WATSON MARLOW
Fluid Technology Group

The long game

How choosing the right positive displacement pumps today will save you in the future

INTRODUCTION

A CHANGING LANDSCAPE

The food and beverage industry is continually changing. Shifting demographics and consumer behaviours place a strain on manufacturers—the ever-changing requirements of the end-users call for more diverse product offerings. Equally, increased environmental concerns mean manufacturers have to become more sustainable in their operations.

A wide range of suppliers serves these markets. They offer new process solutions and packaging options, making it difficult for manufacturers to make significant decisions about their processing equipment.

In practical terms, these shifts in consumer needs are changing the fundamentals of production. For example, more diverse product ranges mean adding new production lines or increased product changeovers—which typically means more downtime. A recent report by the International Society of Automation claims that every factory loses at least 5% of its productivity due to downtime, with some losing as much as 20%. Perhaps more concerning is that nearly 80% of manufacturers said they could not correctly calculate their exact downtime costs.

With the challenge of downtime meeting the increased variety of processing products, the equipment employed throughout a facility needs to be suitable for specific applications. When it comes to pumps and hoses used to transfer delicate products, understanding the limitations and benefits of the different pump types is essential. The texture and viscosity of a product are important characteristics to understand, as it influences the design of a system for production and processing. Therefore, the product's characteristics should also influence the equipment used in the manufacturing process.

The following article will illustrate the importance that process pumps have in enhancing your production capability. With various pump types available on the market, each using different pumping principles, this guide should provide the first step towards choosing the right pump for your application requirements.

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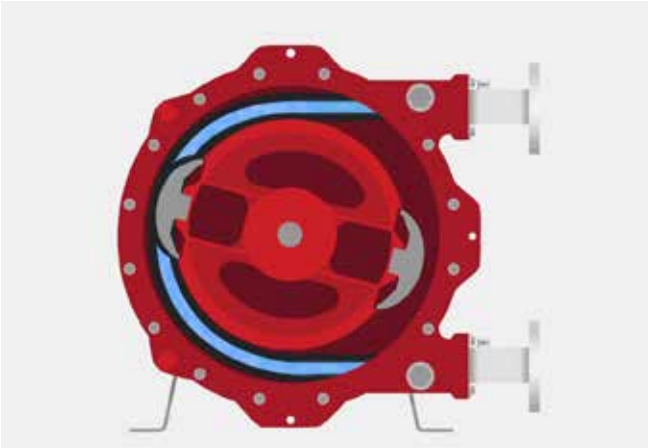
DIFFERENT TYPES OF POSITIVE DISPLACEMENT PUMPS AT A GLANCE

Peristaltic pumps

Peristaltic pumps use an elastomeric tube or hose, which is squeezed against a semi-circular track by rollers mounted to a rotating rotor. Through this design, peristaltic pumps ensure consistent product quality through accurate and repeatable flow rates.

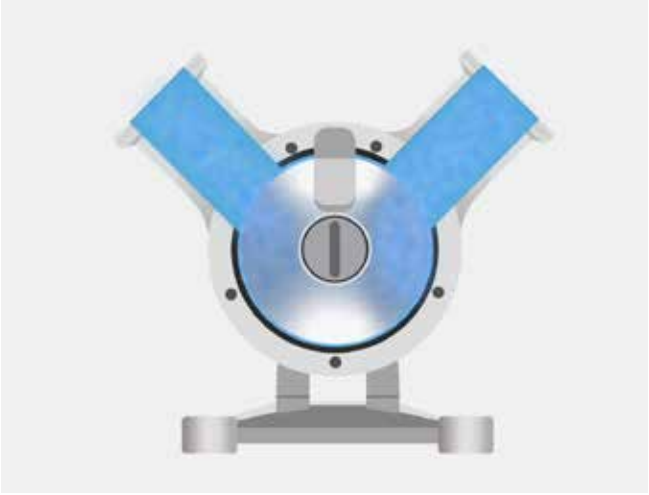
Peristaltic pumps designed by Watson-Marlow are developed through years of experience and testing to guarantee consistent flow for the longest period possible.



Sinusoidal pumps

Sinusoidal pumps take inspiration from sine waves. The smooth oscillation of a sine wave informs the design of a central rotor that creates four evenly sized chambers. As the chamber rotates, it gently conveys the fluid from the inlet port to the outlet port. The pumping gentle action results in a smooth flow with virtually no pulsation.

