Answer on Question #51303, Engineering, Other

Find the quantities by weight and volume required to prepare 1m^3 of a concrete mix which consist of one portland cement bag. 0.07 m^3 gravel and 22 liters of water. The properties if the component are as follows

1-density of sand 1640 kg/m^3

2-density of gravel 1780 kg/m^3

3-specific gravity of aggregates=2.7

4-specific gravity of cement=3.15

Solution:

1 bag [portland cement] = 42.64 kg

A bag of portland cement has a loose dry volume of approximately 28.3 L

Density can be expressed as

$$\rho = \frac{m}{V}$$

where

ρ = density (kg/m^3)

m = mass (kg)

V = volume (m^3)

Quantity of materials required for 1 bag of cement,

	Water	Cement	Sand	Gravel
weight	22 kg	42.64 kg	x	0.07*1780= 124.6 kg
SG	1	3.15	2.7	2.7

$$\frac{22}{1} + \frac{42.64}{3.15} + \frac{x}{2.7} + \frac{124.6}{2.7} = 100\%$$

Thus,

$$x = 2.7 * \left(100 - \frac{22}{1} - \frac{42.64}{3.15} - \frac{124.6}{2.7}\right) = 49.45 \text{ kg}$$

Mix proportions by weight, cement:sand:gravel is

$$1 : \frac{49.45}{42.64} : \frac{124.6}{42.64} = 1 : 1.16 : 2.922$$

Estimate the total volume of dry material by multiplying the required volume of concrete by 1.65 to get the total volume of dry loose material needed (this includes 10% extra to compensate for losses).

$$1 * 1.65 = 1.65\ m^3$$

Determine the required volume of cement, sand and gravel by multiplying the total volume of dry material by each components fraction of the total mix volume i.e. the total amount cement needed

$$V_{cement} = 1.65 * \frac{1}{1 + 1.16 + 2.922} = 0.3247\ m^3$$

$$V_{sand} = 1.65 * \frac{1.16}{1 + 1.16 + 2.922} = 0.3766\ m^3$$

$$V_{gravel} = 1.65 * \frac{2.922}{1 + 1.16 + 2.922} = 0.9487\ m^3$$

$$V_{water} = \frac{0.9487}{0.07} * 0.022 = 0.2982\ m^3$$

Bags of cement: 0.3247 m^3 cement / .0283 m^3 per bag

= 11.47 bags of cement

The weight is

$$m_{cement} = N * m_{bag} = 11.47 * 42.64 \ = 489.1\ \text{kg}$$

$$m_{sand} = \rho_{sand} * V_{sand} = 1640 * 0.3766 \ = 617.6\ \text{kg}$$

$$m_{gravel} = \rho_{gravel} * V_{gravel} = 1780 * 0.9487 \ = 1688.7\ \text{kg}$$

$$m_{water} = \rho_{water} * V_{water} = 1000 * 0.2982 = 298.2\ \text{kg}$$