

Chlorates

Dr Simon Lawrence

Department of Chemistry

University College Cork

simon.lawrence@ucc.ie

Nomenclature

ClO_2 chlorine dioxide

Oxyanion

ClO_4^- perchlorate

ClO_3^- chlorate

ClO_2^- chlorite

ClO^- hypochlorite

Cl^- chloride

Corresponding acid

HClO_4 perchloric acid

HClO_3 chloric acid

HClO_2 chlorous acid

HClO hypochlorous acid

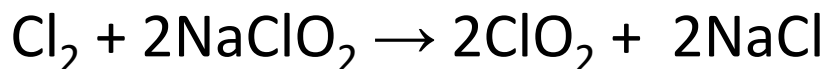
HCl hydrochloric acid

Generation of Chlorine Dioxide

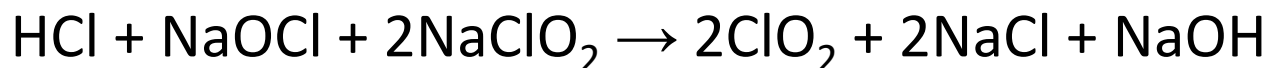
Originally: Sir Humphrey Davy (early 1800s)
potassium chlorate with sulfuric acid

Nowadays, small scale: reaction of sodium chlorite and chlorine

1 Using chlorine directly



2 Chlorine generated *in situ*

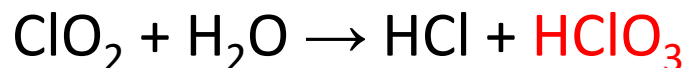


Note: Chlorine dioxide is highly reactive, liable to explode as shock sensitive, so usually generated *in situ*.

ClO_4^- = perchlorate, ClO_3^- = chlorate, ClO_2^- = chlorite, ClO^- = hypochlorite, Cl^- = chloride

Chlorine Dioxide in water

Aqueous solutions (low concentrations) are stable in the dark. However, in light slowly decompose to hydrochloric acid (HCl) and **chloric acid** (HClO_3).



Basic solutions undergo a rapid reaction to give chlorite and chlorate.



Acidic solutions are more stable. Evidence it decomposes to chlorous acid (HClO_2) first, followed by formation of hydrochloric acid and **chloric acid**.

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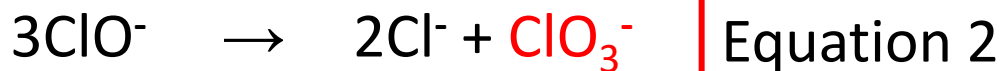
Possible other sources of chlorate

Chlorine initially dissolves in water: $\text{Cl}_2(g) \rightarrow \text{Cl}_2(aq)$

Then reacts, to form hypochlorous acid: $\text{Cl}_2(aq) + \text{H}_2\text{O} \rightarrow \text{HCl} + \text{HOCl}$

In *basic solution*: $\text{Cl}_2 + 2\text{OH}^- \xrightarrow{\text{rapid}} \text{Cl}^- + \text{ClO}^- + \text{H}_2\text{O}$ Equation 1

The hypochlorous anion rapidly disproportionates (simultaneous oxidation and reduction):



At, or below, room temperature, Equation 1 most likely.

As temperature increases, Equation 2 becomes more likely.

ClO_4^- = perchlorate, ClO_3^- = chlorate, ClO_2^- = chlorite, ClO^- = hypochlorite, Cl^- = chloride