Aqua Regia Encyclopedia Article

Aqua Regia

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Aqua Regia

One of the major quests for the alchemists of northern Africa, China, India and Europe, the forerunners of modern chemists, was a process to transform the common, corruptible **metals** into **gold**. Over several centuries, they developed the ability to produce a number of important chemical reagents. Since they did not have our current concept of elements, they named the reagents they prepared by the way they react (such as vitriolic acid, for what we now call **sulfuric acid** because it is so very corrosive) or from where they were found (such as Epsom's **salt**, which is **magnesium sulfate** found in large quantities near Epsom, England) or what was used to produce them. Among the most powerful reagents was **nitric acid** (aqua fortis or strong water) which is both a strong oxidizing acid and **hydrochloric acid** (called muriatic acid from the Latin word muria, for brine, since it was made by treating sea salt with sulfuric acid). A mixture of three parts concentrated hydrochloric acid to one part nitric acid is called "aqua regia" or "royal **water,**" because it dissolves even the "royal" (normally untouchable or incorruptible) metals **silver** and gold.

The ability of aqua regia to dissolve silver in gold is due both to the oxidizing power of the nitrate **ion** and the ability of chloride ion to form highly stable, partially covalent polyatomic ions with the metal ions once they are oxidized. By removing the free metal ions from **solution**, the formation of the chloride containing polyatomic ions allows the **oxidation** reaction to continue toward equilibrium. In the case of gold, the metal atoms are first oxidized by the nitrate ion to gold(III) ions. The gold(III)ions then react with chloride ion to form polyatomic ions containing one gold(III) **atom** and four chloride(-I) atoms, giving the overall reaction: $Au(s) + 3NO_3^- + 4Cl^- + 6H^+ = AuCl_4^- + 3NO_2(g) + 3H_2O$

When alchemists discovered that aqua regia dissolved gold, they were likely convinced that their ability to transform gold into a solution and, by evaporation, into a salt made it possible that other types of materials could transform back into gold if only they could find the right combination and the right conditions.