

PROPERTIES OF ISOAMYL ALCOHOL.

Physical properties:

Isoamyl alcohol is a clear water white liquid. It has an unpleasant, irritating, non residual, disagreeable odor which on dilution becomes agreeably fruity bitter. It has a burning or pungent taste and an apricot flavor. It is slightly soluble in water, and is miscible with alcohol and ether

Synonym	3-methyl-1-butanol
Structure	$(\text{CH}_3)_2\text{CHCH}_2\text{CH}_2\text{OH}$
Classification	Primary alcohol
Melting point ($^{\circ}\text{C}$)	-117.20
Normal boiling point($^{\circ}\text{C}$)	130.60 (at 760 mm Hg)
Density d_4^{20}	0.8120
Specific Gravity (20/4)	0.8094
Refractive Index n_D^{20}	1.4084
Water solubility(g/100 ml)	-----
Solubility of water in wt%(20 $^{\circ}\text{C}$)	-----
Surface tension (dynes per cm.)	25.30 (in air) at 0 $^{\circ}\text{C}$
	23.80 at 20 $^{\circ}\text{C}$
	17.70 at 100 $^{\circ}\text{C}$
Flash point (Open Cup) ($^{\circ}\text{C}$)	56
(Closed Cup) ($^{\circ}\text{C}$)	43
Viscosity (mPas) (cP)	3.86 (at 24 $^{\circ}\text{C}$)
	1.49 (at 59 $^{\circ}\text{C}$)
Inflammability Range (volume per cent air)	1.2 (lower limit)
Heat of vapourization(J/g. $^{\circ}\text{K}$)	500.3
Specific heat (J/g. $^{\circ}\text{K}$)	2.39
(g-cal/g $^{\circ}\text{C}$)	0.686 at 75 $^{\circ}\text{C}$ (liquid)
Coefficient of expansion ($^{\circ}\text{C}$)	0.00089
Weight per gallon (lb)	6.79 at 20 $^{\circ}\text{C}$
Vapor pressure (kPa)	0.27 at 20 $^{\circ}\text{C}$
Critical pressure, P_c (Pa)	3.90×10^6
Critical temperature, T_c ($^{\circ}\text{K}$)	577.20
Critical volume, V_c (m^3/kmol .)	0.327
Critical Acentric Factor, ω_c	0.586
Critical Compressibility Factor, Z_c	0.266

Table 2.1. Physical properties of Isoamyl alcohol

Acidity as acetic acid	0.01% max.
Color, APHA	No. 10 max.
Dryness	A 5ml. sample is clearly miscible with at least 19 parts of 60 Be' gasoline at 60°F.
Easters	Not more than 0.06% as amyl acetate.
Fire Hazard	Moderate
MAC	100 ppm in air.
Molecular Weight	88.15
Non-volatile matter	0.003% max.
Odor	Alcoholic, non-residual.
Toxicity	Highly toxic by ingestion and inhalation.
Auto-ignition Temperature (°F)	657

Table 2.1(cont.) Physical Properties of Isoamyl Alcohol.

Chemical properties:

Isoamyl alcohol undergoes reactions that are typical of the alcohols of a corresponding class and isomeric structure.

The reactions of Isoamyl alcohol are of the following types:

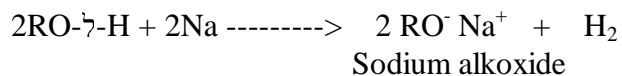
- i. Reactions that result in O-H bond cleavage, RO- $\dot{\gamma}$ -H
- ii. Reactions that result in C-O bond cleavage, R- $\dot{\gamma}$ -OH
- iii. Reactions that result in oxidation of the carbinol carbon

Where R= C₅H₁₁ = (CH₃)₂-CH-CH₂-CH₂

A. Reactions that result in O-H bond cleavage, RO- $\dot{\gamma}$ -H

1. Salt Formation:

Isoamyl alcohol is not sufficiently acidic to react with bases such as sodium or potassium hydroxide, but will react with active metals to yield alcoholate, or alkoxide, of the metal and liberate hydrogen gas.

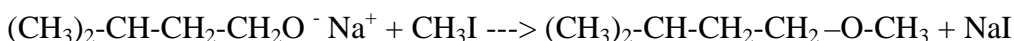


Where R= C₅H₁₁ = (CH₃)₂-CH-CH₂-CH₂

Primary alcohols like Isoamyl alcohol exhibit a greater reactivity on treatment with sodium metal than do secondary alcohols. Of the alkali metals, potassium is more reactive toward any class of alcohols than in sodium.

