Peristaltic Pumps

Sealless Positive Displacement Pumps for Challenging Fluids

By: Chris Pasquali, CEO Factory Direct Pipeline Products, Inc.

The peristaltic pump was patented in 1881 by Eugene Allen to be used for blood transfusions and, although modern industrial peristaltic pumps are much more efficient and compact than Mr. Allen's patented design, the basic principle of operation remains the same.

How Peristaltic Pumps Work

Rotary motion is transferred into a linear motion via rotating rollers or "shoes" against an elastomeric hose, pinching it sufficiently to move the contents of the hose in the direction of rotation.

The flow rate is somewhat proportional to the rotational speed with a key variable being the amount of hose compression. While laboratory size peristaltic pumps utilize non-reinforced tubing and completely "pinch" the tube to provide accurate dosing, industrial size peristaltic pumps are not typically operated in that fashion because the hoses are more rigid and would require replacement frequently if they were compressed completely.

Therefore, an industrial peristaltic pump always has some "slip", especially if the discharge pressure is higher and the fluid has a water-like viscosity. Thus higher viscosity fluids can be pumped at higher pressures than lower viscosity fluids when the hose isn't pinched closed 100%.

Peristaltic Pump Hose Design

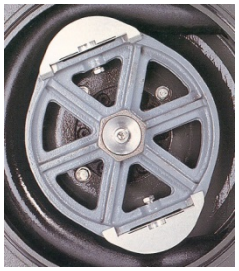
Hoses used for industrial peristaltic pumps are designed specifically for repeated compression and are not to be confused with "standard hoses". Some hoses consist of homogeneous extruded materials and others consist of several layers having reinforced fiber rings within those layers to provide increased rigidity to maintain the circular cross section when not compressed.

A peristaltic pump hose needs replacement when the dosed volume decreases to an unacceptable level, which is a reflection of the hose remaining somewhat elliptical shaped even when not being compressed. This "hose fatigue" can eventually result in cracking or delamination of the internal layer if it is a lined hose design. It is preferable to replace a hose before it completely fails, to prevent the process fluid from leaking into and potentially out of the pump.

It is a little known "industry secret" that most peristaltic pump manufacturers use the same few hose manufacturers and this is because the hose design is especially complex. The hoses we provide for our Vector series of peristaltic pumps will also work in Verderflex® and Watson-Marlow Bredel™ pumps.

Roller and Shoe Design

We offer both roller and shoe designs for hose compression. A roller design is slightly more gentle to the hose during compression as the rollers roll against the surface as the hose is compressed. A shoe design is simultaneously compressing and rubbing against the hose surface and therefore usually a lubricant is used with shoe designs to help extend hose life. The shoe design and addition of a lubricant to be contained within the pump body increases the complexity and cost for shoe style peristaltic pumps.



Shoe designs are capable of higher pressures and therefore the decision for which design is best for a given application is usually both pressure and application based.

Roller designs only require a light coating of silicon grease on the hose surface because the roller "rolls" across the hose surface. Therefore applications involving food and beverages might benefit from this design as the potential for cross contamination if a hose fails is less than shoe design pumps bathed in a lubrication oil – even if that oil is "food grade", it is still often preferable to go with a roller design.

If the pressures are not high, the roller design should provide longer hose life and overall be a more cost effective solution.

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Advantages of Peristaltic Pumps

The most recognizable advantage peristaltic pumps provide compared to other types of positive displacement pumps is that the hose is the only component exposed to the pumped fluid. It is therefore lacking mechanical seals and packing, aspects prone to wear and leakage for other pump designs.

Peristaltic pumps also do not have internal check valves to control the direction of flow and therefore can handle relatively large solids and fibrous (long) solids, which would cause havoc in pumps such as air operated diaphragm pumps that utilize ball-check valves to control the flow direction.

