Pump Technologies and Applications

Marty Davidson, BL Anderson Company
Agenda

• Centrifugal Pumps
  • Pump Curves
  • Applications

• Positive Displacement Pumps
  • Pump Curve
  • Types
  • Applications
Centrifugal Pumps

- Centrifugal pumps are dynamic (kinetic) pumps
- The impeller shape and rotational motion imparts centrifugal force on fluid particles
- This force is converted to pressure as the fluid is pushed against the pump casing
- There are several considerations that must be taken into account when sizing a centrifugal pump for a given application

Radial Flow Centrifugal Pump
Now The Fun Part!

Theory & Pump Curves!
Static Head (SH or StH)

- Head is measured in **feet of liquid**
Total Dynamic Head (TDH)

- In fluid dynamics, **Total Dynamic Head** (TDH) is the **total** equivalent height that a fluid is to be pumped, taking into account friction losses in the pipe.
- TDH = Static Height + Static Lift + Friction Loss.

- TDH Calculation:
  - Static Head (StH) = 20m
  - Friction Loss = 8.6m
  - Total = 28.6m
Centrifugal Pump Curves

When looking at pump curves, we look at **FLOW** (x-axis) and **TDH** (y-axis)

- **FLOW** = GPM
- **TDH** = FEET

- Where will the pump operate?
- Where it reaches a **balance** with the **piping system**
The Piping System

- Factors that need to be taken into consideration:
  - How far? The longer the pipe run, the greater the resistance
  - How high? Elevation difference is the static head
  - Through what size and type of pipe? Each of these creates friction
  - How many valves, bends, and turns?
How the Piping System Effects the Curve

Effect of Pipe Length

Effect of Pipe Roughness

Effect of Pipe Diameter
The System Curve

• We can show the resistance of a piping system with a System Curve
• The pump(s) will run at the intersection of the pump and system curve
• The system curve matters
Best Efficiency Point (BEP)

- The pump is happiest at its **Best Efficiency Point**
- However, pump selections **always involve trade-offs**
  - Solids handling size
  - Speed
  - Cost

Balance with piping system
Allowable Operating Range (AOR)

- Industry standard is 50% to 125% of BEP flow rate at any operating speed

- Continuously left of AOR can cause:
  - Low efficiency
  - Higher bending forces
  - Vibration
  - Clogging
  - Temperature rise
Allowable Operating Range (AOR)

- Continuously right of AOR can cause:
  - Increased power demand
  - Cavitation
  - Higher bending forces
Net Positive Suction Head (NPSH) Curve

- NPSHA (Available) is the absolute pressure at the suction port of the pump.
- NPSHR (Required) is the minimum pressure required at the suction port of the pump to keep the pump from cavitating.
Net Positive Suction Head (NPSH) Curve

- What helps the NPSH Curve?
- Atmospheric pressure 14.7 psia (at sea level)
- Suction head
Net Positive Suction Head (NPSH) Curve

- What hurts the NPSH Curve?
- Low suction head
- Hot liquids
Let’s Look at Some Real Pump Selections

- Sometimes the application flow and head results in a great or at least good fit
- Other times, not so much
A Good Example Including VFDs

This application uses the exact same pump, impeller, and motor for (4) different applications inside the same plant.

NP 3127 HT 3~ Adaptive 489

On req. 60 Hz | 7.5 hp | 460 V | @ 0.00 USD

Sludge pit pump balance with piping system at 60 Hz
A Good Example Including VFDs

Digester pump balance with piping system at 58 Hz

NP 3127 HT 3~ Adaptive 489

On req. 60 Hz | 7.5 hp | 460 V | 0.00 USD

Diagram View
Selected curve: 58 Hz
Duty Point: Digester

BEP
Plant drain pump station balance with piping system at 42 Hz

NP 3127 HT 3 ~ Adaptive 489

On req.
60 Hz | 7.5 hp | 460 V | $0.00 USD

DIAGRAM VIEW
- Selected curve
- 42 Hz

DUTY POINT
- PDPS

BEP
A Good Example Including VFDs

EQ pump balance with piping system at 42 Hz

NP 3127 HT 3~ Adaptive 489
On req.
60 Hz | 7.5 hp | 460 V | $0.00 USD

Diagram View
Selected curve: 38 Hz
Duty Point: EQ

BEP

Flow: 507 US g.p.m.
Head: 34.0 ft
A Challenging Example; Requested Flow Range Too Great

- BEP is 780 gpm
- AOR is therefore 390 – 975 gpm
- Duty points; 175 gpm/6.8 TDH, 347 gpm/10.7 TDH, 694 gpm/25.7 TDH

**Diagram:**
- BEP
- Duty Points
- AOR

**NX 3127 LT 3~ Adaptive 426**
- On req.
- 60 Hz | 8.5 hp | 460 V | $0.00 USD
Positive Displacement Pump Curves

- A **positive displacement pump** makes a fluid move by trapping a fixed amount and forcing (displacing) that trapped volume into the discharge pipe.
- The curve shown here is a peristaltic hose pump curve.

How to use the curves:
1. Flow required indicates pump speed
2. Calculated discharge pressure
3. Net motor power required
4. Product temperature
5. Calculated discharge pressure
6. Maximum recommended pump speed

![Diagram of pump curves](image-url)
Had Enough Theory and Curves?

ME TOO!
Centrifugal Pumps

- Submersible Pumps
- Submersible Dry Pit Submersible Pumps
- Centrifugal Screw Pumps
Centrifugal Pumps

- Split Case Pumps

- Turbine and Propeller Pumps
Centrifugal Pumps

- Solids Handling Pumps
Centrifugal Submersible Pump Common Applications

- Submersible Pump Stations

- Dry-Pit Pump Stations
Turbine & Prop Pump – Common Applications

- WTP Filter Backwash
- High/Low Service Pumps, Water Distribution
Solids Handling Pump – Common Applications

RAS/WAS Pumping

Sludge Transfer
Positive Displacement Pumps

- Positive displacement pumps are those in which energy is imparted to the liquid in a fixed displacement volume.
- Such as a casing or a cylinder, by the rotary motion of gears, screws lobes, reciprocating pistons or plungers, or by repeated occlusion (pinching closed) and restitution (relaxing open) of a hose or tube.
Hose Pumps

- Shoe (Hose Pumps)
- Slides Over Hose
- Shallow Angle Of Occlusion Allows For Higher Pressure Capability
- Lubricant Bath Eliminates Friction & Wear on Hose O.D.

Click Pump for Video
Progressive Cavity Pumps

- Typical Components

**AFTERMARKET PUMP PARTS**
- Rotors • Stators • Drive Shafts
- Conn Rod Kits • Bearing Kits
- Packing Sets • Lip Seals
- Complete Pumps

**L-FRAME & MORE!**

Click Pump for Video
Rotary Lobe Pumps

• Typical Components

Click Pump for Video
Positive Displacement Pump – Common Applications

- Water/Wastewater Sludge Transfer
- RAS/WAS Pumping
- Chemical Feed
- Mechanical Dewatering Equipment Feed
- And more …..

Sludge Transfer

Sodium Hypo Feed
Peristaltic Tube Pumps

- Used for Chemical Feed
Peristaltic Pump Benefits

- Only one wearing part, the tube or hose
- Very Inexpensive Compared to Other PD Pumps
- No Rotors, stators, universal joints, lobes, gears, seals, etc. to replace
- Accuracy to +/- 0.1%
- Can Run Dry Indefinitely
- True “Dry” Self Priming to 30 Feet
- Reversible
- 100% Volumetric Efficiency
Any Questions?
Thank You!