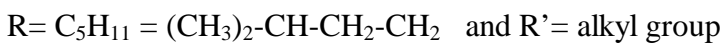
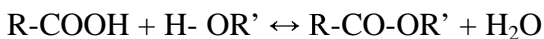
2. Ether Formation:

The alkoxides of the alkali metals are strong bases (nucleophiles) that easily enter into S_N2 displacements of halogen from alkyl halides. This reaction, referred to as the **Williamson Ether Synthesis**, is best used to prepare mixed ethers.



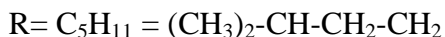
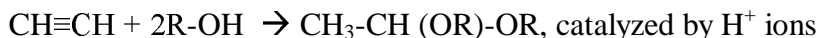
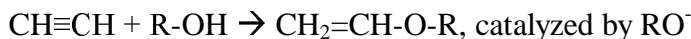
3. Ester Formation:

Isoamyl Alcohol, when permitted to react with carboxylic acids, produce ester. The reaction is catalyzed by strong mineral acids and, as indicated by the double arrow in the equation, is reversible.



4. Vinylation:

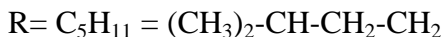
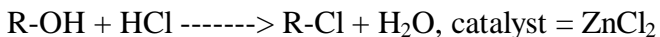
Isoamyl alcohol under goes Vinylation reaction with reacted with acetylene. These reactions are catalyzed by H^+ ions.



B. Replacement of the hydroxyl Group by Acid Anions:

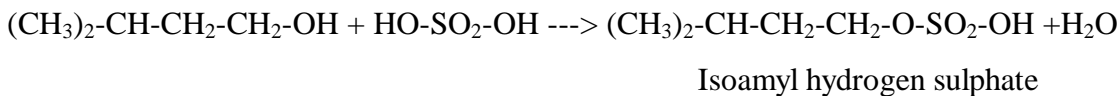
1.

Treatment of an aliphatic alcohol with the **Lucas reagent** (a solution of zinc chloride in concentrated hydrochloric acid) produces an alkyl chloride.



The alkyl chloride, when formed in this manner, is insoluble in the reagent and produces either a cloudy appearance or forms two layers.

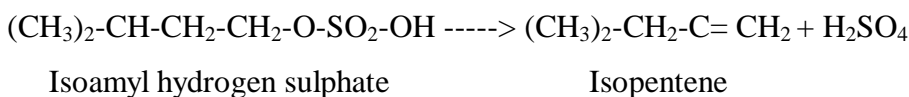
Isoamyl alcohol, when treated with concentrated sulphuric acid at room temperature produces Isoamyl hydrogen sulphate.



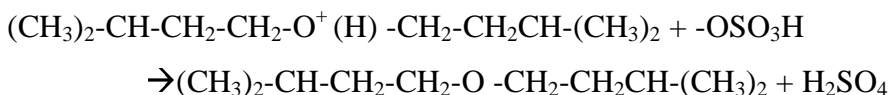
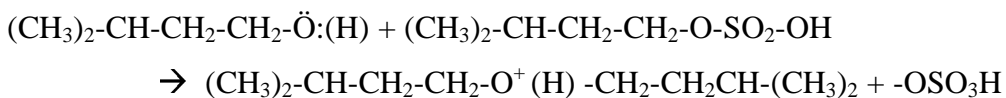
The Isoamyl hydrogen sulphate still has one acidic hydrogen remaining, and is capable of forming salt. The sodium salt of the long chain alkyl hydrogen sulphates are excellent detergents.

2. Cleavage of the C-O bond. Dehydration:

Isoamyl alcohol may, in effect, be hydrated to an olefin when its hydrogen sulphate ester is heated to 150°C or higher.



If the hydrogen sulphate ester is heated with an excess of alcohol at a temperature lower than 150°C, the bisulphate ion is displaced by alcohol to produce ether.



C. Oxidation:

When oxidized, primary alcohols give organic products containing the same number of carbon atoms. Primary alcohols can be oxidized to carboxylic acids. Reagents usually employed for the oxidation of alcohols are potassium dichromate in combination with concentrated sulphuric acid, or a hot, alkaline solution of potassium permanganate.

