

A significant contribution to atmospheric Carbon dioxide levels comes from the thermal decomposition of limestone in the manufacture of cement and of lime for agricultural purposes.

Cement works roast 1000 million tones of limestone per year and a further 200 million tones is roasted in kilns to make lime.

What is the total annual mass output of carbon dioxide (in million tones) from these two processes?

**Solution:**

The thermal decomposition of limestone is:



Using atomic masses from the periodic table, we will find the following:

$$M(\text{CaCO}_3) = 40 + 12 + 16 \cdot 3 = 100 \text{g/mol} = 100 \text{kg/kmol}$$

$$M(\text{CaO}) = 40 + 16 = 56 \text{g/mol} = 56 \text{kg/kmol};$$

$$M(\text{CO}_2) = 12 + 16 \cdot 2 = 44 \text{g/mol} = 44 \text{kg/kmol}.$$

If we roast 100 kg of limestone we obtain 44kg of CO<sub>2</sub>, for the equation of reaction. From 1000 million tones of limestone we obtain:

$$m(\text{CO}_2) = \frac{1000 \cdot 44}{100} = 440 \text{ million tones}$$

When we prepare 56kg lime (CaO) we also obtain 44 kg CO<sub>2</sub>. If we prepare 200 million tones CaO we also obtain the mass of CO<sub>2</sub>:

$$m(\text{CO}_2) = \frac{200 \cdot 44}{56} = 157.14 \text{ million tones.}$$

The total mass CO<sub>2</sub> output from two processes:

$$m(\text{CO}_2) = 440.0 + 157.4 = 597.4 \text{ million tones.}$$

**Answer:**

The total mass CO<sub>2</sub> output from two processes is 597.4 million tones.