

Meso 2,3 Butanediol

Decoding Meso-2,3-Butanediol: A Deep Dive into its Chemistry and Applications

Meso-2,3-butanediol, often abbreviated as meso-2,3-BD, is a fascinating chiral molecule with significant implications across various fields. This article aims to provide a comprehensive understanding of meso-2,3-butanediol, exploring its structure, properties, synthesis, and applications. We will delve into its unique characteristics stemming from its internal symmetry and examine its role in different industries.

Understanding the Structure and Stereochemistry

Meso-2,3-butanediol is a vicinal diol, meaning it possesses two hydroxyl (-OH) groups on adjacent carbon atoms. The crucial aspect of this molecule lies in its stereochemistry. Butanediol itself can exist as four stereoisomers: two enantiomers (R,R and S,S) and two diastereomers, one of which is meso-2,3-butanediol. The meso isomer possesses an internal plane of symmetry, which bisects the molecule, rendering it achiral despite having two chiral centers. This internal symmetry effectively cancels out the optical activity that would otherwise be present in its chiral counterparts. This can be visualized by imagining a plane cutting through the molecule, dividing it into two mirror-image halves.

Physical and Chemical Properties

Meso-2,3-butanediol is a colorless, viscous liquid at room temperature. Its relatively high boiling point (190–192 °C) reflects the presence of strong intermolecular hydrogen bonds between the hydroxyl groups. It exhibits good solubility in water and polar organic solvents, due to its ability to form hydrogen bonds. The chemical reactivity of meso-2,3-butanediol is largely dictated by its hydroxyl groups, which can participate in various reactions like esterification, etherification, and oxidation. For instance, reacting it with acetic acid will produce a diacetate ester.

Synthesis of Meso-2,3-Butanediol

Several methods exist for synthesizing meso-2,3-butanediol. One common route involves the reduction of acetoin (3-hydroxy-2-butanone). This can be achieved using various reducing agents, such as sodium borohydride (NaBH_4) or catalytic hydrogenation. Another approach utilizes the fermentation of sugars by specific microorganisms. Certain bacterial strains can selectively produce meso-2,3-butanediol as a major byproduct during fermentation, making this a potentially sustainable and environmentally friendly synthesis method. This bio-based production is gaining traction due to increasing demands for environmentally friendly chemicals.

Applications in Diverse Industries

The applications of meso-2,3-butanediol span various sectors: Polymer Chemistry: Meso-2,3-butanediol serves as a valuable monomer or comonomer in the synthesis of polyesters and polyurethanes. Its incorporation improves the flexibility and hydrophilicity of the resulting polymers. For example, it can be used in the production of biodegradable plastics. Pharmaceutical Industry: It's used as an intermediate in the synthesis of various pharmaceuticals, acting as a building block for more complex molecules with potential medicinal properties. Cosmetics and Personal Care: Due to its moisturizing properties, it finds application in lotions, creams, and other personal care products. Its humectant properties attract and retain moisture. Solvent and Reagent: Its ability to dissolve both polar and non-polar compounds makes it a useful solvent in certain chemical reactions. Additionally, it can serve as a reagent in various

organic synthesis pathways. Food Industry (potentially): While not currently a widely used food additive, its potential as a food-grade humectant is being explored. Further research and regulatory approval would be necessary before widespread use.

Conclusion

Meso-2,3-butanediol, with its unique stereochemical properties and versatile reactivity, stands as a crucial chemical compound. Its significance stems from its diverse applications across numerous industries, ranging from polymer science to pharmaceuticals. The growing interest in sustainable and bio-based production methods further underscores its importance in the development of environmentally friendly technologies.

Frequently Asked Questions (FAQs):

1. Is meso-2,3-butanediol toxic? Like many chemicals, meso-2,3-butanediol has a certain level of toxicity. However, its toxicity is relatively low at typical exposure levels. Proper handling and safety measures should always be observed. 2. What is the difference between meso-2,3-butanediol and its chiral isomers? The key difference lies in the stereochemistry. Meso-2,3-butanediol is achiral due to its internal plane of symmetry, while its chiral isomers are optically active. This difference affects their physical properties and reactivity. 3. Can meso-2,3-butanediol be separated from its chiral isomers? Yes, advanced separation techniques like chiral chromatography can be employed to separate meso-2,3-butanediol from its optically active isomers. 4. What are the environmental implications of meso-2,3-butanediol production? Traditional synthetic routes may have some environmental impact. However, bio-based production methods offer a more sustainable alternative, reducing reliance on fossil fuels and minimizing waste. 5. Where can I find meso-2,3-butanediol? Meso-2,3-butanediol can be purchased from various chemical suppliers, both online and offline. The availability may vary depending on the desired purity and quantity.

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2,3-butanediol is the organic compound with the formula CH_3CHOH_2 . It is classified as a vic diol glycol. It exists as three stereoisomers: a chiral pair and the meso isomer.

2,3-butanediol c4h10o2 cid 262 structure chemical names physical and chemical properties classification patents literature biological activities safety hazards toxicity information supplier

2,3-butanediol is a synthetic or plant derived Paula's Choice uses the latter form that can play multiple roles in cosmetics its humectant properties help it to hydrate skin and its solvent dispersing and

2,3-butanedione has three isomers: levo (2R,3R), dextro (2S,3S), and meso forms with optical activity and the meso form with no optical activity. Figure 1 generally shows that 2,3-butanedione has a low freezing point of 60°C and is

other names butane 2 3 diol dimethylethylene glycol 2 3 butylene glycol 2 3 dihydroxybutane d 2 3 butane diol 2 3 butandiol 2 3 butanediol isomer 1 2 3 butanodiol 2 3 butanediol isomer 3

jan 15 2026 2,3 butanediol is a commodity chemical usually produced from oil it can be used as a precursor in the manufacture of a range of chemical products including the solvents methyl ethyl

Jul 25 2024 2,3-butanediol also known as 2,3-butanediol is an organic compound with the formula $C_4H_{10}O_2$. It is a colorless viscous liquid that is miscible with water in all proportions. 2,3

1 3 propanediol and 2 3 butanediol are two promising chemicals which have a wide range of applications and can be biologically produced the separation of these diols from fermentation broth

sep 29 2022 2 3 butanediol 2 3 bd is a fascinating chemical with a wide range of uses the industrial development of this chemical has not been adequately researched due to the presence of

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