1. An operator mixes 40 lb of lime in a 100-gal tank containing 80 gal of water. What is the percent of lime in the slurry?

   Solution:

   Method 1: Using lbs formula: $\text{mg/l} = \dfrac{40}{\dfrac{80}{1,000,000} * 8.34} = 59,952 = 60,000 mg/l = \boxed{6\%}$

   Method 2: Using unit conversion: $\dfrac{40 \text{ lbs}}{80 \text{ gal}} * \dfrac{454 \text{ gms}}{\text{lb}} * \dfrac{1000 \text{ mg}}{\text{gm}} * \dfrac{\text{gal}}{3.785 \text{ l}} = 60,000 mg/l = \boxed{6\%}$

2. Find the detention time in minutes for a clarifier that has a diameter of 152 ft and a water depth of 8.22 ft, if the flow rate is 6.8 mgd.

   Solution: $\text{DT} = \dfrac{Volume}{Flow} = \dfrac{0.785 * 152^2 * 8.22 \text{ ft}^3}{\dfrac{6.8 * 1,000,000 \text{ gal}}{\text{day}} * \dfrac{ft^3}{7.48 \text{ gal}} * \dfrac{\text{day}}{1,440 \text{ min}}} = \boxed{236 \text{ min}}$

3. Water is flowing at a velocity of 1.70 fps in a 10-in. diameter pipe. If the pipe changes from the 10-in. to a 6-in. pipe, what will the velocity be in the 6-in. pipe?

   Solution:

   Method 1: Finding the Q given the velocity in the 10 in. pipe and then using that Q to find velocity in the 6 in. pipe. Note: The Q remains the same, only the velocity will change as the pipe becomes smaller.

   Step A - Finding the flow rate:

   $\text{Q} = \text{V} * \text{A} = \dfrac{1.70 \text{ ft}}{\text{sec}} * 0.785 * (\dfrac{10}{12})^2 \text{ ft}^2 = 0.9267 \text{ ft}^3/\text{sec}$

   Step B - Finding the veocity through the 6 in. pipe:

   $\text{Q} = \text{V} * \text{A} \implies \text{V} = \dfrac{\text{Q}}{\text{A}} \implies \dfrac{0.9267 \text{ ft}^3/sec}{0.785 * \left(\dfrac{6}{12}\right)^2 \text{ft}^2} = \boxed{4.7 \text{ ft/sec}}$

   Method 2: Using proportions method.

   As Q is constant, $\text{V} \propto \dfrac{1}{\text{A}} \propto \dfrac{1}{\text{D}^2} \implies V * \text{D}^2 = constant$

   $\implies \text{V}_{10} * {\text{D}_{10}}^2 = V_6 * \text{D}_6^2 \implies V_6 = \dfrac{\text{V}_{10} * {\text{D}_{10}}^2}{\text{D}_6^2} = \dfrac{1.70 * 10^2}{6^2} = \boxed{4.7 \text{ ft/sec}}$