Design Problem 2 – Hydraulics & Pump Characteristics

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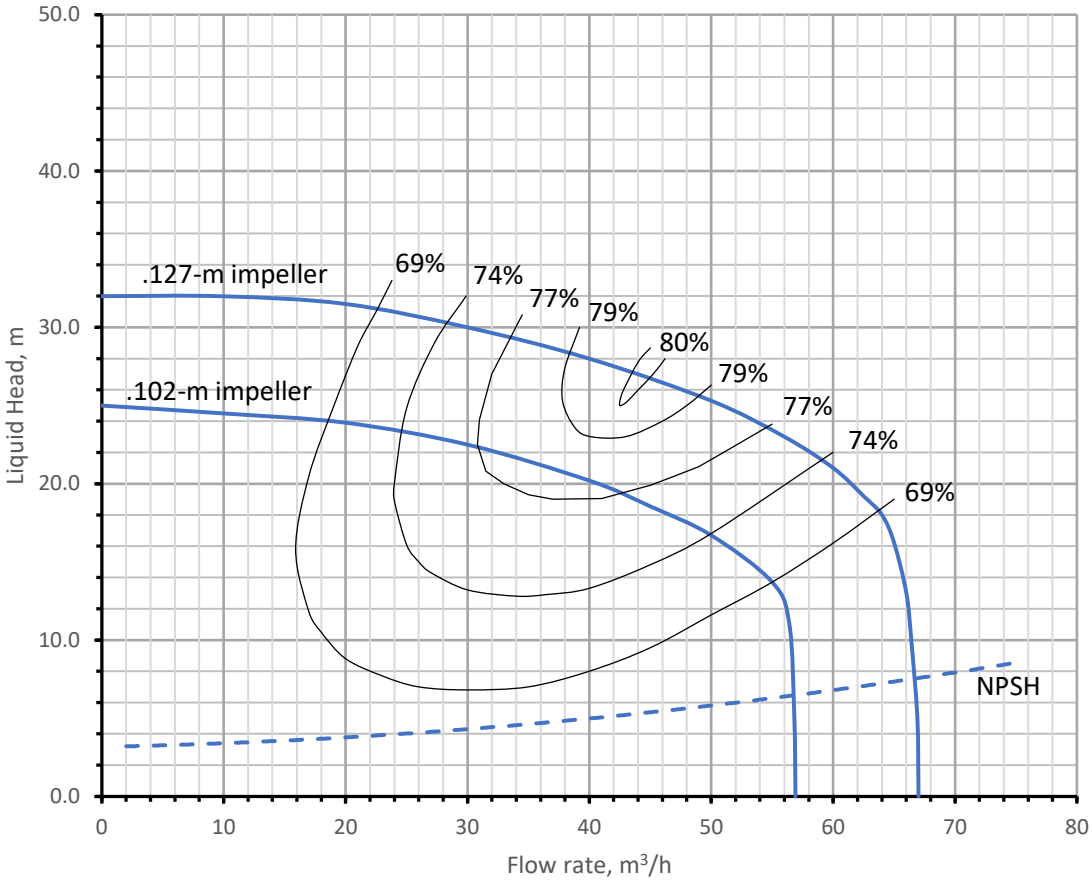
Objective

The objective is to determine the operating point for a pump-pipe system using the pump characteristic curve, and to implement the solution in CHEMCAD. This exercise accompanies the pump video by Jacques Chaurette.

Problem Statement, Part 1

A process liquid is pumped from a storage tank to a distillation column using a centrifugal pump. The pump characteristic curve is shown below. The pipeline is 100 m long and is 80 mm-internal-diameter commercial carbon steel pipe. Miscellaneous losses from fittings and valves are equivalent to 600 pipe diameters. The storage tank operates at atmospheric pressure and the column at 1.7 bara. The lowest liquid level in the tank is 1.5 m above the pump inlet, and the feed to the column is 3 m above the pump inlet. The density of the fluid is 868 kg/m^3 and its viscosity is 0.631 mNs/m^2.

Generate and plot the system curve on the given axes, and use the plot to determine the operating point, pump efficiency, and NPSH for the 0.102-m and .127-m impellers.



Problem Statement, Part 2

In this part of the problem, your job is to use CHEMCAD to simulate the pump and pipe system described earlier in CHEMCAD. Your instructor will provide you with two items to help you do this: (1) PowerPoint slide deck that has instructions for how to build the process, and (2) an Excel file that has the pump characteristic curve in it. The Excel file is explained in PowerPoint. Follow the instructions in PowerPoint carefully and use the results, along with the results from part one, to complete the data table below to compare the CHEMCAD result to your calculations. Note: Details of the CHEMCAD simulation such as feed composition are provided in the PowerPoint slide deck.

	Excel/Plot	CHEMCAD
0.102-m impeller		
Flow Rate, m^3/h		
Liquid head, m		
Efficiency, %		
NPSH, m		
0.127-m impeller		
Flow Rate, m^3/h		
Liquid head, m		
Efficiency, %		
NPSH, m		

Submission Requirements for Parts 1 and 2

1. Sketch of the system curve on the same axes as the characteristic curve, with a minimum of six points added to the plot and a "smooth" curve added to the points.

2. PDF of plot and completed table with signed cover sheet. You may use the Microsoft Word document in Canvas, along with drawing tools, to make a sketch of the plot and to complete the table, and then convert this to pdf for your submission

3. Supporting calculations in Excel and CHEMCAD in SharePoint.

Supporting Calculations *(Use space below. Append additional sheets as necessary)*