

Ethanol

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Introduction

- Ethyl alcohol, $\text{CH}_3\text{CH}_2\text{OH}$ (synonyms: ethanol, methyl carbinol, grain alcohol, molasses alcohol, grain neutral spirits, cologne spirit, wine spirit), is a colorless, neutral, mobile flammable liquid with a molecular weight of 46.07, a boiling point of 78.3 and a sharp burning taste.
- Although known from antiquity as the intoxicating component of alcoholic beverages, its formula was worked out in 1808.

Properties

- Also referred to as ethyl alcohol.
- It's chemical formula: $\text{CH}_3\text{CH}_2\text{OH}$.
- Molecular Weight: 46.07grams.
- Ethanol is an alcohol (has a hydroxyl group, an -OH bonded to a carbon atom).
- Is a clear, colorless liquid with slight odor.
- In dilute aqueous solution, has relatively sweet flavor, but when concentrated, it has a burning taste.

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Properties (continued)



- Melting point of -114.1 degrees Celsius.
- Boiling point of 78.5 degrees Celsius.
- Density of 0.798 g/mL at 20 degrees Celsius.
- Stable but highly flammable.
- Incompatible with acids, alkali metals, moisture, peroxides, etc.



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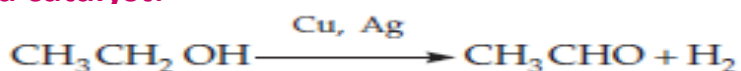
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Properties of Ethanol

- Ethyl alcohol undergoes a wide range of reactions, which makes it useful as a raw material in the chemical industry.

- Some of the reactions are as follow:

- (i) **Oxidation:** Ethanol may be oxidized to acetaldehyde by oxidation with copper or silver as a catalyst:



- (ii) **Halogenation:** Halides of hydrogen, phosphorous and other compounds react with ethanol to replace the – OH group with a halogen:



Properties of Ethanol

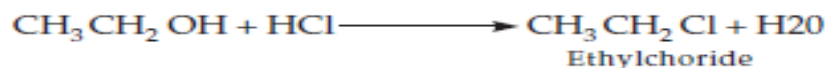
- (iv) **Haloform Reaction:** Hypohalides will react with ethanol to yield first acetaldehyde and finally the haloform reaction:



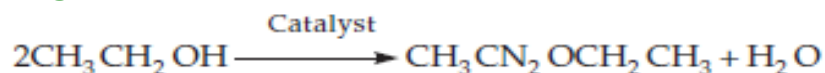
Chloroform

Properties of Ethanol

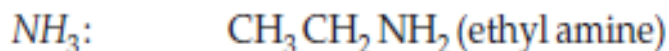
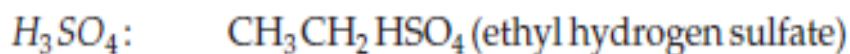
(v) Esters: Ethanol reacts with organic and inorganic acids to give esters:



(vi) Ethers: Ethanol may be dehydrated to give ethers



(vii) Alkylation: Ethanol alkylates (adds alkyl-group to) a large number of compounds:



Uses of Ethanol

1. Used as thermometer for temp.'s below Hg's freezing point (- 40 degrees Celsius).
 2. Used as antifreeze in automobile radiators.
 3. Used to make several types of alcohol (such as whisky and brandy).
 4. Used to burn in automobile engines like gasoline.
- Ethanol can be mixed with gasoline (1:9) to help reduce air pollution- CO is reduced in exhaust gas

Uses of Ethanol (continued)

5. **Use as a chemical feed stock:** In the chemical industry, ethanol is an intermediate in many chemical processes because of its great reactivity as shown above. It is thus a very important chemical feed stock.
6. **Solvent use:** Ethanol is widely used in industry as a solvent for dyes, oils, waxes, explosives, cosmetics etc.

