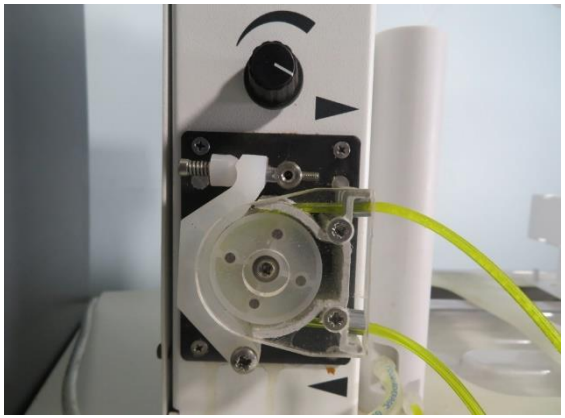
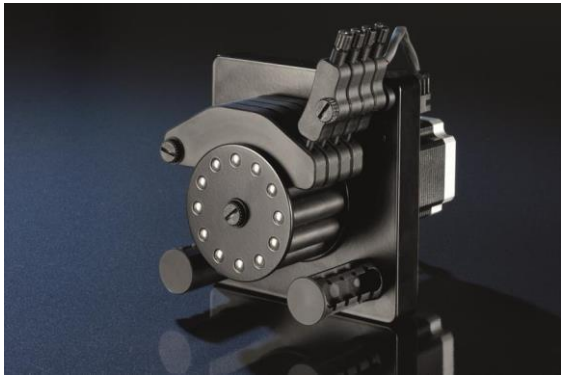
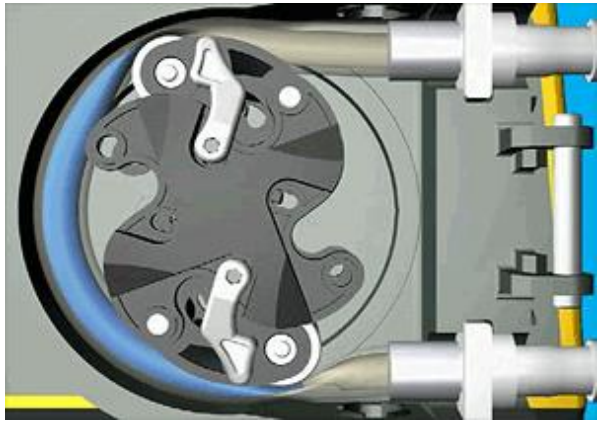
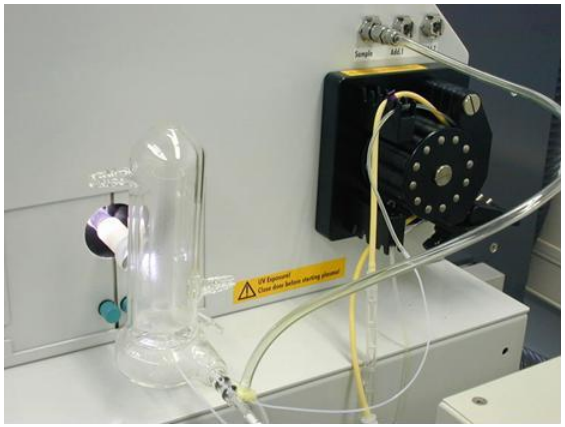
Instrumental Technique: Peristaltic Pump