Certa pumps from MasoSine meet the highest standards in hygiene and cleanability combined with improving process efficiency and minimising total cost of ownership.

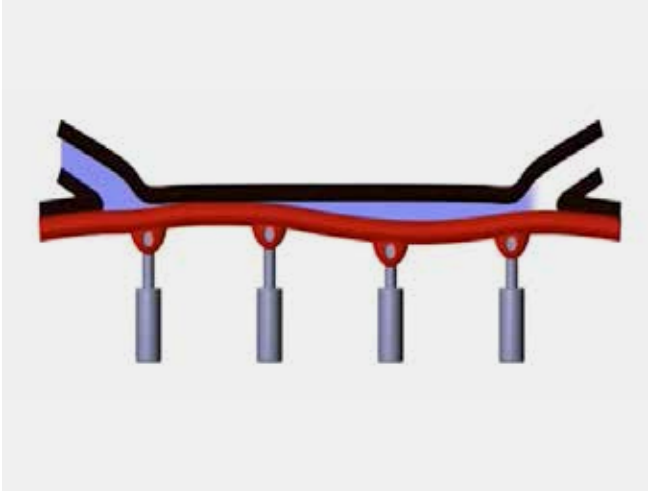


Conveying Wave Technology

Conveying Wave Technology is a new positive displacement pump technology based on a peristaltic movement of a membrane.

To achieve the peristaltic pumping action, the pump incorporates an EPDM element rather than a tube, which acts against a PEEK track. As a result the fluid contact elements is subjected to very low stress levels.

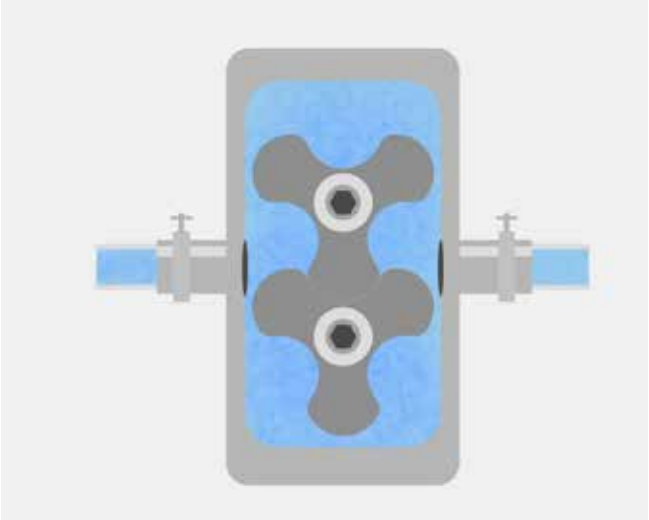
Qdos® CWT™ pumps from Watson-Marlow will deliver significantly longer service life than a traditional pump.



Rotary lobe pumps

Rotary lobe pumps makes use of two rotary lobes that rotate, trapping a volume of liquid into a chamber. The even rotation of the rotor creates a vacuum on the priming side of the pump.

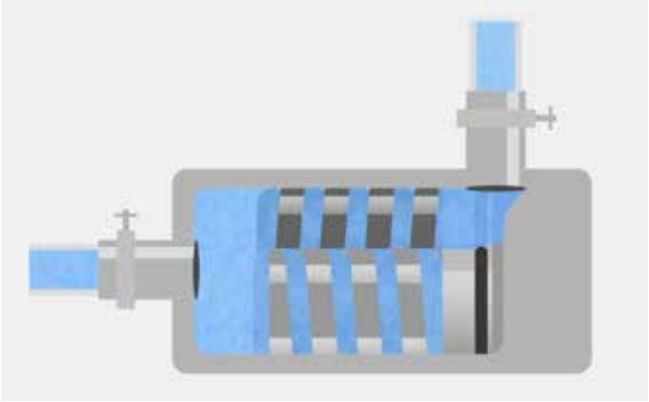
The pump has two sets of mechanical seals to maintain. They are difficult to clean because of dead spots in the casing. The pumps must be specifically designed for the application, and typically have a long service life but when they fail, maintenance can be complex, expensive and time-consuming.



Twin screw pumps

Twin Screw Pump are constructed of two screw shaped rotors in a housing. As the pump rotates, the connection of the two rotating screws, along with the pump housing, form volumetric chambers. These chambers fill with media and move it the pump to the higher pressure discharge side of the pump.

