Instructions for Preliminary Selection of a Pump for a Given Head-Capacity-Viscosity Condition

Given the desired capacity and head of the viscous liquid to be pumped and the viscosity and specific gravity at the pumping temperature, Fig. 5 can be used to find approximate equivalent capacity and head when pumping water.

Enter the chart (Fig. 5) at the bottom with the desired viscous capacity, \((Q_{vis})\) and proceed upward to the desired viscous head \((H_{vis})\) in feet of liquid. For multistage pumps, use head per stage. Proceed horizontally (either left or right) to the fluid viscosity, and then go upward to the correction curves. Divide the viscous capacity \((Q_{vis})\) by the capacity correction factor \((C_Q)\) to get the approximate equivalent water capacity \((Q_{w \text{ approximately}})\).

Divide the viscous head \((H_{vis})\) by the head correction factor \((C_H)\) from the curve marked "1.0 x Q_w" to get the approximate equivalent water head \((H_{w \text{ approximately}})\). Using this new equivalent water head-capacity point, select a pump in the usual manner.

The viscous efficiency and the viscous brake horsepower may then be calculated.

This procedure is approximate as the scales for capacity and head on the lower half of Fig. 5 are based on the water performance. However, the procedure has sufficient accuracy for most pump selection purposes. Where the corrections are appreciable, it is desirable to check the selection by the method described below.

EXAMPLE. Select a pump to deliver 750 gpm at 100 feet total head of a liquid having a viscosity of 1000 SSU and a specific gravity of 0.90 at the pumping temperature.

Enter the chart Fig. 5 with 750 gpm, go up to 100 feet head, over to 1000 SSU, and then up to the correction factors:

\[
C_Q = 0.95 \\
C_H = 0.92 \text{ (for 1.0 } Q_{nw}) \\
C_E = 0.635 \\
Q_{w} = \frac{750}{0.95} = 790 \text{ gpm} \\
H_{w} = \frac{100}{0.92} = 108.8 - 109 \text{ feet head}
\]

Select a pump for a water capacity of 790 gpm at 109 feet head. The selection should be at or close to the maximum efficiency point for water performance. If the pump selected has an efficiency on water of 81 per cent at 790 gpm, then the efficiency for the viscous liquid will be as follows

\[
E_{vis} = 0.635 \times 81\% = 51.5 \text{ per cent}
\]

The brake horsepower for pumping the viscous liquid will be:

\[
bhp_{vis} = \frac{750 \times 100 \times 0.90}{3960 \times 0.515} = 33.1 \text{ hp}
\]

For performance curves of the pump selected, correct the water performance as shown below.

Instructions for Determining Pump Performance on a Viscous Liquid When Performance on Water is Known
Given the complete performance characteristics of a pump handling water, determine the performance when pumping a liquid of a specified viscosity.

From the efficiency curve, locate the water capacity (1.0 x Qw) at which maximum efficiency is obtained.

From this capacity, determine the capacities (0.6 x Qw), (0.8 x Qw) and (1.2 x Qw).

Enter the chart at the bottom with the capacity at best efficiency (1.0 x Qw), go upward to the head developed (in one stage) (Hw) at this capacity, then horizontally (either left or right) to the desired viscosity, and then proceed upward to the various correction curves.

Read the values of (CE) and (CQ), and of (CH) for all four capacities.

Multiply each head by its corresponding head correction factor to obtain the corrected heads. Multiply each efficiency value by (CE) to obtain the corrected efficiency values which apply at the corresponding corrected capacities.

Plot corrected head and corrected efficiency against corrected capacity. Draw smooth curves through these points. The head at shut-off can be taken as approximately the same as that for water.

Calculate the viscous brake horsepower (bhpVIS) from the formula given above.

Plot these points and draw a smooth curve through them which should be similar to and approximately parallel to the brake horsepower (bhp) curve for water.