Md Rabiul Islam

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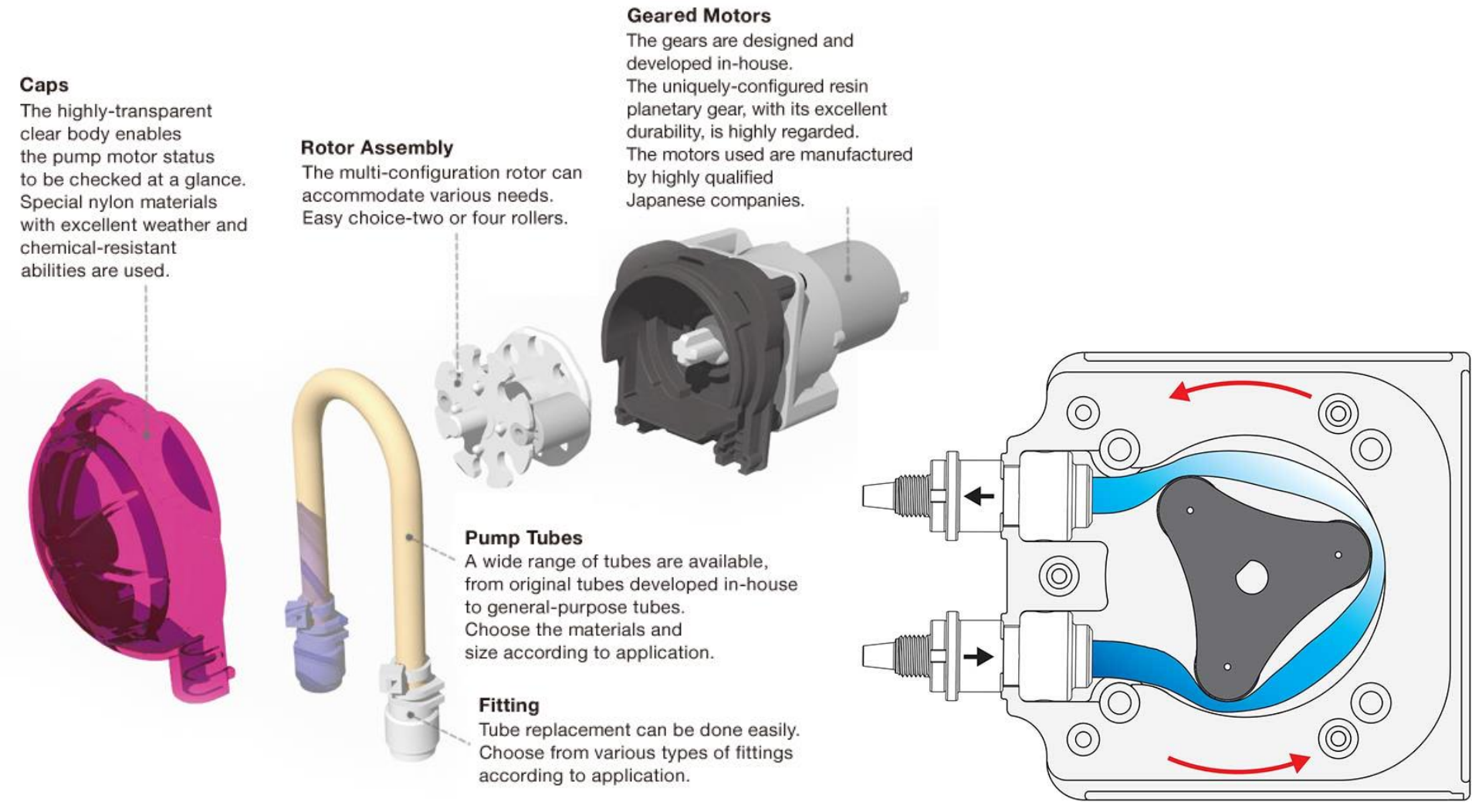
What is Peristaltic Pump?

A **peristaltic pump** is one kind of PD (positive displacement) pump mainly used to pump different types of liquids, and these pumps are commonly known as roller pumps. The actual pumping principle, called peristalsis, is based on alternating compression and relaxation of the hose or tube, drawing content in and propelling product away from the pump.

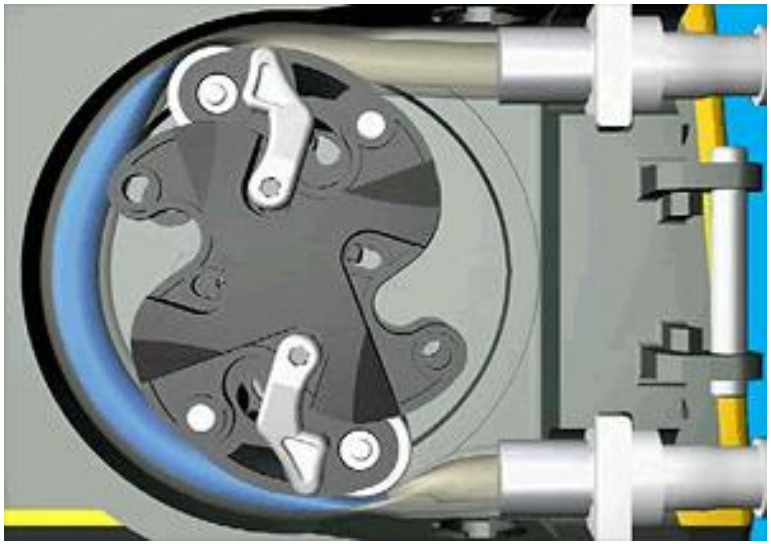


History:

