motor and you can drop another back in and be up and operational again very quickly,” Nash continues.

Different sizes of pump are also available. For example, a manufacturer can use a small, higher-RPM pump for its dark chocolate production, and a much larger version of the same pump, rotating at a slower speed to accommodate its white chocolate production line. Nash adds, “The important thing is we are not spinning them fast – it depends on the viscosity. If we try and run too quickly the chocolate just won’t go into the pump.”

Modular nature

Additionally, the modular nature of the design allows for the efficient replacement of worn components in multiple pumps, regardless of size, as the pumps share many commonly replaced parts such as, bushings, O-rings and ball-bearings.

When looking to install chocolate pumps, even the type of metal used for the pump itself can become a key consideration. For example, cast iron has a higher thermal conductivity meaning that chocolate can melt more quickly than would be the case with stainless steel pumps. Should the pump contaminate the product, it can also be detected by x-ray and removed using magnets.

The type of seals used are also important.

Low maintenance pumping at Carletti

There are no excuses for slips in quality when it comes to chocolate production with so many ‘expert’ consumers and a highly competitive market. As a result, operators of the Polish manufacturing plant of Danish chocolate manufacturer Carletti were determined to get to the root cause of a problem that was causing black particles to appear in its white chocolate.

Maintenance manager Radoslaw Redosz explains: “For a long time we had issues with black particles in the white chocolate, when producing at high pressure. The black particles were a huge problem for us. We always must deliver a high quality and a white chocolate that is actually white.”

The company finally switched to Desmi Rotan pumps which were capable of meeting production demands of up to 300,000 kilograms of chocolate a month while cutting maintenance and vastly improving reliability. And significantly the troublesome black particles also disappeared.



“When we started using Desmi Rotan pumps it was clear that this is a pump that we can trust and that is almost maintenance-free,” adds Redosz. “On previous pumps we have had to change the seal often – at least every second month but today it is rare that this maintenance is needed, as the pump is almost maintenance-free.”

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Radoslaw Redosz, maintenance manager, Carletti

If a seal fails, it can lead to leakages with the chocolate escaping along the shaft and into the atmosphere. This can lead to costly breaks in production.

Proper lubrication

The most basic and traditional form of seal is using food-grade packing. This method is designed to leak to allow for proper lubrication. More reliable and more common is the dynamic O-ring seal which can also conform to food grade hygiene standards easily. This type of seal is commonly used on rotary lobe or circumferential piston style pumps often in a single or double O-ring configuration.

Other types include a triple lip which offers a longer life span but are expensive to replace while double mechanical seals will need a food-grade fluid barrier. With temperature and pressures across the manufacturing process so important in producing high quality chocolate, the installation of sensors and gauges is also essential to minimize pipe strain.

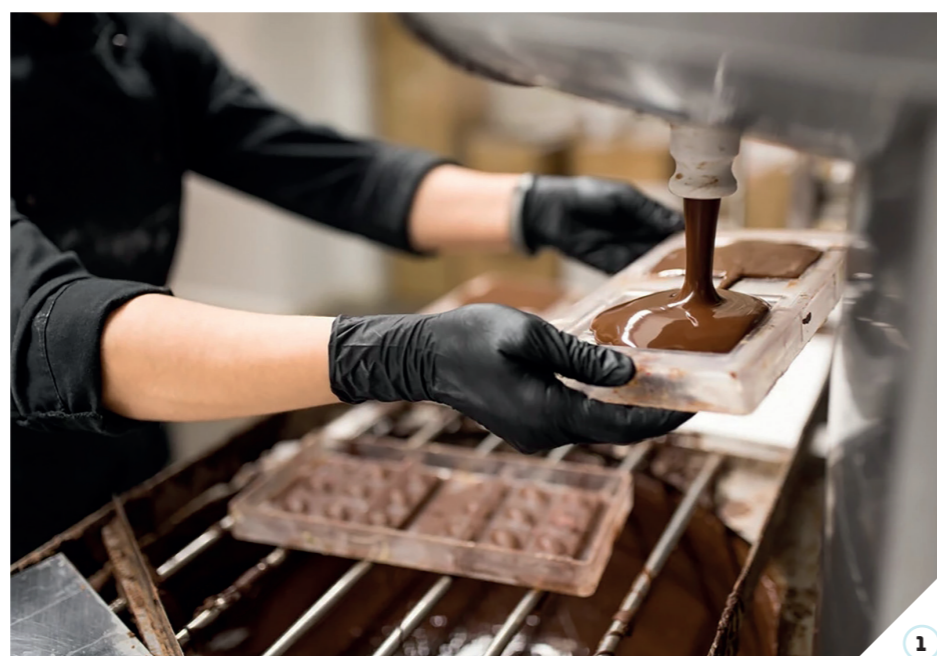
Viscous product

Whatever the configuration, cleaning and maintenance are particularly important with such a viscous product as chocolate. Nash says, “It is not an easy product but the issues with it are well known. There are problems with chocolate bunging in the pipeline, there is improper maintenance on the gland – there are all sorts of issues that can occur to upset the operation.

“We do rely on a lot of help from operations and maintenance people in these plants so that when the pump goes in, it is properly heated, the seal arrangement is lubricated to the pump pressurized and then they can operate effectively,” he concludes. ☺

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1