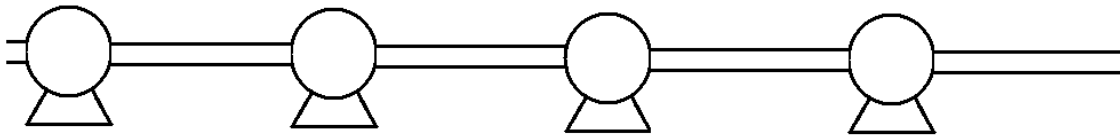


TOPIC

Fluids – Section X – Question 8

QUESTION

A 1.2 m diameter pipeline is used to transport $1.3 \text{ m}^3/\text{s}$ (940,000 bbl/day) of crude oil over a distance of 1200 km. Because the pressures generated would be too high to do this with a single pump, a series of pumping stations are used as shown in the drawing below. Each pumping station is designed to pump the liquid from 200 kPa at the pump inlet to 1300 kPa at the pump exit. The pipe is smooth and may be assumed to be straight with no elevation gain or loss. Pumps operate at 80 % efficiency. The density and viscosity of the crude oil are 850 kg/m^3 and $0.1 \text{ kg/m}\cdot\text{s}$, respectively.



The number of pumping stations required is closest to

- (A) 3
- (B) 14
- (C) 23
- (D) 33

HINTS

- The pressure drop in each segment is 1100 kPa
- The number of piping stations is equal to the total length divided by the length of pipe between stations.
- The pressure drop between stations can be related to the length between stations.
- Remember the friction factor.

CONTRIBUTOR

Scott Campbell