

Formaldehyde

The chemical compound formaldehyde, is a gas with a strong pungent smell. It is the simplest aldehyde. The chemical formula is H_2CO and has a boiling point of -21°C (262 K). Formaldehyde was first synthesized by the Russian chemist Aleksandr Butlerov in 1859 but it was conclusively identified by Hoffman in 1867.

Formaldehyde readily results from the incomplete combustion of carbon-containing materials. It may be found in the smoke from forest fires, in automobile exhaust, and in tobacco smoke. In the atmosphere, formaldehyde is produced by the action of sunlight and oxygen on atmospheric methane and other hydrocarbons. Small amounts of formaldehyde are produced as a metabolic byproduct in most organisms, including humans.

Terminology

The relationship between formalin, formaldehyde and paraformaldehyde is often confusing. This comes from the historical usage of the terms, which were often quite imprecise.

Formaldehyde

This chemical has the formula HCHO and it is called formaldehyde. It is a gas. The often used expression 37-40% formaldehyde is a misnomer as it infers that the gas dissolves in water to a saturation point somewhere between those concentrations, whereas it actually depends on whether the saturation point is measured by weight (37%) or by volume (40%).

Formalin

A solution of formaldehyde in water, of any concentration, is called formalin. The saturated solution of formaldehyde in water is sometimes called strong formalin, or 100% formalin, or saturated formalin. All refer to the same thing.

10% Formalin

10% formalin is a 1:10 dilution of 100% formalin in water, i.e. 1 part saturated formaldehyde in water diluted with 9 parts plain water. Since 100% formalin contains 40% formaldehyde, a 1:10 dilution would contain 4% formaldehyde. Since 100% formalin usually contains some methanol to inhibit polymerisation, it will also contain a small amount of this.

Paraformaldehyde

Paraformaldehyde is polymerised formaldehyde, usually obtained as a white powder. If mixed with water and heated it depolymerises and dissolves in the water. A 4% solution made by heating 4 grams paraformaldehyde in 100 mL water until it has all dissolved is the same as 4% formaldehyde, i.e. once it has depolymerised it is no longer paraformaldehyde. It is a formaldehyde solution, aka formalin. Since it is made from pure formaldehyde polymer it will contain no methanol unless deliberately added. For this reason it has been called "methanol free 10% formalin".

10% formalin and 4% formaldehyde on the one hand, and 4% paraformaldehyde on the other, are essentially all the same and differ only in the presence of a small amount of methanol in the former.

Most references in the histological world now recommend that the terms be used with the following meanings to improve communication.

- **Formaldehyde:** the gas HCHO.
- **Formalin:** formaldehyde dissolved in water without reference to concentration. Its use to mean 10% formalin is deprecated.
- **100% formalin:** formaldehyde gas dissolved in water to saturation, usually containing a varying amount of methanol.
- **Strong formalin:** same as 100% formalin.
- **Saturated formalin:** same as 100% formalin. Deprecated
- **x% formalin:** x parts 100% formalin diluted with 100-x parts water or other diluent. This use to refer to 10% formalin is encouraged.
- **Paraformaldehyde:** polymerised formaldehyde dry chemical.
- **4% paraformaldehyde:** deprecated.
- **4% formaldehyde:** deprecated.

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