GRUNDFOS ECADEMY

BASIC HYDRAULICS AND PUMP PERFORMANCE

CAVITATION AND ITS EFFECTS ON PUMPS

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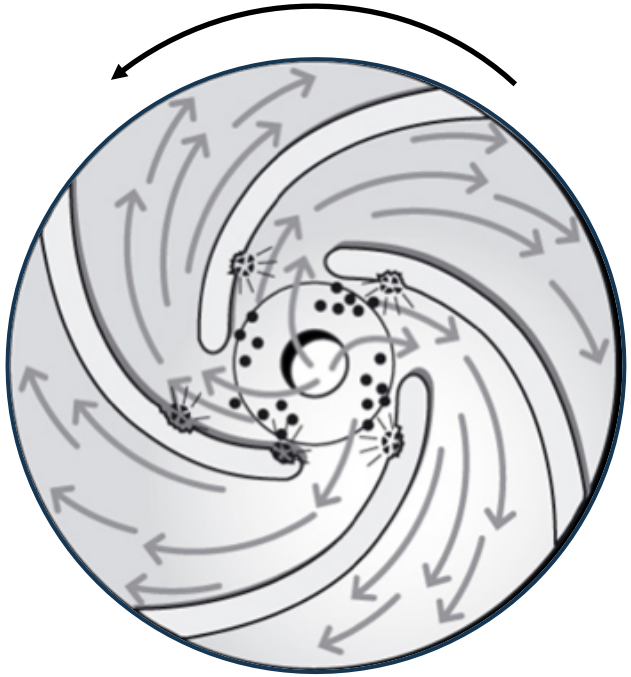
Cavitation: Definition

Cavitation in a pump is the collapse of vapour bubbles in areas where the pressure locally drops to the fluid vapour pressure. The extent of cavitation depends on how low the pressure is in the pump.

Cavitation first occurs at the point in the pump where the pressure is lowest, which is most often at the blade edge at the impeller inlet, see figure.

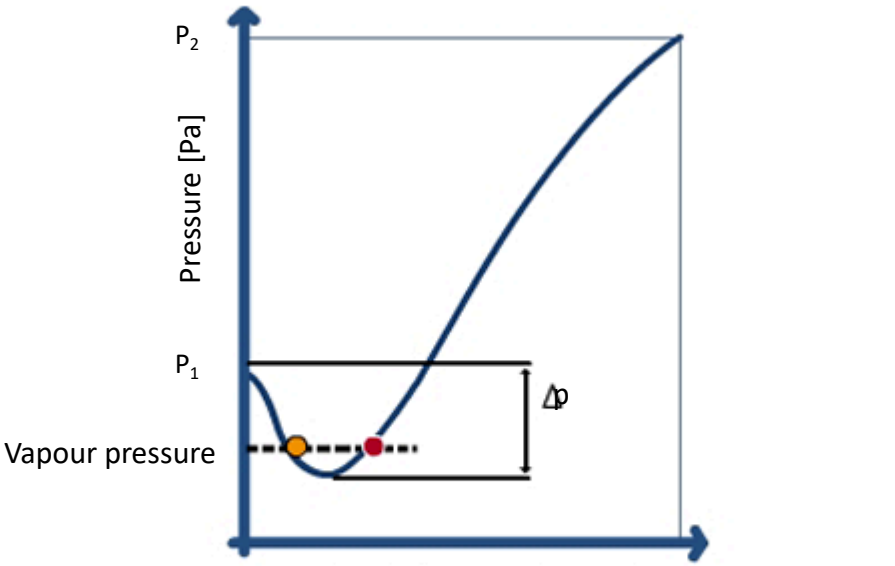
Cavitation is an important issue that must be addressed when working with pumps. It causes noise and vibration and depending on the severity can destroy the pump.



Causes of cavitation

Water boils at 100°C at 1bar atmospheric pressure. Water can boil at ambient temperate as a result of a localised pressure drop within the pump.

The water pressure starts to drop at the impeller inlet and increases as it moves towards the impeller outlet. If the water pressure is low enough it will create vapour bubbles that will collapse when the pressure increases. This implosion of the bubbles is called cavitation and due to the water change of phase releases enormous amount of energy that eventually damages the impeller.