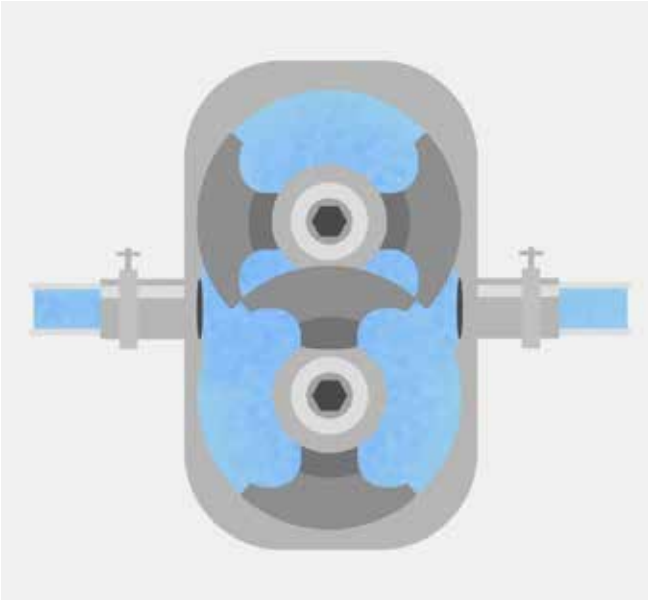
The pumps have a number of components that make complex and time consuming to maintain.



Circumferential piston pumps

Circumferential piston pumps are essentially a mixture of the principles applied in both diaphragm and syringe pump technologies. The pump has a central cavity where fluid is drawn in and out by the movement of a piston. This movement has a direct influence over performance, though this is limited by the power of the drive motor and the rpm the pump can operate.

Piston pumps are expensive to maintain, requiring disassembly for cleaning, which can still be difficult to achieve properly. The result is that there is an increased risk of contamination. The valves in a piston pump are also prone to clogging which makes them a poor choice for particulates handling.



UNDERSTANDING **YOUR REQUIREMENTS**

Making sense of how to optimise production relies on expert teams to work in partnership with specific requirements. Through this partnership, teams can choose the right pump for specific applications. The different steps in any food or beverage process present different challenges. An understanding then of the limitations of certain pump types impacts the suitability for the application.

The three key considerations for any application are:

- Product characteristics
- Required flow rate
- System conditions

PRODUCT CHARACTERISTICS

Ensuring consistent and reliable product quality is fundamental to any company. When handling high-value media, any loss of product can be financially damaging. The viscosity of different fluids can be modified if handled incorrectly, resulting in runny or separated sauces or unwanted shear of dairy products. For materials containing solids such as fruit mixtures, the wrong type of pump can easily cause damage, reducing quality or, most critically, remove the key part of the product you are trying to preserve.