Since there are no moving, sliding or rotating components dependent upon the fluid being pumped for lubrication or cooling, peristaltic pumps can operate dry and are often used to "suck dry" tanks and totes.

Peristaltic pump hoses can be replaced with minimal effort – the design of a peristaltic pump is rather simplistic from a user's perspective, so it is easy to replace a hose and to know when a hose requires replacement. There are no other parts to replace!

Peristaltic Pump Applications

Building & Construction
Adhesives, dyes, glues, grout, iron oxide pigments, paints, plaster, pottery, tile

Ceramic & Glass
Clay slips, dyes, enamels, glazes, grinding water, grout, quartz paste, silicon

Chemical Processing
Abrasive mixes, acids, adhesive resins, caustic soda, detergent paste, latex, pigments, polyester mixes, polymers

Distilleries
Alcohol, spices, spirits

Electrical
Polyester slurries for insulating wire

Food & Beverage Processing
Bentonite and carbon slurries, butter, cake dough, cake frosting, caramel, chocolate, cream, egg yolks with whites, fats, flavorings, fruit juices, gelatins, ice cream, jams and preserves, milk, mustard, potato waste, syrups, tomato sauce, water and salt mixtures, yeast solution, yogurt

Marine
Sewage, wastewater, solid waste

Meat Processing
Acids, animal and waste blood, hair and bone mixtures

Medical, Pharmaceutical & Cosmetics
Face creams, latex, lotions, plasma, protein solutions, shampoo, vaccines, Vaseline

Mining, Tunneling & Quarrying
Coal, copper and platinum slurries

Photographic
Acids, diluents, thinners

Pulp & Paper
Abrasive, fibrous fluids, aluminum sulfate, boiler wastewater, caustic soda (lye), cold seal, dyes, hydrochloric acid, inks, pre-paint coatings, sulfuric acid

Tanneries
Acids, dyes, ferrous sulfate, waste fluids with solids

Textile Manufacturing
Acids, adhesives, bleach, dyes, sizing

Water & Wastewater Treatment
Acids, activated carbon, aluminum sulfate, caustic soda (lye), ferrous chloride, flocculants, foam inhibitors, lime slurries, solid waste

Proper Sizing of Peristaltic Pumps

The hose size (it's ID), the amount of compression and the frequency of compression will dictate the flow rate. Our sizing guidelines are to operate the pump near 30 RPM (the slower the better) and the resulting hose life should be 1,500 to 2,000 hours for fiber-braided hoses. (extruded hoses 700 to 1,000 hours). Since hose life is directly proportional to the amount and frequency of compression, utilizing a larger size peristaltic pump will enable you to operate at lower RPM's and requires less hose compression. The initial cost difference between two different size pumps might be quickly offset by longer hose life and less frequent hose replacements. If your pump will operate for >8 hours daily you should select a pump which operates close to 30 RPM. Likewise, if your pump is used for only a few hours daily/weekly, you can operate it at 60-90 RPM.

The pump shaft speed is achieved via a gearbox or gear-motor, because using a mechanical speed reduction with a standard 1800 RPM motor reduces the motor size (HP) required. Once a gearbox/motor is selected, the maximum shaft speed is fixed and you can use an optional VFD to further reduce the shaft speed if desired.

The amount of compression applied to the peristaltic hose is adjustable by installing shims under the roller or shoe mounts. The initial set-up procedure involves installing shims until the desired flow is achieved, thus compressing the hose minimally.

If you have peristaltic pumps, talk to us about your application and pump model and we will help ensure you are using the best hose design and at a competitive cost.

If you are using an air operated diaphragm pump and experience frequent check valve fouling or wish to reduce your compressed air consumption, contact us and we will review your application to see if a peristaltic pump would be a good alternative.

Our goal is to help you solve your application in the most cost effective and reliable manner possible, let our 25+ years of experience go to work for you today!

Chris Pasquali has been trained by Wanner Engineering, Inc., having provided sales and engineering support for them since 1991.