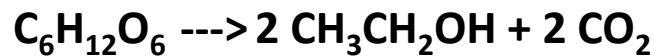
Uses of Ethanol (continued)

7. **General utility:** Alcohol is used as a disinfectant in hospitals, for cleaning and lighting in the home, and in the laboratory second only to water as a solvent.
8. **Fuel:** Ethanol is mixed with petrol or gasoline up to 10% and known as gasohol and used in automobiles.

The Alcohol Part



- Made since ancient times by fermentation of sugars (beverage ethanol is still made by this process: simple sugars are the raw material, and Zymase an enzyme from yeast, changes the simple sugars into ethanol and carbon dioxide by this the formula)



- Reaction is complex because impure cultures of yeast produce other substances and various other organic acids (in the production of beverages, such as whisky and brandy, the impurities bring about flavor)

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The Alcohol Part (continued)

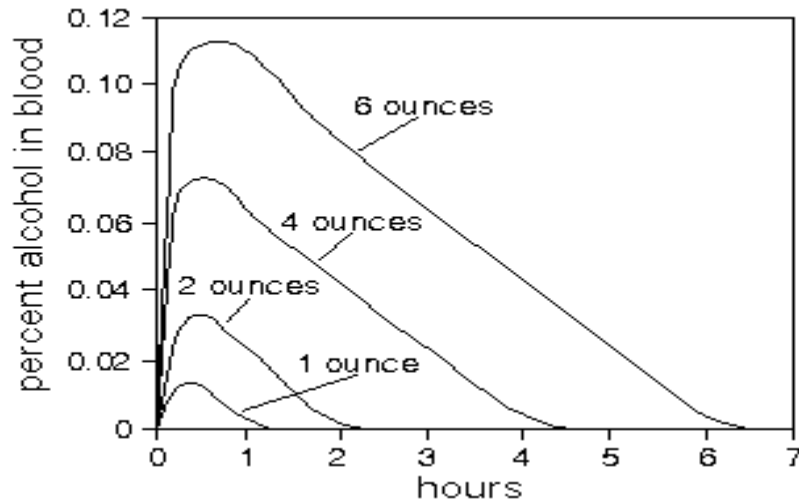
- ✓ Since ethanol is toxic, the body disposes of it immediately.
- ✓ Ethanol acts as a depressant that affects the central nervous system and suppresses certain brain functions.
- ✓ Classic symptoms of intoxication include: slurred speech, unsteady walk, inability to react quickly, etc.
- ✓ However, moderate amounts of alcohol stimulate the mind and relax the muscles.

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The Alcohol Part



Ethanol in the Brain

- Ethanol affects neurotransmitters in the brain.
- One neurotransmitter is gamma-aminobutyric acid (GABA).

Production

- **Three main processes for the manufacture of ethanol:**
 - ✓ **fermentation of carbohydrates (transformation of carbohydrates to ethanol by growing yeast cells).**
 - ✓ **hydration of ethylene (achieved by passing a mixture of ethylene and a large excess of steam)- most common process used in USA today (70 to 90 percent).**
 - ✓ **reduction of acetylene (achieved by hydration of acetylene).**

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Production (continued)

- **Because there is a tax in all countries on the production of ethyl alcohol for beverage purposes, the ethyl alcohol that is used for industrial purposes must be rendered unfit to drink (denatured) to escape taxation.**

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Denatured Alcohol

- All over the world and even in ancient times, governments have derived revenue from potable alcohol. For this reason when alcohol is used in large quantities it is denatured or rendered unpleasant to drink.
- The base of denatured alcohol is usually 95% alcohol with 5% water; for domestic burning or hospital use denatured alcohol is dispended as methylated spirit, which contains a 10% solution of methanol, pyridine and coloring material.

Denatured Alcohol

- For industrial purpose methanol is used as the denaturant.
- In the United States alcohol may be completely denatured (C.D.A. – completely denatured alcohol) when it cannot be used orally because of a foul taste or four smelling additives.
- It may be specially denatured (S.D.A. – specially denatured alcohol) when it can still be used for special purposes such as vinegar manufacture without being suitable for consumption.