Answer on Question #51352 – Math – Geometry

Grains of fine California beach sand are approximately spheres with an average radius of 50 μm and are made of silicon dioxide, which has a density of $2.4*10^3$ kg/m^3. What mass of sand grains would have a total surface area (the total area of all the individual spheres) equal to the surface area of cube 1.2 m on an edge.

Solution

r = 50 μm = $5*10^{-5}$ m; ρ = $2.4*10^3$ kg/m^3; a = 1.2 m; m – ?

One grain has the surface area: $S_g = 4\pi r^2$.

The surface area of cube: $S_c = 6a^2$.

Number of grains, that have total surface area equal to the surface area of cube, is given by

$$N = S_c / S_g = \frac{3a^2}{2\pi r^2}.$$

Volume of one grain: $V_0 = 4\pi r^3/3$.

$m = \rho * V_0 * N = \rho \frac{4\pi r^3 * 3a^2}{3*2\pi r^2} = 2\rho r a^2 = 2*2.4*10^3*5*10^{-5}*1.44 =$ **0.3456 kg**

Answer: m = 0.3456 kg