OVERVIEW OF THE PUMP SYSTEM TRAINING SESSION

The approach and goals of this session

The designer of this course wanted to address questions that people have about the operation of pump systems. Specifically how centrifugal pumps work and how fluids react to pressure and movement in a system. Suppose you have a problem with a pump and the pump vendor says: “Your pump has insufficient head for the flow rate that you require.” There will probably be a pause while you consider this statement, if you do not understand this, you will not be able to fully participate in discussions on how to modify the pump or the system, you are at his mercy.

The following are situations or events that many of us may have experienced, they are representative of the topics that are addressed in this session.

Pump terminology can be quite obscure, this is one of the reasons why we often let pump manufacturers or consultants select a pump for our application. For example, what is N.P.S.H.? Does the system in which the pump will be installed provide enough of it and how does it affect the pump. What is head? Is it similar to pressure or is it something entirely different. What is the process by which one calculates the head required of the pump ensuring that you have the required flow rate though your system and an optimal pump selection? If you cannot answer or discuss these questions, you will be entirely dependant on the pump vendor and the consultant. We will change this situation.

The pressure in a pump system varies considerably from one end to other, this is a normal. For example, fluid pressure varies with elevation, the fluid that is transferred to a higher elevation looses pressure because part of the pressure in a fluid is due to its weight and the higher up you go in a system the less fluid weight there is at the high point. Therefore the high points of systems will have low pressure compared to the pressure at the outlet of the pump.

Have you ever heard this statement: “There is insufficient pressure at the outlet of this pipe, there must be something wrong with the pump.” This is a highly misleading statement. If the pipe is open to atmosphere, as is often the case, there is no pressure at the outlet of the pipe since there is no containment of the fluid. The only pressure at the outlet is the atmospheric pressure in the

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environment. Usually what a person means is that there is insufficient flow at the outlet of the pipe, something can be done about that!

How can the atmospheric pressure affect your pump? Atmospheric pressure varies with elevation. If your plant is located at an altitude less than a 1000 feet as compared to sea level, you have the maximum atmospheric pressure available which corresponds to 14.7 psia. Luckily many plants are situated at these elevations where the level of atmospheric pressure is maximum. Other places are not so fortunate, for example Mexico City is at 8000 feet in altitude and the atmospheric pressure is 11.4 psia. Johannesburg in South Africa which is at 5000 altitude has a pressure of 12.2 psia. In these regions, one must be careful, why? The atmospheric pressure pushes on the top of the fluid surface of the suction tank, this pressure contributes to the level of pressure at the pump suction. The pump requires a minimum amount of pressure at the suction (called NPSH required) in order to work properly for a given flow rate. When the pressure is insufficient the CAVITATION phenomenon can start which produces severe damage by erosion to the impeller, lower capacity and excessive vibration.

More topics that are covered in this session:

- What types of centrifugal pumps are available in industry and what are they used for?
- How centrifugal pumps affected by fluid viscosity and density?
- How do you measure the performance of a pump and compare it to its characteristic curve?
- Can a centrifugal pump lift fluid up from below its centerline?
- Is it possible to have low pressure or pressure that is below atmospheric pressure in a pump system?
- Where are low pressures areas normally located in a system and what are the implications?
- What is cavitation and how can it be avoided?
- How can you avoid the formation of vortexes and therefore air entrainment at the inlet of a pump
- What is the effect of control valves and variable speed drives on a pump system?
- When does a recirculation valve need to be used?
- Why is it best to increase the impeller diameter of a pump when more flow is needed and to decrease it when less is required?
- …and others

Learn how to recognize and solve these problems

Presence of air at the pump inlet due to :

- air entrainment
- cracks in the suction piping
- insufficient submersion
- poorly sized suction piping

Presence of air at the pump discharge due to :

- air pockets
- cracks in the discharge piping

Excessive vibrations due to :

- cavitation
- flow demand too low
- flow demand too high for pump

NPSH available is too low or the pressure is insufficient at the pump inlet

The role of high fluid temperature reducing the NPSH available and producing cavitation

Insufficient flow from pumps that are installed in parallel

Insufficient pressure at the last pump for pumps installed in series

Flow rate and head insufficient due to a small impeller diameter or motor with the incorrect rotational speed

Insufficient flow due to a higher than expected fluid viscosity due to :

- inadequate fluid temperature
- inadequate dilution

The effect of a motor with an inadequate horsepower capacity, insufficient speed or incorrect direction of rotation

The effect of a motor with an insufficient power capacity due to a change in the density of the fluid

Effects of blockages associated with jammed manual valves, plugged equipment or fittings and piping.

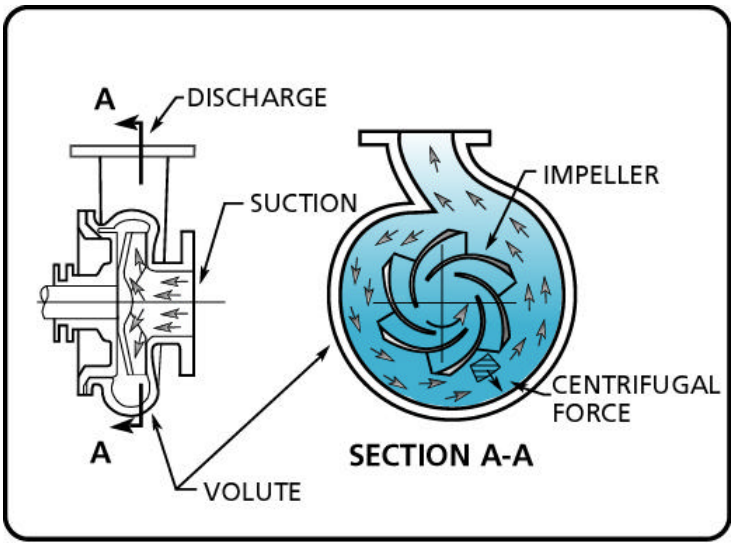
Siphon effect causing the reverse rotation of a pump due to:

- reverse flow
- lack of a check valve

How is this course different from other similar technical training sessions

Visualizing fluid movement and using centrifugal pumps

The author has been very attentive in making the presentation visually effective. More than a hundred color images have been specifically created to help you understand. These images as well as the accompanying explanations are all available in a practical sturdy book.



Typical presentation image.

Demonstrating principles

When you really want someone to understand and remember an important principle, you SHOW THEM. A miniature pump system and other devices have been specifically designed for this purpose. Those concepts that are sometimes hard to understand are now inescapably shown to you in real life. This knowledge will reinforce your retention of the theory of fluid movement and how pumps affect fluids.


Miniature pump system.

A memorable experience helps retain information

Operating on the theory that people who have fun learn easier and retain the information longer, the author has designed a game that reviews the subject matter. You compete one against the other and get to answer questions to advance all your men to the FINISH LINE and become the local PUMP EXPERT.

Pump system board game used for training purposes…WARNING: could be fun.