

37.45 A 90% efficient pump normally delivers 50gpm of 50°F chilled water at a head of 20ft of water with a rotational speed of 900rpm. What is the percent increase in brake horsepower required to increase the volume flow rate by 10%? Assume the pump is oversized and has sufficient capacity in reserve to deliver the additional flow.

- A. 10%
- B. 21%
- C. 33%
- D. 46%

Refer to the **Pump Affinity Laws**. Change in speed and change in volume flow rate are proportional. Therefore, when the volume flow increases by 10%, the speed also increases by 10%. Establish the ratio of new to old volume flow rate and speed.

$$\frac{Q_2}{Q_1} = \frac{N_2}{N_1} = 1.1$$

The percent increase in brake horsepower is a function of the cube of the change in speed (or volume flow rate).

$$\frac{bhp_2}{bhp_1} = \left(\frac{N_2}{N_1}\right)^3 = (1.1)^3 = 1.33$$

Therefore, a 33% increase in power is required to support a 10% increase in the speed / volume flow rate.

Note there is no need to calculate the actual brake horsepower to determine the percent change. The specific value of various parameters given are additional information not required to answer the fundamental question put forth, which is purely an application of the pump affinity laws.

Answer C