

[EVS] Assignment 1: Understanding Air Pollution

1. A burning power plant consumes 10,000 tons coal/day

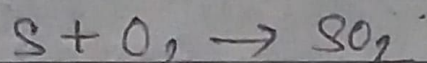
→ A burning power plant consumes 10^7 kg coal/day

$$[1 \text{ ton} = 10^3 \text{ kg}]$$

Given, coal contains 2% sulfur by weight

∴ 10^7 kg coal produces (0.02×10^7) kg sulfur per day

The relevant chemical reaction:



∴ 32 g of sulfur produces 64 g of sulphur dioxide

Assuming 100% of sulphur is converted to SO_2 ,

$$\therefore \text{Amount of } SO_2 \text{ produced per day} = \left(\frac{64 \text{ g}}{32 \text{ g}} \right) \times (0.02 \times 10^7) \frac{\text{kg}}{\text{day}}$$

$$= 0.04 \times 10^7 \text{ kg/day}$$

$$= 4 \times 10^5 \text{ kg/day}$$

$$= 4 \times 10^8 \text{ g/day}$$

Given, sulfur oxides produced per day are confined in a volume of $10^{11} \text{ m}^3/\text{day}$

$$\begin{aligned} \therefore \text{Concentration of SO}_2 &= \frac{4 \times 10^8 \text{ g/day}}{10^{11} \text{ m}^3/\text{day}} \\ \text{in the air surrounding} & \\ \text{the power plant} &= 4 \times 10^{-3} \text{ g/m}^3 \\ &= \underline{4000 \text{ } \mu\text{g/m}^3} \end{aligned}$$

If all conditions are same, to keep concentration of SO_2 as $365 \text{ } \mu\text{g/m}^3$.

$$\begin{aligned} \text{Amount of sulfur dioxide released} &= 365 \times 10^{11} \frac{\mu\text{g}}{\text{m}^3} \times \frac{\text{m}^3}{\text{day}} \\ \text{per day} &= 365 \times 10^5 \text{ g/day} \end{aligned}$$

Let sulfur content in coal be $x\%$, then

$$365 \times 10^5 \text{ g/day} = \left(\frac{64 \text{ g}}{32 \text{ g}} \right) \times \frac{x}{100} \times 10^7 \frac{\text{kg}}{\text{day}}$$

$$\Rightarrow 365 = (2x)(1000)$$

$$\begin{aligned} \Rightarrow x &= \frac{365}{2 \times 1000} = 182.5 \times 10^{-3} \\ &= \underline{0.1825\%} \end{aligned}$$

\therefore Sulfur content in coal should be 0.1825%.

2. No. of gasoline powered cars = 10^9

Average distance travelled by a car = 16000 km/year

Since, Gasoline is consumed at the rate of 7.8 l per 100 km.

\therefore Amount of gasoline consumed by a car =

\therefore Total gasoline consumed = No. of cars \times $\frac{\text{service provided}}{\text{car}}$ \times $\frac{\text{gasoline}}{\text{distance}}$

$\Rightarrow I = P \times R \times A \times T$

\therefore Gasoline = $10^9 \times \frac{16000 \text{ km}}{1 \text{ year}} \times \frac{7.8 \text{ l}}{100 \text{ km}}$
 $= 1248 \times 10^9 \text{ l/year}$

\therefore Annual Consumption of gasoline = $1248 \times 10^9 \text{ l}$

Given, 1 litre of gasoline produces 2.3 kg of CO_2

\therefore Annual production of CO_2 = $1248 \times 10^9 \times 2.3 \text{ kg/year}$
 from burning of gasoline in cars = $2870.4 \times 10^9 \text{ kg/year}$

Since 25% of CO_2 overheads emission is incurred at production, refinery and downstream,

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$$\begin{aligned}\therefore \text{Amount of CO}_2 \text{ produced due to automobiles} &= \left(2870.4 \times 10^9 \frac{\text{kg}}{\text{year}} \right) \times 1.25 \\ &= 3588 \times 10^9 \text{ kg/year} \\ &= 3588 \times 10^6 \text{ ton/year} \\ &= 3.588 \text{ gigaton/year}\end{aligned}$$

$$\therefore \text{Annual CO}_2 \text{ emission from automobiles} = \underline{\underline{3.588 \text{ Gt}}}$$