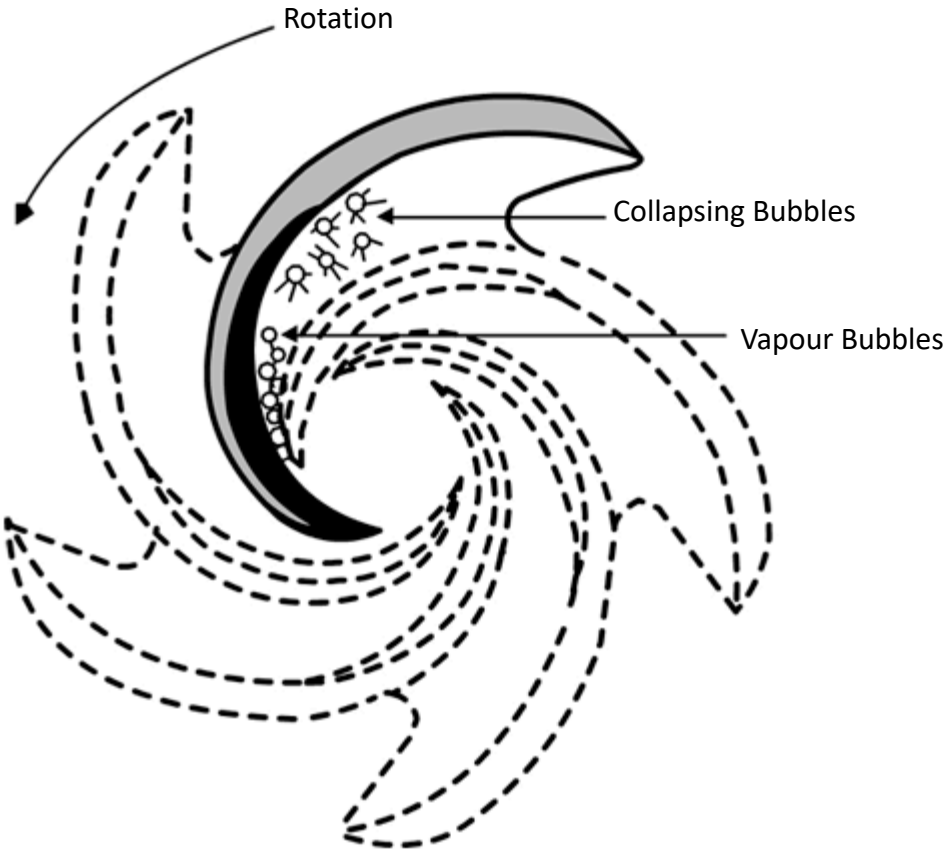


Effects of cavitation on pumps

Cavitation can be heard as loud noise and vibration.

The vapour bubbles in the water implode causing the noise. This is followed by a heavy mechanical impact.

Cavitation causes pitting of the impeller and pump housing.



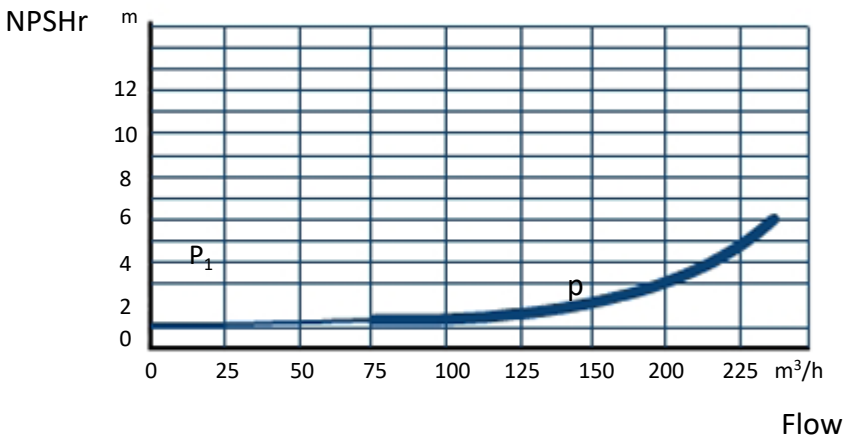
Avoiding cavitation

To avoid cavitation, you must first understand Net Positive Suction Head (NPSH).

NPSH is an expression of how close the fluid is to vapourisation. The pump manufacturer provides a NPSH requirement. The following is a practical example for estimating the minimum suction pressure pressure at the pump to avoid cavitation:
At 30°C, water vapour is only 0.43 m.

Assuming that friction loss is 1 m, by pumping 200 m^3/h with the pump curve placed at the right, the NPSH required by the pump manufacturer is 3 m. Therefore, the minimum inlet pressure to avoid cavitation should be:
3 + 1 + 0.43 = 4.43 m.

Good practice is to add a safety factor of 0.5 m. For this example, cavitation is avoided if the pump suction pressure during operation is always above 5 m.

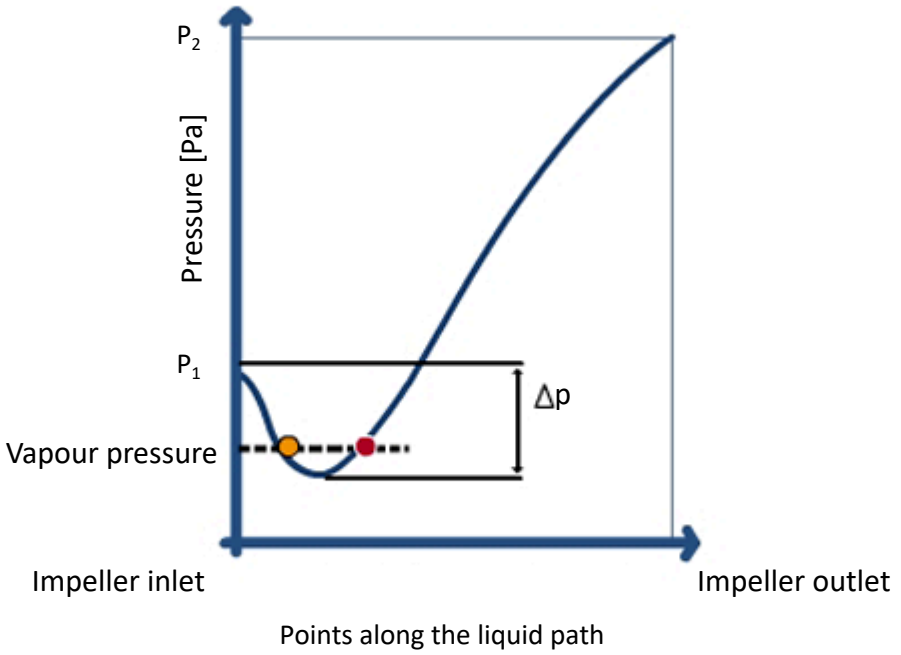


The NPSH curve requirement from the pump manufacturer

Avoiding cavitation (continued)

The practical approaches to avoid cavitation are as follows:

- Lower the pump inlet and increase the inlet pressure.
- Reduce friction loss in the suction pipe.
- Reduce the flow of the pump.
- Increase the elevation of the suction water level.
- If cavitation still occurs, choose another pump with a lower NPSH requirement.



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