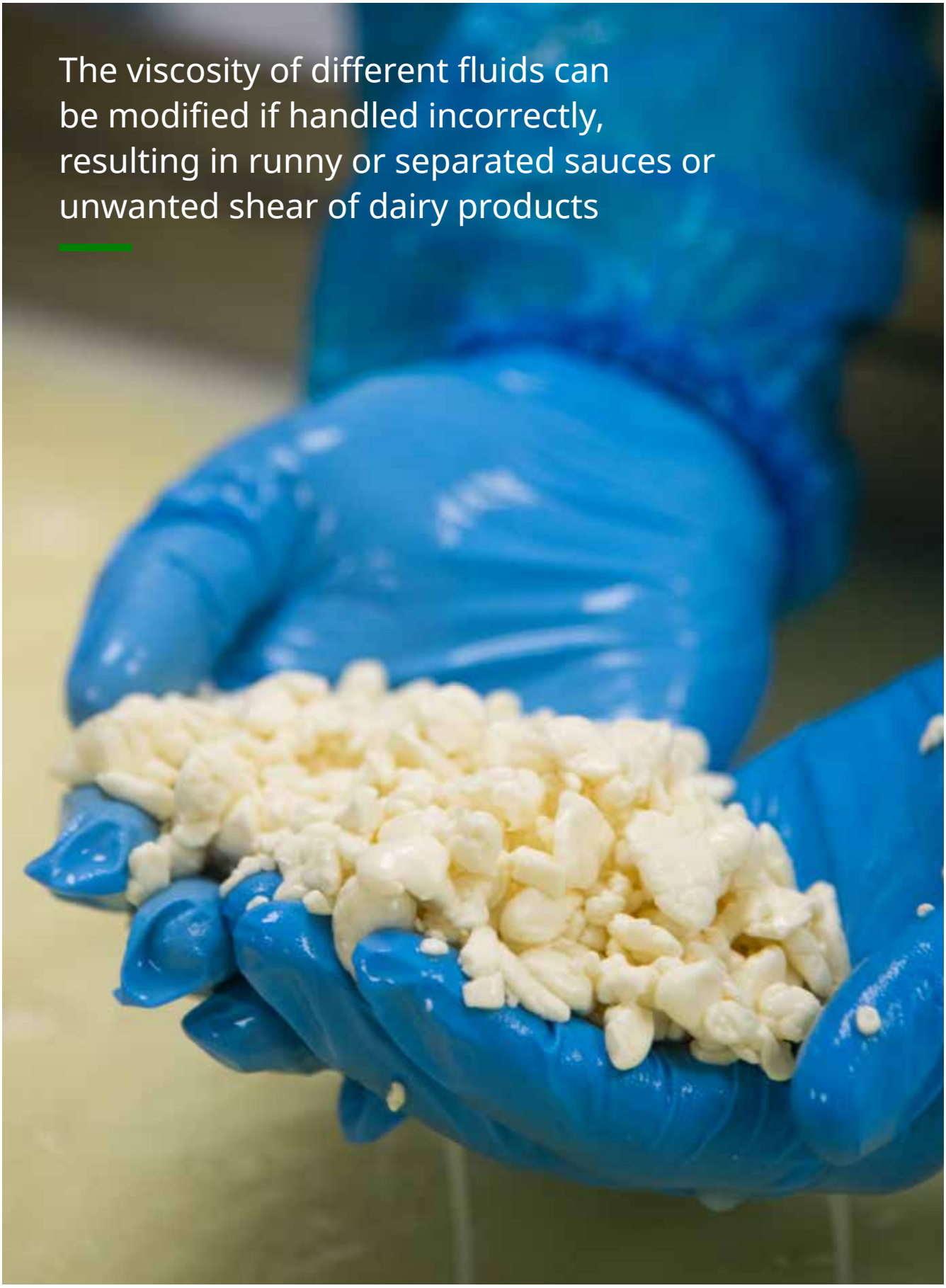
Many engineers in food and beverage plants are faced with pumping various products, ranging from frozen orange juice to cheese curd and whey. Viscosities can register in the thousands, or even millions of centipoise (cP).

There are two main challenges when it comes to pumping viscous products. The first is the significant energy that is required to power a pump challenged with handling viscous media. In a recent survey by the Food and Drink Federation of 100 decision-makers at UK food and beverage plants, three-quarters said that coping with rising energy bills has affected their decision to expand.

The challenge is not simply about money, as increased importance is being placed on responsible and sustainable operations. The need to save energy and reduce the carbon footprint has never been greater.

The second challenge is that viscous product is practically difficult to pump. For example, pumping equipment needs to prime to start operation. Getting viscous products into a pump requires equipment to create a strong enough vacuum to draw material into the pump.

Pumping viscous products is made more complicated because many rotary positive displacement pump types (lobe, twin-screw etc.) suffer significant damage when run dry. This means that, in certain instances, peristaltic hose or tube technologies are better suited as they are capable of running with no fluid in the hose or tube. Dry running is also possible for air operated diaphragm pumps, but in doing so, the technology suffers a significant decrease in service life.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REQUIRED FLOW RATE – BIGGER DOES NOT ALWAYS MEAN BETTER

Put simply, the higher the flow rate the more product can be created. In a perfect world, the smallest pump would be capable of processing the highest volume of product, but this is not possible in practice. Flow rate, therefore, is not only about the size of a pump or the speed at which it is run but the optimisation of a complete system.

Sinusoidal (sine) pumps from MasoSine have a comparatively high flow rate but provide the added benefit of gentle product handling, which increases yield and maintains product quality. This is especially true in curds and whey transfer. Typically, customers increase their pumps flow rate to increase production capacity but damage the product in the process. With rotary lobe and twin screw pumps, there are areas of entrapment where increased pressure is evident within the pump chamber (see fig 1.).

For in-line dosing and mixing applications, a steady and constant flow is required to ensure consistent product quality. An example is in soft drink manufacturing, where syrup is continuously metered into the water line. Sine pumps excel in these applications as the pumping principle provides continuous flow with low pulsation.

