# THE CHEMISTRY OF SOLVENT ABSORPTION OF CARBON DIOXIDE

Solvents used in carbon dioxide capture are either chemical solvents or physical solvents.

## Chemical solvents

With chemical solvents, the absorption primarily depends on chemical reactions between the solvent and $CO_2$. Post capture, heat is required to release the $CO_2$ and regenerate the solvent.

### Amines

An amine is basically an ammonia compound with one or more of the hydrogen atoms replaced by a substitute, designated by R in the following equations.

**Primary or secondary amines:**

$CO_2 + 2(R\text{-}NH_2) \leftrightarrow R\text{-}NH\text{-}COO^- + R\text{-}NH_3^+$

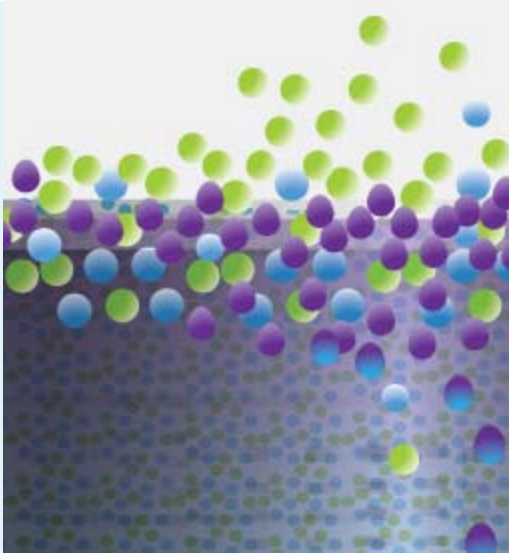
**Tertiary amines:**

$R_3\text{-}N + CO_2 + H_2O \leftrightarrow R_3HN^+ + HCO_3^-$

*Examples:*

*Monoethanolamine (MEA) – (a primary amine)*

*Methyldiethanolamine (MDEA) (a tertiary amine)*
*(e.g. R: HO-$CH_2$-$CH_2$, $CH_3$)*



### Ammonia

The chemical absorption of $CO_2$ using ammonia involves a number of ionic reactions that form ammonium bicarbonate

$CO_2 + NH_3 + H_2O \leftrightarrow NH_4HCO_3$ (Ammonium bicarbonate)

### Carbonates

Potassium carbonate

$CO_2 + K_2CO_3 + H_2O \leftrightarrow 2KHCO_3$

Ammonium carbonate

$(NH_4)2CO_3 + CO_2 + H_2O \leftrightarrow 2(NH_4)HCO_3$

## Physical solvents

Absorption in a physical solvent relies on the solubility of $CO_2$ in the solvent rather than a chemical reaction with the solvent. The solvent is regenerated by changing pressure or temperature. Examples of physical solvents are methanol, dimethyl ethers of polyethylene glycol and N - methyl - 2 - pyrrolidone (NMP).

March 2012