CHEMPUMP
A DIVISION OF TEIKOKU USA INC.

ENGINEERING DATA SHEET

Effect of Viscosity on Chempump Selection		
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04/01/99	**07/19/93**	**5E**

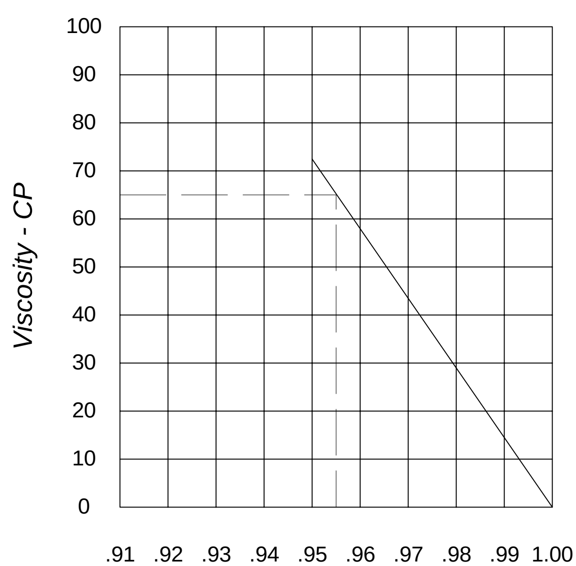
Liquids with high viscosities have an effect on the operating conditions of centrifugal pumps with respect to head, capacity, efficiency and power requirements. Pumps (which have been tested with water) will require corrections when pumping viscous liquids.

For the Chempump centrifugal pumps, applications where the fluid viscosity is greater than 30 cps should be sized as follows:

The Hydraulic Institute publishes performance correction factors for viscous fluids. These correction factors are applicable to the pump portion of the Chempump, however additional corrections must be made for the losses through the drive section (rotor cavity) due to close running clearances and the resultant viscous drag. For applications where the fluid to be pumped has a viscosity between 15 cps and 75 cps, the following procedures must be used (for fluids with viscosity above 75 cps, consult the factory).

HYDRAULIC CORRECTION

To determine the model and impeller diameter a close approximation can be made by the following charts which are based on the hydraulic institute data.



Head & Flow Correction Factor

(Figure 1)

From head and flow correction factor chart, figure 1 select factor to calculate equivalent water head and flow, e.g., viscosity of 65 cps. indicates a factor of .955.

Calculate equivalent water head and equivalent water flow from the following:

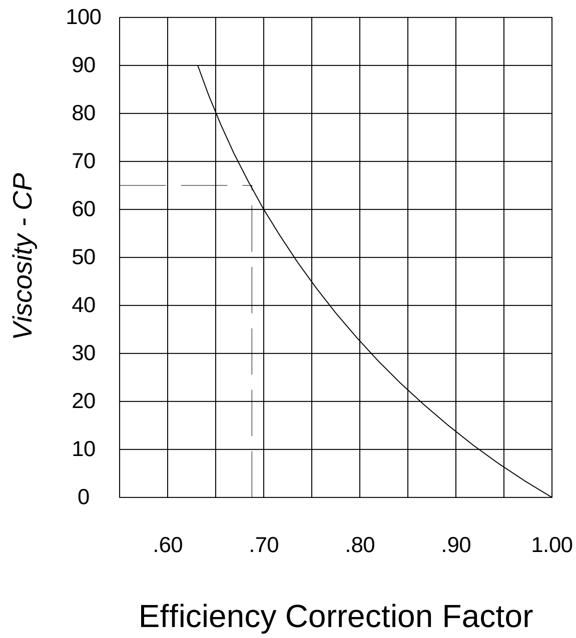
$$\text{Equivalent water head} = \frac{\text{Desired head (ft.)}}{\text{Correction factor}}$$

$$\text{Equivalent water flow} = \frac{\text{Desired flow (gpm)}}{\text{Correction factor}}$$

Using equivalent head and flow, select impeller diameter from standard performance curves.

MOTOR CORRECTION

To determine the motor size required for the pump and impeller diameter selected refer to figure 2 for the efficiency correction.



(Figure 2)

1. From Efficiency Correction Factor Chart, determine factor to calculate viscous efficiency, e.g., viscosity of 65 cps indicates a factor of .68.

2. Calculate viscous efficiency from the following:

   Viscous Efficiency = water efficiency x factor

   Note: Water efficiency is the efficiency noted on performance curve at desired head and flow.

3. Using the following formula, calculated the watt draw at the desired head and capacity while handling the viscous fluid:

$$\text{Viscosity Kilowatts} = \frac{.189 \times H \times Q \times \text{Sp. Gr.}}{\text{Viscosity Efficiency} \times 1000}$$

   Note: H and Q in the above formula are the desired head and capacity respectively.

4. Select the motor size which has a watt rating that exceeds the watts draw requirement calculated above. To insure a motor size that is non-overloading over the entire range of operation of the unit, the above steps should be repeated at a capacity at the maximum capacity on the curve for the selected impeller diameters. The watt draw requirement at that point should not exceed the watt rating of the motor size selected.

   The above method of model selection is based on actual test data and although usually correct, should be referred to Chempumps's Application Engineering Department for verification. In addition, this above method should be used only on Newtonian (uniform) fluids. Gels, slurries, paper stock and other non-Newtonian fluids may produce widely varying results, depending on the particular characteristics of the liquids.

Example:

Select a pump to produce 30 GPM @ 150 TDH pumping a fluid with a specific gravity of 1.1 and a viscosity of 65 cps.

- Hydraulic Corrector

  From Figure 1, the correction factor is .955.

  $$\text{Equivalent Water Head is } \frac{150}{.955} = 157$$

  $$\text{Equivalent Water Flow is } \frac{30}{.955} = 31.4$$

  From Performance Curve A-70058, a 6¼" impeller should be selected.

- Motor Corrector

  From Figure 2, the efficiency correction factor is .68 from Performance Curve A-70058. The Water Efficiency at 30 GPM @ 150 TDH is 33%.

  $$\text{Viscous Efficiency}_{(DES)} = \text{Water Efficiency} \times .68 = .33 \times .68 = .224$$

  $$\text{Viscosity Kilowatts}_{(DES)} = \frac{.189 \times 150 \times 30 \times 1.1}{.224 \times 1000} = 4.2$$

  The Viscosity Efficiency at this End of Curve (EOC) is determined by obtaining the Water Efficiency at the maximum flow and multiplying it by the Efficiency Correction Factor.

  End of Curve for a design point of 30 GPM @ 150 TDH is 50 GPM @ 137 THD and a Water Efficiency of 41%.

  $$\text{Viscous Efficiency}_{(EOC)} = .41 \times .68 = .28$$

  $$\text{Viscosity Kilowatts}_{(EOC)} = \frac{.189 \times 137 \times 50 \times 1.1}{.28 \times 1000} = 5.09$$

The correct pump selection is a GB-5K with a 6¼" impeller.