STUDY OF HETEROCYCLIC COMPOUND TETRAHYDROFURAN (THF)

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ABSTRACT

Tetrahydrofuran (**THF**) is an organic compound with the formula $(CH_2)_4O$. It is a colorless, water-miscible organic liquid with low viscosity at standard temperature and pressure. The compound is heterocyclic. A **heterocyclic compound** is a cyclic compound that has atoms of at least two different elements as members of its ring(s). The counterparts of heterocyclic compounds are **homo cyclic compounds** although heterocyclic compounds may be inorganic, most contain at least one carbon. Since in organic chemistry non-carbons usually are considered to replace carbon atoms, they are called heteroatoms, meaning 'different from carbon and hydrogen' (rings of heteroatom of the same element are homocyclic). The IUPAC recommends the Hantzsch-Widman nomenclature for naming heterocyclic compounds. Heterocyclic compounds can be usefully classified based on their electronic structure. The saturated heterocyclics behave like the acyclic derivatives. Thus, piperidine and Tetrahydrofuran are conventional amines and ethers, with modified steric profiles.

Key Words: Acyclic derivatives, Tetrahydrofuran and piperidine, amines and ethers

INTRODUCTION

Heterocyclic chemistry is the branch of chemistry dealing with synthesis, properties, and applications of heterocycles **Classification based on electronic structure.** The study of heterocyclic chemistry focuses especially on unsaturated derivatives, and the preponderance of work and applications involves unstrained 5- and 6-membered rings. Included are pyridine, thiophene, pyrrole, and furan. Another large class of heterocycles is fused to benzene rings, which for pyridine, thiophene, pyrrole, and furan are quinoline, benzothiophene, indole, and benzofuran, respectively. Fusion of two benzene rings gives rise to a third large family of compounds, respectively the acridine, dibenzothiophene, carbazole, and dibenzofuran. The unsaturated rings can be classified according to the participation of the heteroatom in the pi system. Tetrahydrofuran (THF) is an organic compound with the formula $(CH_2)_4O$. It is a colorless, water-miscible organic liquid with low viscosity at standard temperature and pressure. The compound is heterocyclic. As one of the most polar ethers with a wide liquid range, it is a useful solvent. Its main use is as a precursor to polymers. THF has an odor similar to its chemical cousin, diethyl ether, but is a much less potent anesthetic than diethyl ether.

REVIEW OF LITERATURE

About two hundred thousand tones of Tetrahydrofuran are produced annually. The most widely used industrial process involves the acid-catalyzed dehydration of 1,4-butanediol, akin to the production of diethyl ether from ethanol. The butanediol is derived from condensation of acetylene with formaldehyde followed by hydrogenation. Du Pont developed a process for producing THF by oxidizing n-butane to crude maleic anhydride followed by catalytic hydrogenation. A third major industrial route entails hydroformylation of allyl alcohol followed by hydrogenation to the butanediol.

THF can also be synthesized by catalytic hydrogenation of furan. Where furan is derived from pentose, this method can involve renewable resources. Nevertheless, this route is not widely practiced.

MATERIAL AND METHOD

THF can be polymerized by strong acids to give a linear polymer called poly (tetramethylene ether) glycol (PTMEG), CAS Registry Number [25190-06-1], also known as PTMO, polytetramethylene oxide. The primary use of this polymer is to make elastomeric polyurethane fibers like Spandex.

THF is also a starting material for the preparation of tetrahydrothiophene using hydrogen Sulphide over a heterogenous acid catalyst. The other main application of THF is as an industrial solvent for PVC and in varnishes. It is an aprotic solvent with a dielectric constant of 7.6. It is a moderately polar solvent and can dissolve a wide range of nonpolar and polar chemical compounds. THF is water-miscible, and can form solid clathrate hydrate structures with water at low temperatures.

Laboratory use

Although a minor application, THF is a popular solvent in the laboratory when a moderately higher-boiling ethereal solvent is required and its water miscibility is not an issue. The oxygen center of ethers can coordinate to Lewis acids such as Li^+, Mg^{2+}, and boranes, forming adducts. Hence, like diethyl ether, THF can be used in hydro oration reactions to synthesize primary alcohols, and as a solvent for organ metallic compounds such as organolithium and Grignard reagents. Although similar to diethyl ether, THF is a stronger base. Thus, while diethyl ether remains the solvent of choice for some reactions (e.g., Grignard reactions), THF fills that role in many others where strong coordination is desirable, and the precise properties of ethereal solvents such as these (alone and in mixtures and at various temperatures) allows for fine-tuning modern chemical reactions.

THF is often used in polymer science. For example, it can be used to dissolve polymers prior to determining their molecular mass using gel permeation chromatography. THF dissolves PVC as well and is the main ingredient in PVC adhesives. It can be used to liquefy old PVC cement, and is often used industrially to degrease metal parts.

THF is used as a component in mobile phases for reversed-phase liquid chromatography. It has greater elution strength than methanol or acetonitrile, but is less commonly used than these solvents.

CONCLUSION AND RESULT

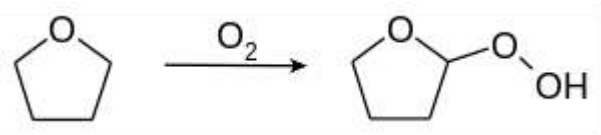
2-Methyl THF

2-Methyltetrahydrofuran (2MeTHF) is a THF alternative that is being promoted as being more ecologically friendly. Whereas 2-MeTHF is more expensive, it may provide for greater overall process economy. 2MeTHF has solvating properties that are intermediate between diethyl ether and THF, has limited water-miscibility, and forms an azeotrope with water on distillation. Its lower melting point makes it useful for lower temperature reactions, and its higher boiling point allows procedures under reflux at higher temperatures (relative to THF).

Precautions

THF is considered a relatively nontoxic solvent, with the median lethal dose (LD_{50}) comparable to that for acetone. Reflecting its remarkable solvent properties, it penetrates the skin causing rapid dehydration. THF readily dissolves latex and is typically handled with nitrile or neoprene rubber gloves. It is highly flammable.

The greatest danger posed by THF follows from its tendency to form highly-explosive peroxides on storage in air. To minimize this problem, commercial samples of THF are often inhibited with BHT. THF should not be distilled to dryness, because the explosive peroxides concentrate in the residue.



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