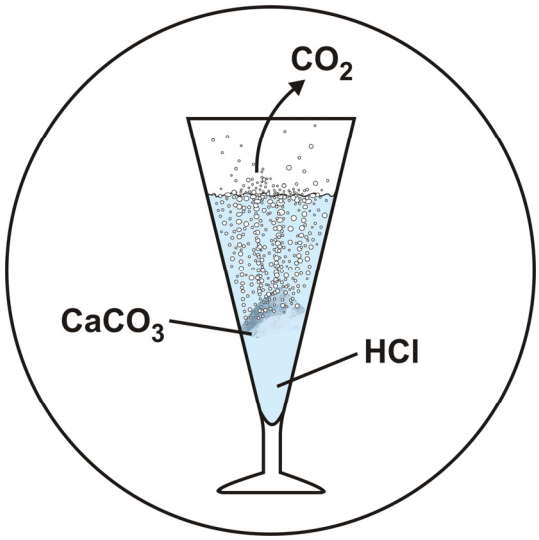
Dissolution of Marble in Hydrochloric Acid



Equipment:

goblet

Chemicals:

marble or „limestone“ (calcium carbonate) in pieces
(for example old marble plate)
hydrochloric acid (1 molar)

Safety:

hydrochloric acid (HCl) (1 molar):

H290
P390, P406

It is highly recommended to wear safety glasses.

Procedure:

Pieces of marble (or limestone) are put in hydrochloric acid, an aqueous solution of hydrogen chloride, HCl.

Observation:

A strong effervescence can be observed.

Explanation:

Calcium carbonate is dissolved by hydrochloric acid, thereby forming gaseous carbon dioxide:

$$\underline{CaCO_3|s + 2\ H^+|w \rightarrow Ca^{2+}|w + H_2O|l + CO_2|g}$$

$$\Sigma\mu^{\ominus}: \qquad -1128.8 \qquad > \qquad -1185.1 \qquad kG$$

$$\Rightarrow \text{ chemical drive } \mathcal{A}^{\ominus}: +56.3\ kG$$

Thereby, we had to consider that HCl is a strong acid and is entirely dissociated into hydrogen and chloride ions, H^+ and Cl^-. The H^+ ions are responsible for the reaction while the Cl^- ions remain more or less inactive.

The chemical drive of the reaction is positive, i.e. the combined reactants have a higher chemical potential than the products and subsequently, the reaction takes place spontaneously.

Necessary chemical potentials ($T^{\ominus}$ = 298 K, $p^{\ominus}$ = 100 kPa):

Substance	Chemical potential $\mu^{\ominus}$ [kG]
$CaCO_3$|s	–1128.8
H^+|w	0
Ca^{2+}|w	–553.6
H_2O|l	–237.1
CO_2|g	–394.4

Disposal:

After the complete dissolution of the marble pieces, the produced solution is neutralised and flushed down the drain with water.