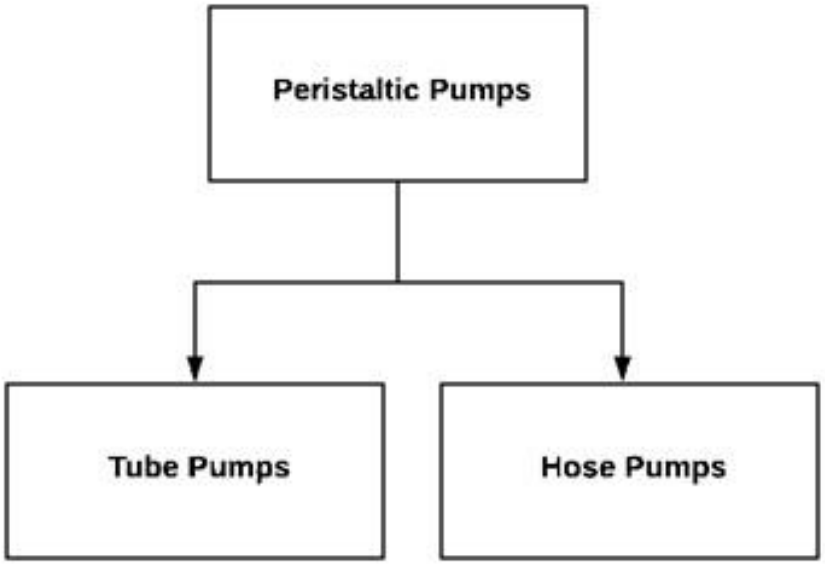
The peristaltic pump was first patented in the United States by **Rufus Porter and J.D. Bradley** in 1855 (U.S. Patent number 12753) as a well pump, and later by Eugene Allen in 1881 (U.S. Patent number 249285) for blood transfusions. It was developed by heart surgeon Dr. Michael DeBakey for blood transfusions while he was a medical student in 1932 and later used by him for cardiopulmonary bypass systems. A specialized nonocclusive roller pump (US Patent 5222880) using soft flat tubing was developed in 1992 for cardiopulmonary bypass systems. The first technically and commercially viable peristaltic pump for use outside the laboratory was developed by Bernard Refson, an inventor who went on to establish Watson-Marlow Fluid Technology Group, a peristaltic pump manufacturer.

Working principle of a peristaltic pump:

A rotating shoe or roller passes along the length of the hose or tube creating a temporary seal between the suction and discharge sides of the pump. As the pump's rotor turns this sealing pressure moves along the tube or hose forcing product to move away from the pump and into the discharge line. Where the pressure has been released the hose or tube recovers creating a vacuum, which draws the product into the suction side of the pump, the priming mechanism.
Combining these suction and discharge principles results in a powerful self-priming positive displacement action.



Type of peristaltic pumps:



- Lower pressure peristaltic pumps typically have dry casings and use rollers along with non-reinforced, extruded tubing..This class of pump is sometimes called a "tube pump" or "tubing pump“. Typically pressure of the pump can maintain up to **5 bar.** Tube pumps are ideal for low supply rates, and these are completely programmable with the choice of numerous heads.
- Higher pressure peristaltic hose pumps which can typically operate against up to **16 bar** in continuous service. The hose pumps are ideal for supplying extremely hard content. Reinforced tubes called ‘hoses’ are used and hence the name ‘hose pump’.

