

# Essay on chemistry – nitric acid



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Nitric acid is a highly reactive oxidizing agent used in making fertilizers, explosives, and rocket fuels, and in a wide variety of industrial metallurgical processes. It is also a component of acid rain. Its chemical formula is  $\text{HNO}_3$  and it has been known as “ aqua fortis”, which means strong water, to alchemists. It is a transparent, colorless to yellowish, fuming corrosive liquid. Nitric acid is a strong acid and therefore it completely dissociates in water. It has a gravity of 1. 41 and the concentration of the hydronium ions(1) yields a pH of 0. . Its boiling point is 122C and its melting point is -42C. It was first mentioned by Pseuso-Geber, a European alchemist born in the 13th century. Described by Albert the Great in the 13th century and named by Ramon Lull, who prepared it and called it “ eau forte” (aqua fortis). There were people saying that it was discovered by Joseph-Louis Gay-Lussac or Johann Rudolf, but nobody knows who really did discover that. As it is a intoxicating, oxidizing acid, it reacts most with metals, but does not react with pure gold.

However, noble metals could be oxidized and dissolved by nitric acid which leads to colour changes of gold-alloy surface. So nitric acid is used in jewelry shops to spot low-gold alloys (< 14 carats(2)) and to asses the gold purity. Nitric acid also reacts powerfully with most of the organic material, which may also explode. It reacts with non-metallic elements except for nitrogen, oxygen, noble gases, silicon and halogens. It oxides them to their highest oxidation states(3) as acids with the formation of nitrogen dioxide for concentrated acid and nitric oxide for dilute acid.

Chromium (Cr), iron (Fe) and aluminium (Al) dissolve in dilute nitric acid, which the concentrated acid forms a metal oxide layer that protects the metal from further oxidation, and it is called passivation. Nitric acid can be

made in laboratory or industrially. In laboratory, nitric acid can be made from copper(II) nitrate or by reacting approximately equal masses of a nitrate salt with 96% sulfuric acid ( $\text{H}_2\text{SO}_4$ ), and distilling this mixture at nitric acid's boiling point of  $83^\circ\text{C}$  until only a white crystalline mass, a metal sulfate, remains. Then, the red fuming nitric acid obtained may be converted to the white nitric acid, which the equation is  $\text{H}_2\text{SO}_4 + \text{NO}_2 \rightarrow \text{HSO}_4(\text{s}) + \text{HNO}_3(\text{g})$ . In view of the fact that it is a really violent and strong acid, people make this acid for many different uses. It can be used in various forms as the oxidizer in liquid-fueled rockets. The forms include red fuming nitric acid and white fuming nitric acid. Red fuming nitric acid, known as RFNA, is a oxidizer used as a rocket propellant, which can be stored very long. It consists mainly of nitric acid, but also contains 13% of dinitrogen tetroxide(4) and 3% of water.

It breaks down to a certain degree to form nitrogen dioxide. The white fuming nitric acid, known as WFNA, does not contain free dinitrogen tetroxide. It consists of pure nitric acid with 2% of water and less than 0.5% of dissolved nitrogen dioxide. If the forms are mixed with sulfuric acid, it forms with the HF inhibitor. Nitric acid can also be used in some woodwork. In a low concentration (10% of nitric acid in water), it is sometimes used to artificially make pines and maple look older. It produces a grey-gold, old looking wood colour on wood.

By looking at the usage of nitric acid, we can see that, this kind of acid has a great impact to the society and the global economy. As it is not quite expensive, and you can make it in laboratories, there were many incidents where people throw glasses containers holding nitric acid on crowded streets.

Many people got hurt, the nitric acid burnt through their clothes and burn them. Concentrated nitric acid makes human skin yellow, because of a reaction with keratin(5). The keratin is the key structural material making up the outer layer of the human skin, and it is also a structural component of hair and nails.

It will turn orange when neutralized. However, this acid has many usages and also helps us a lot. It helps the astronauts to fly to space where nitric acid is used in rocket fuels. It also helps us decorate our places with artificial old wood furniture. This acid creates more job opportunities in the job market as the companies need people to work for it. Nitric acid is extremely hazardous and corrosive, and mostly, a poison. Inhaling will cause you breathing problems and lead to pneumonia and pulmonary edema, which may be fatal.

Other symptoms may include choking, coughing, irritation of both nose and throat, and also respiratory tract. Ingesting it can cause sudden burn or pain in the mouth, throat, esophagus, and gastrointestinal tract. It can also cause skin burns if there is any skin contact. Concentrated solutions can cause deep ulcers and stain skin a yellow or yellow-brown colour. If it gets into the eye, it is even worse, as it is corrosive, the vapors are irritating and will cause damage to the eyes including burns and permanent eye damage.

Long-term exposure to concentrated vapors may cause erosion of teeth and lung damage. Long-term exposures seldom occur due to the corrosive properties of the acid. People with pre-existing skin disorders, eye disease, or cardiopulmonary diseases must be susceptible to the effects of this substance. There are rules to follow when using the nitric acid. If people

don't follow it, it will be very dangerous to use it. Acid rain is a form of precipitation which contains a high level of sulfuric and nitric acids.

It has a pH of approximately 5.5-6. It is produced when sulfur dioxide and various nitrogen oxides combine together with atmospheric moisture. Acid rain can contaminate drinking water, damage the plants and aquatic life. It also erode buildings and monuments. If the plants are damaged, people won't be able to see the green things again and will also affect our eyesight. And we won't have vegetables to eat after acid rain because acid may cause many harmful effects to our body. If we still eat the vegetables, then we be sick.

The government had made an effort to reduce the amount of sulfur dioxide released, but it can be produced naturally by volcanic eruptions. Nitrogen oxide can be produced by lightning strikes. Acid rain had become a political issue in 1980s, where Canada claimed that pollutants from the US were contaminating the forests and waters, so power plants were asked to reduce the amount of sulfur dioxide released. Although there are harmful effects of nitric acid, people still keep on producing nitric acid. They only reduced producing them, still shows that there are still benefits of this acid!