METHANOL

Product Overview:

- **Product Name**: Methanol
- **CAS Number**: 67-56-1
- **Molecular Formula**: CH_3OH
- **Synonyms**: Methyl alcohol, Wood alcohol, Carbinol, Methylic alcohol

Chemical and Physical Properties:

- **Molecular Weight**: 32.04 g/mol
- **Density**: 0.7918 g/cm³ (at 20°C)
- **Melting Point**: -97.6°C
- **Boiling Point**: 64.7°C
- **Solubility**: Miscible with water, ethanol, ether, acetone, and chloroform.

Safety and Hazards:

- **Toxicity**: Methanol is highly toxic. Ingesting or inhaling methanol can cause nausea, dizziness, headache, and in extreme cases, blindness, organ failure, and death.
- **Flammability**: Methanol is highly flammable and should be handled with care. It has a flashpoint of 11-12°C.
- **First Aid**: In case of ingestion, induce vomiting immediately and seek medical attention. If inhaled, move the person to fresh air. Contact poison control for further guidance.
- **Precautions**: Avoid contact with skin and eyes, and ensure proper ventilation during use.

Names and Identifiers:

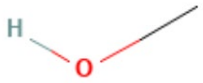
- **CAS Number**: 67-56-1
- **IUPAC Name**: Methanol
- **InChI Key**: XLYOFNOQVPJJNP-UHFFFAOYSA-N
- **Other Synonyms**: Methyl alcohol, Wood alcohol, Carbinol, Methylic alcohol.

Regulatory Information:

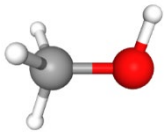
- **FDA**: Methanol is approved for use in certain industrial applications but is not approved for direct human consumption.
- **EU**: Methanol is classified under the **REACH Regulation** in the EU. It is also listed in the **EINECS (European Inventory of Existing Commercial Chemical Substances)**.
- **OSHA**: The Occupational Safety and Health Administration (OSHA) in the U.S. has set guidelines for handling methanol in workplaces to prevent health hazards.

✓ **Structural Information**:

- **2D and 3D Images**:
  - 2D Structure:



  - 3D Conformer:



✓ **Vendors and Supply Chain**:

- **Suppliers**: Methanol is widely available from **chemical suppliers**, **industrial chemical vendors**, and major **petrochemical companies**.
- **Bulk Pricing**: Pricing varies depending on market conditions, quantity, and supplier. Typically, methanol is sold in bulk quantities ranging from **drums (200 liters)** to **tankers**.
- **Purchase Links**: Available through major chemical suppliers like **Sigma-Aldrich**, **Thermo Fisher**, and **Dow Chemical**.

✓ **Use and Manufacturing**:

- **Fuel**: Used as a fuel or fuel additive in internal combustion engines and as a fuel for some experimental cars.
- **Chemical Manufacturing**: A precursor to many important chemicals, including formaldehyde, acetic acid, and various plastics.
- **Solvent**: Commonly used as a solvent in paints, varnishes, and lacquers.
- **Antifreeze**: Used in antifreeze formulations due to its low freezing point.
- **Pharmaceuticals**: Used as a solvent in medications and as a topical disinfectant.
- **Electronics Industry**: Used in the manufacture of integrated circuits and other electronic components.

✓ **Toxicity**:

- **Toxicity Information**: Methanol is highly toxic when ingested, inhaled, or absorbed through the skin. It can cause symptoms such as headache, dizziness, nausea, vomiting, and, in severe cases, coma and death.
- **Lethal Dose**: The lethal dose for humans is approximately 30 to 240 mL of pure methanol. Immediate medical attention is critical if exposure occurs.
- **Effects on Health**: Long-term exposure or high concentrations of methanol can cause permanent damage to the nervous system, including blindness, organ failure, and death.