Peristaltic pumps provide superior dosing and metering accuracy, particularly for low flow rate applications. The pumps can run dry but have performance issues with high viscous products. However, a high turndown ratio means the pumps provide outstanding accuracy in dosing applications such as flavour and colour dosing. The outstanding accuracy of peristaltic pumps also makes them perfect for filling, dosing and dispensing duties.

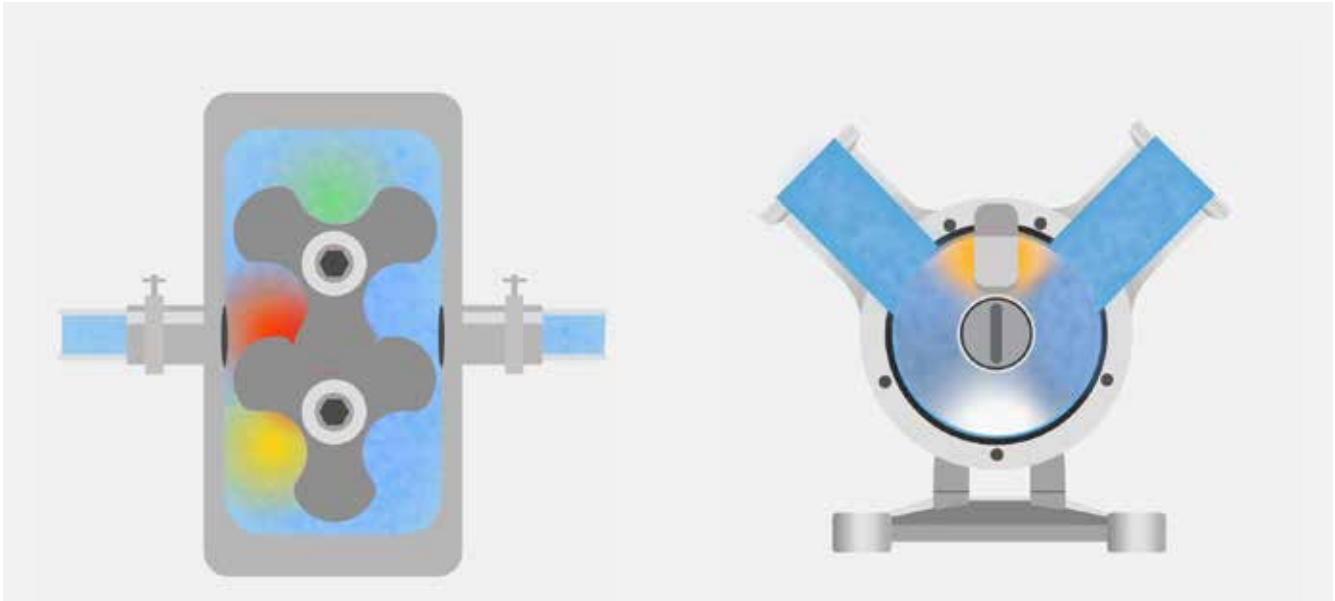

Fig 1. Image shows a typical pressure increase at entrapment areas in a rotary lobe pump compared to a sinusoidal pump. The higher pressure would cause damage to the product.

SYSTEM CONDITIONS – IS YOUR SYSTEM SET UP TO ACCOMMODATE THE PUMP?

Ultimately, the suitability of any pump type for specific applications requires an understanding of a complete system. To avoid unnecessary downtime and get the most from a production process, teams must work together to recognise limitations and potential problem areas.

As companies grow, for example, the immediate response to increasing production would be to introduce bigger pumps to get more from the production. However, if the complete system is not set up to accommodate higher flow rates, complications can arise.

One way of thinking about this, especially in pumping viscous products, is the a milkshake. Every milkshake is provided with a wide diameter straw to ease the movement of the thick fluid through the straws. If the straw was too thin, the pressure demands would be too high, and the vacuum capacity would reach its maximum, leaving no atmospheric pressure to move to fluid.

This same principle applies to a system. Suppose a pump is running at a higher capacity. In that case, the connecting pipe or hose work must be appropriately configured (both length and diameter) and installed to ensure pumping is not only possible but optimised.

At Watson-Marlow, our products are backed by expert teams who will work with you to configure and install equipment to get the most from your production. With hose and tubing technologies also highly engineered to work together with our pumping equipment, our portfolio brings significant benefits in terms of time and cost savings, including reduced maintenance and downtime.

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