

## Introduction

Ethylene glycol, 1,2-ethandiol, with the molecular formula  $\text{HOCH}_2\text{CH}_2\text{OH}$ , is the simplest diol. It was first prepared by Wurtz in 1859 by the treatment of 1,2-dibromoethane with silver acetate to give ethylene glycol di-acetate, which was then hydrolyzed to ethylene glycol.

Ethylene glycol was first used industrially in place of glycerol during World War I as an intermediate for explosives (ethylene glycol dinitrate) but has since developed into a major industrial product.

## 2. Uses of Ethylene Glycol

The following is a summary of the major uses of ethylene glycol:

### Antifreeze

A major use of ethylene glycol is as antifreeze for internal combustion engines. Solutions containing ethylene glycol have excellent heat transfer properties and higher boiling points than pure water. Accordingly, there is an increasing tendency to use glycol solutions as a year-round coolant. Ethylene glycol solutions are also used as industrial heat transfer agents

Mixtures of ethylene glycol and propylene glycol are used for defrosting and de-icing aircraft and preventing the formation of frost and ice on wings and fuselages of aircraft while on the ground. Ethylene glycol-based formulations are also used to de-ice airport runways and taxiways.

Asphalt-emulsion paints are protected by the addition of ethylene glycol against freezing, which would break the emulsion. Carbon dioxide pressurized fire extinguishers and sprinkler systems often contain ethylene glycol to prevent freezing.

Ordinary dynamite will freeze at low temperatures and cannot then be detonated. Ethylene glycol dinitrate, which is an explosive itself, is mixed with dynamite to depress its freezing point and make it safer to handle in cold weather. Mixtures of glycerol and ethylene glycol are nitrated in the presence of sulfuric acid to form solutions of

nitroglycerin in ethylene glycol dinitrate, which are added to dynamite in amounts ranging from 25 to 50%.

### Polyester Fibers

The use of ethylene glycol for fibers is becoming the most important consumer of glycol worldwide. These fibers, marketed commercially under various trade names like Dacron, Fortel, Kodel, Terylene etc are made by the polymerization of ethylene glycol with bishydroxyethyl terephthalate (Bis HET).

### Resins

Polyester resins made from maleic and phthalic anhydrides, ethylene glycol, and vinyl-type monomers have important applications in the low-pressure lamination of glass fibers, asbestos, cloth and paper. Polyester-fiberglass laminates are used in the manufacture of furniture, automobile bodies, boat hulls, suitcases and aircraft parts.

Alkyd-type resins are produced by the reaction of ethylene glycol with a dibasic acid such as *o*-phthalic, maleic or fumaric acid. These resins are used to modify synthetic rubbers, in adhesives, and for other applications. Alkyds made from ethylene glycol and phthalic anhydride are used with similar resins based on other polyhydric alcohols, such as glycerol or pentaerythritol in the manufacture of surface coatings.

Resin esters made with ethylene glycol are used as plasticizers in adhesives, lacquers and enamels.

### Hydraulic Fluids

Ethylene glycol is used in hydraulic, brake and shock absorber fluids to help dissolve inhibitors, prevent swelling of rubber, and inhibit foam formation. Hydrolubes, which are water-based mixtures of polyalkylene glycols and presses and die casting machines, and in airplane hydraulic systems because of their relatively low viscosity at high pressure. An added advantage of primary importance is that these hydrolubes are inflammable.

### Capacitors

Ethylene glycol is used as a solvent and suspending medium for ammonium perborate, which is the conductor in almost all electrolytic capacitors. Ethylene glycol, which is of high purity (iron and chloride free), is used because it has a low vapor pressure, is non-corrosive to aluminum and has excellent electrical properties.

### Glyoxal

An important use for ethylene glycol is as the intermediate for the manufacture of glyoxal, the corresponding dialdehyde. Glyoxal is used to treat polyester fabrics to make them “permanent press.”

### Other uses

Ethylene glycol is used to stabilize water dispersions of urea-formaldehyde and melamine-formaldehyde from gel formation and viscosity changes. It is used as a humectant for textile fibers, paper, leather and adhesives and helps make the products more softer, more pliable and durable.