✓ Materials and Industries Using Methanol

1. **Fuel**:
    - **Methanol** is used as an alternative **fuel** or **fuel additive**. It is blended with gasoline to produce **M85** (85% methanol and 15% gasoline) for use in **methanol-powered vehicles**. It is also used in **flex-fuel vehicles**.
    - **Material Interaction**: Methanol's high octane rating helps improve engine performance.
2. **Chemical Manufacturing**:
    - **Formaldehyde Production**: Methanol is the primary feedstock for the production of **formaldehyde**, which is then used in the production of resins, plastics, and other chemicals.
    - **Acetic Acid Production**: Methanol is used in the **Cativa process** to produce **acetic acid**, an important chemical for manufacturing **acetates** and **vinegar**.
    - **Plastics**: Methanol is used in the production of **polycarbonate**, **epoxies**, and other polymers.
    - **Material Interaction**: Methanol reacts with other chemicals like carbon monoxide (CO) and hydrogen (H_2) in industrial processes to create these valuable compounds.
3. **Solvent**:
    - Methanol is widely used as a **solvent** in the **pharmaceutical**, **cosmetic**, and **chemical industries**.
    - **Material Interaction**: It dissolves a wide variety of organic and inorganic compounds, which makes it a versatile solvent in many applications, including **paint thinners**, **varnishes**, **cleaning agents**, and **inks**.
4. **Pharmaceuticals**:
    - **Methanol** is used as a **solvent** and **extractant** in the preparation of pharmaceutical products. It is also used in the production of **methanol-based topical disinfectants**.
    - **Material Interaction**: Methanol dissolves active pharmaceutical ingredients and helps extract compounds from raw plant materials in the formulation of medicines.
5. **Antifreeze and De-icer**:
    - Methanol is used in **antifreeze formulations** because of its low freezing point. It is also used as a **de-icing fluid** for **aircraft** and **roads** during the winter.

- **Material Interaction**: Methanol lowers the freezing point of water, making it an effective solution for preventing ice formation.

6. **Electronics Industry**:
   - **Methanol** is used in the **electronics industry** to clean components and in the production of **semiconductors** and **flat panel displays**.
   - **Material Interaction**: Methanol dissolves oils, fluxes, and residues left over from manufacturing processes.
7. **Gasoline Additive**:
   - Methanol is used as a **gasoline oxygenate** to increase the oxygen content of fuel, reducing vehicle emissions and improving fuel efficiency.
   - **Material Interaction**: When blended with gasoline, methanol helps improve the combustion process by increasing oxygen availability.
8. **Paints, Coatings, and Adhesives**:
   - **Methanol** is used as a **solvent** in the production of **paints**, **coatings**, and **adhesives**.
   - **Material Interaction**: Methanol helps dissolve pigments and resins, ensuring smooth application and better adhesion to surfaces.
9. **Food Industry**:
   - **Methanol** is used in the **production of artificial sweeteners** like **aspartame** and as a **carrier solvent** for flavoring agents.
   - **Material Interaction**: It helps in the extraction of compounds and maintains the stability of food products.
10. **Fuels and Energy**:
    - **Methanol** is used in **biofuels** and **renewable energy** production. It can be derived from biomass through gasification and used as a fuel for internal combustion engines or in **methanol fuel cells**.
    - **Material Interaction**: Methanol serves as a cleaner alternative to gasoline and diesel in energy production.
11. **Pulp and Paper Industry**:
    - **Methanol** is used as a **solvent** in the **pulping process** in the paper industry, where it helps to break down lignin and release cellulose fibers.
    - **Material Interaction**: Methanol helps dissolve the lignin in wood, making it easier to extract the cellulose needed for paper production.
12. **Leather Industry**:
    - **Methanol** is used in the **leather tanning process** to remove natural oils from animal hides before tanning.
    - **Material Interaction**: Methanol helps in the degreasing of hides, making them more receptive to tanning chemicals.
13. **Personal Care and Cosmetics**:
    - **Methanol** is used as a **solvent** and **preservative** in cosmetics and personal care products, including **shampoos**, **soaps**, and **perfumes**.

- **Material Interaction**: Methanol helps dissolve active ingredients, making it easier for them to be incorporated into cosmetic formulations.

14. **Paint Removal and Cleaning**:
    - **Methanol** is often used in **paint removers** and **cleaning agents** due to its effectiveness in dissolving resins, oils, and other organic compounds.
    - **Material Interaction**: Methanol breaks down paint, varnish, and adhesives, making it easier to remove from surfaces.
15. **Battery Manufacturing**:
    - **Methanol** is used in **sodium-ion** and **fuel cell** technology as a key component in the production of batteries and energy storage solutions.
    - **Material Interaction**: Methanol helps in the generation of **hydrogen** for fuel cells and is used in other battery-related chemical processes.
16. **Fertilizers**:
    - **Methanol** is sometimes used in the manufacture of **urea-formaldehyde fertilizers** and other nitrogen-based fertilizers.
    - **Material Interaction**: Methanol helps in the synthesis of **urea** and **ammonium nitrate**.