Pump Options: What, When and Where

ADS TECHNICAL COMMITTEE MEETING

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Overview

- The intent of this project is to create a brief overview of the different pump types and their applicability to the common processes typical in a salad dressing, sauce and mayonnaise plant on the finished product side. Pumps used for Ingredient feeds are a separate discussion.
- This is not a hard and fast guideline for or meant to be an engineering resource but was created with the R&D, QA and Microbiologist in mind so as products are scaled to the plant and possible challenges are discovered, basic information is provided here that could help find a root cause or a possible solution.
- It is always suggested that you contact your pump supplier for deeper technical information and resources and work with your engineering team to find solutions to issues.

Scope

- Though there are other pump types, the committee selected and reviewed what is deemed the (9) most popular types typically found on the process side of dressing, sauce and Mayonnaise plants.
- **Even within each pump type, there are differences by brand so each manufacturers information should be checked for your given situation.**
- This guideline is not intended to compare brands and the data is generalization with applicability in some cases subjective.

Possible Impact on emulsions

There are many factors besides what physically happens in a pump that can impact an emulsion. These include line pressures, flow velocity, distance pumped, piping temperature, number of elbows, piping diameter changes, partial line "restrictions" as well as abuse from wear on a pump that has not been properly maintained. On a scale from low to high with high being the most impact, we would offer the following:

Centrifugal	Positive Rotary Lobe	External Circumferential piston	Twin Screw	Reciprocating piston pump	Peristaltic (Hose / tubing)	Progressive cavity / Single Screw	Sinusoidal	Diaphragm
High	Low	Low	Low	High	Low	Low	Low	High

Possible Impact on particulates

There are many factors besides what physically happens in a pump that can impact particulates suspended in a base liquid or semi-solid. Typically, here we refer to particulate such as blue cheese crumbles in a base, pickle relish in tartar, leafy herbs etc. Impacts on these particulates include turbulence / turbidity, flow velocity, distance pumped, number of elbows, piping diameter changes, partial line "restrictions" as well as abuse from wear on a pump that has not been properly maintained. On a scale from low to high with high being the most impact, we would offer the following:

Centrifugal	Positive Rotary Lobe	External Circumferential piston	Twin Screw	Reciprocating piston pump	Peristaltic (Hose / tubing)	Progressive cavity / Single Screw	Sinusoidal	Diaphragm
High	Low	Low	Low	High	Med	Med	Low	High

Flow Rate Range

- All of the described pumps have models that will easily handle flow rates of 0-200 GPM and beyond. Care should be taken to insure that a pump is sized correctly and not a smaller pump being run at over speed to handle higher flows or a larger pump being run at low speed as these could impact product quality. Consult a knowledgeable pump distributor or the manufacturer for applicability.

Applicability for various finished products

	Centrifugal	Positive Rotary Lobe	External Circumferential piston	Twin Screw	Reciprocating piston pump	Peristaltic (Hose / tubing)	Progressive cavity / Single Screw	Sinusoidal	Diaphragm
Separating dressings (<500 CPS)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Emulsified dressings (<3500 CPS)	No*	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes but **
FF Mayo premill (<120,000 CPS)	No*	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No**
FF Mayo Post Mill (>140,000 CPS)	No*	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No**
whipped dressing (>140,000 CPS)	No*	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No**

*Not rated for high viscosity

** Pulsation could damage emulsion as well as particulate

Cleanability

Always Consult pump suppliers and internal sanitarians for suggested procedures, chemicals and minimum flowrates required for pumps to clean properly

	Centrifugal	Positive Rotary Lobe	External Circumferential piston	Twin Screw	Reciprocating piston pump	Peristaltic (Hose / tubing)	Progressive cavity / Single Screw	Sinusoidal	Diaphragm
CIP'able without disassembly for emulsified products without leafy	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	No
CIP'able without disassembly for emulsified products with leafy	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	No
Requires disassembly for cleaning	No	No	No	No	Yes	No	No	No	Yes

Ability to self prime

As viscosities increase and gravity alone cannot prime your pump, “self priming describes the pumps ability to create suction to draw product to it and pump forward.

