

Science Information from the Beagle:

Laboratory and Industrial Acids and Bases

By: John Farrell Kuhns
and the
H.M.S. Beagle Staff

The liquid acids and bases used in laboratories and industry are usually of different strengths and purities and are typically sold in different size containers. The strength, purity and container sizes reflect the needs of the users of these different chemicals. The following information is meant to be a guide, but is by no means exhaustive and may be incomplete.

Acetic Acid (Ethanoic Acid), CH_3COOH : This acid is usually offered as a “glacial” acid, so named because it freezes at 16.7°C which is a little below room temperature. The glacial acetic acid that conforms to the reagent chemical specifications of the American Chemical Society (ACS) is a minimum of 99.7% pure and has a specific gravity (sp.gr.) of 1.050. The glacial acid was formerly sold in 1 pound and 5 pound bottles; the latter was about 5 pints. The “5 pint” bottle is still used today by most manufacturers, but the nominal size is now 2.5 liters. In place of the 1 pound bottle, most manufacturers now offer 500 mL bottles. The bottle cap color most often seen on the 2.5 L bottles is brown.

Another commonly sold concentration of the acid is 36% and this is usually made to meet prevailing pharmaceutical (drug) specifications. However, this concentration of acetic acid is commonly used to make photographic developer stop bath solutions.

Ammonium Hydroxide, NH_4OH : This liquid base is an aqueous (water) solution of ammonia. The usual concentration is 28.0% to 30% ammonia (NH_3). This is equivalent to about 52% NH_4OH . This chemical is sold in this strength in an ACS reagent grade and an industrial grade usually referred to as Stronger Ammonia Water. The reagent grade material has a sp.gr. of 0.900 and is sold in 500 mL and 2.5 L sizes. Formerly the larger size was a 4 pound bottle. The bottle cap color most often seen on the 2.5 L bottles is green.

Hydriodic Acid, HI: This is one of the most expensive of the mineral acids. Its typical strength, when sold as an ACS reagent, is 47% minimum and it has a sp.gr. of 1.500. It is sold in 100 mL, 500 mL and 2.5 L bottles.

Hydrobromic Acid, HBr: Hydrobromic acid, like hydriodic acid has few industrial uses. It is usually sold as a 47.0% to 49.0% ACS reagent in 100 mL, 500 mL and 2.5 L bottles. It has a sp.gr of 1.500.

H.M.S. Beagle - 180 English Landing Drive, Parkville, MO 64152 - 816.587.9998 - fax: 816.587.9997

Hydrochloric Acid, HCl: This is the least expensive of the hydrohalide acids, and it is one of the most useful industrial acids being used in cleaning masonry and as a pH adjuster in swimming pools. The industrial form is usually known as muriatic acid.

For laboratory use this acid is sold as a 36.5% to 38.0% ACS reagent with a sp.gr. of 1.180. The typical sizes are 500 mL and 2.5 L. Formerly, the larger size was sold as a 6 pound bottle and the cap color is blue.

The acid of industry, muriatic acid, is often a pale yellow to yellow color (due to impurities like iron) and has a concentration of 32% and a density of 20° Baume, which equals a sp.gr. of 1.160. Muriatic acid is most often sold in quarts and gallons and 15 gallon carboys. Both concentrations of this acid fume in moist air.

Hydrofluoric Acid, HF: Because of its reactivity towards glass, this acid is sold in poly containers. Before the regular use of plastic containers HF was sold in wax bottles. The laboratory, ACS reagent, grade acid is 48.0% to 51.0% and has a sp.gr. of 1.160. It is sold in 500 mL and 4 L containers.

There are two acids of industry. One has a nominal concentration of 52% and the other of 70%. All three concentrations fume in moist air. These two concentrations are also sold in 500 mL and 4 L containers.

Nitric Acid, HNO₃: Both the industrial acid and the laboratory, ACS reagent grade, acids are sold as 68.0% to 70.0% and have a sp.gr. of 1.408. The reagent grade acid is sold in 500 mL and 2.5 L bottles with red colored caps. Formerly, the larger size was a 7 pound bottle. The industrial or technical grade acid is usually sold in stainless steel carboys that resemble beer kegs. This acid fumes in moist air.

Nitric Acid, Fuming, HNO₃: This is a more concentrated form of nitric acid having a minimum strength of 90.0% and a sp.gr. of 1.500. Unlike 70% nitric acid, this acid is usually reddish in color due to free nitrogen oxides. Like the name suggests its fumes strongly when opened to the air.

Perchloric Acid, HClO₄: Perchloric acid is sold in three, ACS reagent, strengths for laboratory use. The typical strength is 69.0% to 72.0% with a sp.gr. of 1.660. There are two weaker strengths of 60.0% to 62.0% with a sp.gr. of 1.540 and of 48.0% to 50.0% with a sp.gr. of 1.400. The usual sizes of this acid for laboratory use are 500 mL and 2.5 L.

A technical grade acid for industrial use is sold with a concentration of 68.0% to 72.0% and is usually sold in sizes of greater than 50 liters.

Phosphoric Acid, H₃PO₄: This mineral acid has many uses in both the laboratory and industry. The usual strength is 85.0% minimum and it has a sp.gr. of 1.690. This acid does not fume in air. The typical laboratory sizes are 500 mL and 2.5 L.

Sulfuric Acid, H_2SO_4 : Sulfuric acid is considered to be the most valuable and most useful of all chemicals after water. It is sold as both an ACS reagent grade acid with a concentration of 95.0% to 98.0% and a sp.gr. of 1.840, and an industrial grade acid with a concentration of 93% and a density of 66° Baume (sp.gr. = 1.835).

The reagent acid is sold in 500 mL and 2.5 L bottles. Formerly, the larger size was a 9-pound, 5-pint bottle with a yellow cap. This acid does not fume in air and has no noticeable odor.

Sulfuric Acid, Fuming, $\text{H}_2\text{SO}_4 + x\text{SO}_3$: As the name suggests, this acid fumes in moist air due to the high concentration of sulfur trioxide dissolved in the acid. The ACS reagent acid has an assay of 18.0% to 24.0% SO_3 . It is usually sold in 500 mL and 4 Kg sizes. Another concentration with 26.0% to 29.5% SO_3 is also available from some suppliers.

Publication #SI-1-v.1.0