Different type of tubing use in peristaltic pump:

The tubing needs to be elastomeric to maintain the circular cross section after millions of cycles of squeezing in the pump. These pumps can be designed with different kinds of tubing materials. These materials oppose from chemicals as well as high pressures. There are different kinds of tubing materials which include **PVC** (Polyvinyl chloride), Fluoropolymer, and **Silicone rubber**. Poly-tetra-fluoro-ethylene(**PTFE**) is a material that can withstand may known industrial chemicals

This requirement eliminates a variety of non-elastomeric polymers that have compatibility with a wide range of chemicals, such as PTFE, polyolefins, PVDF, etc. from consideration as material for pump tubing. The popular elastomers for pump tubing are nitrile (NBR), Hypalon, Viton, **silicone**, **PVC**, EPDM, EPDM+ polypropylene (as in Santoprene), polyurethane and **natural rubber**. Of these materials, natural rubber has the best fatigue resistance, and EPDM and Hypalon have the best chemical compatibility. Silicone is popular with water-based fluids, such as in bio-pharma industry, but have limited range of chemical compatibility in other industries.

Extruded **fluoropolymer** tubes such as FKM (Viton, Fluorel, etc.) have good compatibility with acids, hydrocarbons, and petroleum fuels, but have insufficient fatigue resistance to achieve an effective tube life.There are a couple of newer tubing developments that offer a broad chemical compatibility using lined tubing and fluoroelastomers.

TUBE SELECTION FACTORS

Peristaltic pump is increasing in popularity because of its contamination free fluid transfer . Each application has its own type of tube material. So when designing, tube material selection, is an important factor. The factors are

1) Chemical compatibility
2) Pressure
3) Temperature
4) Dimension
5) Tolerance
6) Life expectancy
7) Gas permeability
8) Transparency
9) Regulatory approval
10) Cost

Applications

- **Medicine**
  - Dialysis machines
  - Open-heart bypass pump machines
  - Medical infusion pumps
- **Testing and research**
  - AutoAnalyzer
  - Analytical chemistry experiments
  - Carbon monoxide monitors
  - Media dispensers
- **Agriculture**
  - 'Sapsucker' pumps to extract maple tree sap
- **Food manufacturing and sales**
  - Liquid food fountains (ex. cheese sauce for nachos)
  - Beverage dispensing
  - Food-service Washing Machine fluid pump
- **Chemical handling**
  - Printing, paint and pigments
  - Pharmaceutical production
  - Dosing systems for dishwasher and laundry chemicals
- **Engineering and manufacturing**
  - Concrete pump
  - Pulp and paper plants
  - Minimum quantity lubrication
  - Inkjet printers
- **Water and Waste**
  - Chemical treatment in water purification plant
  - Sewage sludge
  - Aquariums, particularly calcium reactors

Advantages

The advantages of Peristaltic Pumps include the following.

•**No contamination** due to the single element of the pump to get in touch with the liquid being pushed is the center of the tube, and it is simple to purify the inside of the pump.

•It requires **less protection, and low cost to maintain** due to their lack of valves glands & seals..

•The designing of the pump stops backflow without valves.

•These pumps have different control methods like knob control, foot pedal, touch screen control, etc.

•They are **able to handle slurries, viscous, shear-sensitive and aggressive fluids**.

•Pump design prevents backflow and siphoning without valves..

Disadvantages

The disadvantages of Peristaltic Pumps include the following

•The tubes which are flexible will be **apt to degrade by time & need periodic substitute**.

•The liquid flow will be pulsed, mostly at **small rotational rates**. So, these types of pumps are not much suitable wherever a level reliable flow can be necessary. Another kind of PD (positive displacement) pump must be considered.

Thank you

TUBING MATERIALS

There are several material now available
for tubing they are

1. MARPRENE

Marprene is a thermoplastic material. It is an exclusive product made by the Watson-Marlow Bredel's tube manufacturing company. Its features are

- wide chemical compatibility, resistant to oxidizing agents like ozone compounds.
- Opaque to visible and ultra-violet rays
- Has low permeability to gases like oxygen , carbon dioxide and nitrogen

Marprene is mostly used.

2. BIOPRENE

- Bioprene offer similar benefits as marprene
- Bioprene has longer life span
- It can handle fluid temperatures upto 80 degrees
- Bioprene can be sterilized with ethylene oxide or gamma irradiations.

3) SILICONE

- Is the widely used laboratory tubing.
- Mainly used for small tubing bore (upto 9.6mm).
- Platinum-curing is provided to prevent contamination to the fluid.
- This material is used in medical devices, chemical analysis etc.

4) NEOPRENE

- Useful for abrasive slurries
- Sustained pressure applications
- bore sizes above 12.6mm
- As neoprene has a greater permeability,