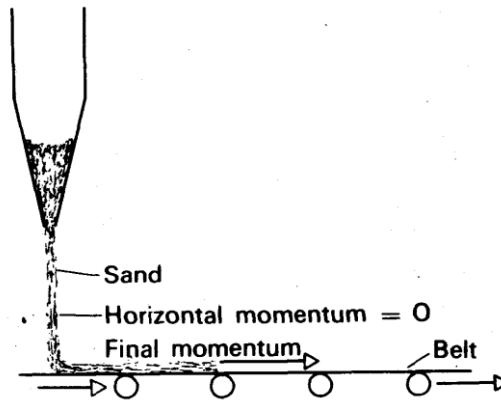


Answer on Question #41220, Physics, Mechanics | Kinematics | Dynamics

Sand drops at the rate of 2000 kg/min from the bottom of a hopper onto a belt conveyor moving horizontally at 250 m/min. Determine the force needed to drive the conveyor, neglecting friction.

Solution:



The initial horizontal velocity of the sand is zero.

The final horizontal velocity is 250 m/min = 250/60 m/s.

The impulse of force is equal to the change in momentum of an object provided the mass is constant:

$$\text{Impulse} = F\Delta t = m\Delta v$$

Thus, the force is

$$F = \frac{m\Delta v}{\Delta t}$$
$$\frac{m}{\Delta t} = 2000 \frac{\text{kg}}{\text{min}} = \frac{2000}{60} \frac{\text{kg}}{\text{s}}$$

The momentum change per second is

$$\frac{m\Delta v}{\Delta t} = \frac{2000 \cdot (250 - 0)}{60 \cdot 60} = 138.9 \frac{\text{kg m}}{\text{s}^2}.$$

Thus,

$$F = 138.9 \text{ N}.$$

Answer. $F = 138.9 \text{ N}$.