Resource Activity 3

Teaser: Can we capture CO2 instead of emitting it into the atmosphere?

Carbon capture

Emissions of greenhouse gases (GHGs) increase global temperatures and result in climate change.

The most significant GHG is CO_2 because

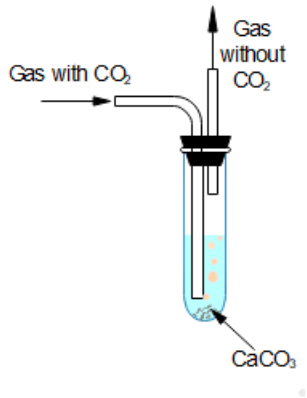
(i) it is emitted in the greatest quantities,

(ii) has a long residence time in the atmosphere.

Carbon capture involves capturing industrially generated carbon dioxide, preventing its emissions.

Few technologies exist for carbon capture; for example, we can use alkaline solutions (high pH), which can be percolated with a gas containing CO_2. Let's assume we have a solution of calcium hydroxide, Ca(OH)2:

$Ca(OH)_{2(solution)} + CO_{2(g)} \rightarrow CaCO_{3(s)} + H_2O_{(l)}$



Once the gas is cleaned, it can be safely released into the atmosphere. But now we are left with another problem, what to do with $CaCO_3$ and where to get more of that alkaline solution? The answer - we can regenerate the solution by firstly thermally decomposing $CaCO_3$:

$CaCO_{3(s)} \rightarrow CaO_{(s)} + CO_{2\,(g)}$

$CaO + H_2O \rightarrow Ca(OH)_2$

The problem here is that the thermal decomposition requires a lot of energy (happens above 825ºC), which imposes high costs. Alternatively, we can use other components that do not bind CO_2 so strongly, for example, monoethanolamine (MEA), $OH(CH_2)_2NH_2$.

The removal of CO_2 from the industrial gas is called post-combustion capture.

You notice that during the regeneration of the alkaline agent, we release CO_2, but this time, this is pure CO_2 with no other gas. What we can do with this CO_2 is to store it underground, *e.g.* in a depleted oil reservoir, aiming for timescales of hundreds of years. If the CO_2 originated from fossil fuels, then the carbon is being put back to where it was taken from. If the CO_2 originated from

biomass, then effectively, we removed CO_2 from the atmosphere (CO_2 was used to grow plants). This technology may help with cleaning the atmosphere from CO_2 that was already released.