

Thermal Siphon Speed measurements

From 2011 UBMS

From the movie, the pond sludge went through 1 m in 29 s.

The speed is:

$$v = \frac{\text{distance}}{\text{time}} = \frac{1 \text{ m}}{29 \text{ s}} = 0.0345 \text{ m/s}$$

For a cylinder:

$$\text{Area} = \pi R^2$$

$$\text{Volume} = \text{Area} \times \text{length}$$

$$\text{Pumping Speed} = \text{Area} \times \frac{\text{length}}{\text{time}}$$

For our tube, the diameter is 19.4 mm or .0194 m

The radius is thus:

$$R = \frac{\text{diameter}}{2} = .0097 \text{ m or about 1 cm}$$

The area is thus:

$$\text{Area} = \pi (.01)^2 = 3.14 \times 10^{-4} \text{ m}^2$$

The pumping speed is then

$$\text{Pumping Speed} = 3.14 \times 10^{-4} \text{ m}^2 \times 0.0345 \text{ m/s} = 1.08 \times 10^{-5} \frac{\text{m}^3}{\text{s}}$$

In terms of liters per second:

$$1000 \text{ liters} = 1 \text{ m}^3 \Rightarrow \text{Pumping Speed} = .00108 \frac{\text{Liters}}{\text{sec}}$$

In terms of Liters per minute:

$$\text{Pumping Speed} = .00108 \times 60 = 0.648 \frac{\text{liters}}{\text{minute}}$$

The ice chest holds about 20 liters of water. How long to change this much fluid?

$$\text{amount} = \text{pumping speed} \times \text{time} \Rightarrow \text{time} = \frac{\text{amount}}{\text{pumping speed}} = \frac{20}{.0648} = 308 \text{ min}$$

Our panel was about twice as efficient as the one in the video so the time for our panel would have been about 1/2 of this or about 150 minutes. However, the pumping speed is probably not so low as the panel heats up more. Also the whole story is not told by the amount of fluid displaced. The largest source of error is probably the assumption that pumping speed is constant.