Centrifugal	Positive Rotary Lobe	External Circumferential piston	Twin Screw	Reciprocating piston pump	Peristaltic (Hose / tubing)	Progressive cavity / Single Screw	Sinusoidal	Diaphragm
Minimal	Minimal	Moderate	Higher	Moderate	Higher	Minimal	Minimal	Higher

Normal allowable maximum product temperatures

Consideration should always be given to product temperatures relative to downstream impacts. Allowable product max temperatures related to the pumps can vary by manufacturer so it is always best to contact the manufacturer for guidance. Below is a basic guideline for standard pumps. Options are available such as different mechanical seals or other components which will allow some pumps to be used at higher temperatures.

Centrifugal	Positive Rotary Lobe	External Circumferential piston	Twin Screw	Reciprocating piston pump	Peristaltic (Hose / tubing)	Progressive cavity / Single Screw	Sinusoidal	Diaphragm
UP TO 250°F	UP TO 200°F WITH STANDARD CLEARANCE ROTORS; UP TO 300°F WITH HOT CLEARANCE ROTORS	UP TO 200°F WITH STANDARD CLEARANCE ROTORS; UP TO 300°F WITH HOT CLEARANCE ROTORS	UP TO 425°F	UP TO 450°F	UP TO 176°F	UP TO 250°F	UP TO 213°F	UP TO 250°F

Typical maximum allowed backpressure

Back Pressure is dictated by the flow rate, product viscosity, pipe dia, piping run length and other factors as fluids are pumped through the discharge line. As BP increases, depending on the pump type, flow rate can slow and in some cases cause damage to the pump or other equipment in the line. The following table is created to illustrate what standard maximum line pressures are allowed in each pump type. Note that line pressure can never exceed ratings for the piping, hoses, other components, or connections within the pumped line which many times have ratings less than the pump itself.

Centrifugal	Positive Rotary Lobe	External Circumferential piston	Twin Screw	Reciprocating piston pump	Peristaltic (Hose / tubing)	Progressive cavity / Single Screw	Sinusoidal	Diaphragm
150 PSI	290 PSI	450 PSI	500 PSI	25,000 PSI	232 PSI	200 PSI	217 PSI	125 PSI

Video's that explain "How they work"

Short video's are easily accessible on the internet either on the Manufacturers website or on YouTube. Here are some links to short as generic as we could examples.

Centrifugal pumps https://www.youtube.com/watch?v=lmjlQqo8mX4

Rotary Lobe Positive pumps https://www.youtube.com/watch?v=wJmYEh7jBqI

Ext. Circumferential piston pumps https://www.youtube.com/watch?v=bmDv6J-HfJA

Twin Screw Pumps https://www.youtube.com/watch?v=dIT-45msZzQ

Peristaltic Hose Pump https://www.youtube.com/watch?v=Lhy9xJqDkqg

Progressive cavity Pump https://www.youtube.com/watch?v=SYfEOloKr6o

Sinusoidal Pump https://www.watson-marlow.com/us-en/support/how-it-works/

Diaphragm Pump https://www.youtube.com/watch?v=Y6To-bgL4GE

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Ampco Pumps - Michael Boyd - MBoyd@ampcopumps.com

AxiFlow Technologies - Joby Ferary - JFerary@AxiflowTechnologies.com

SPX Flow Technology - Jeff Sporer - jeffrey.sporer@spxflow.com

Watson-Marlow Fluid Technology Group - Ricky Bortz- Ricky.Bortz@wmftg.com

Leslie Drew (Ingredion) Mike Parsey, (Shambaugh & Sons)

Eric Esterline (Bay Valley Foods) Jim Patacchiola, (Brooks Bottling)

Nancy Hulse (Golden State Foods) Ben Rucker, (CRB)

Wanda Jurlina (CP Kelco) Bill Scott (Scott Turbon Mixer)

Pete Leitner (Admix) Yipping Su (Ken's Foods)

Colm Swan (Socius Ingredients)