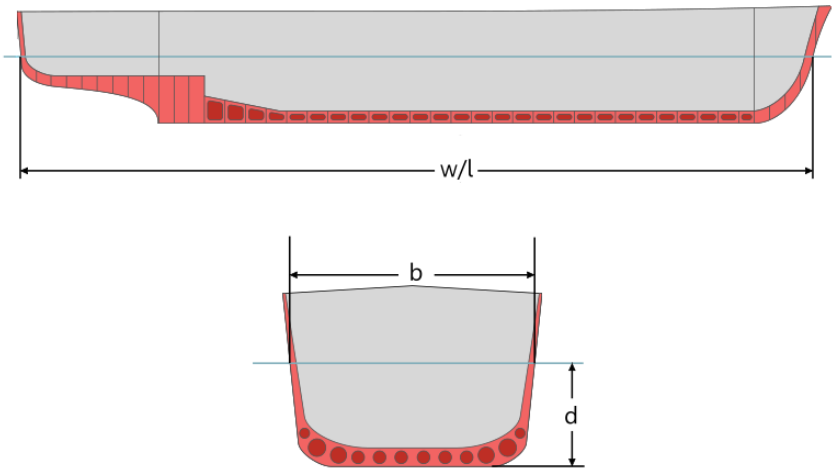
Answer on Question 49750, Physics, Mechanics | Kinematics | Dynamics

Question:

A ship of draft 10 m is loading in salt water density 1015 kg/m3. Calculate the change in draft on entering salt water of density 1025 kg/m3.

Solution:



Let's consider a ship that moves from salt water of density $1015\frac{kg}{m^3}$ to salt water of density $1025\frac{kg}{m^3}$. The ship must displace the same mass of water in each case. The mass of water displaced in case of salt water with density $1015\frac{kg}{m^3}$ will be:

$$m_{w.old} = \rho_{w.old} V_{ship\ under\ waterline} = \rho_{w.old} (w/l) b d_{old},$$

where $\rho_{w.old} = 1015\frac{kg}{m^3}$ is the old density of salt water, w/l is the length of the ship at waterline, b is the beam of the ship, the ship's width at the widest point as measured at the ship's nominal waterline, $d_{old} = 10m$ is the old draft.

The mass of water displaced in case of salt water with density $1025\frac{kg}{m^3}$ will be:

$$m_{w.new} = \rho_{w.new} V_{ship under waterline} = \rho_{w.new} (w/l) b d_{new}.$$

So, we equate both expressions:

$$\rho_{w.old}\left(w/l\right)bd_{old} = \rho_{w.new}\left(w/l\right)bd_{new}.$$

From this formula we obtain the new draft:

$$d_{new} = \frac{\rho_{w.old}\cdot d_{old}}{\rho_{w.new}} = \frac{1015\frac{kg}{m^3}\cdot 10m}{1025\frac{kg}{m^3}} = 9.9m.$$

Answer:

The draft in salt water of density $1025\frac{kg}{m^3}$ will be 9.9 meters.