DME Production & Standardization in China

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ENN Group
Overview of DME Production in China

Introduction of DME Standardization in China

Introduction of Issued DME Standards
Overview of DME Production in China

As of 2010, the total capacity was 9.828 Mt and output was 2.377 Mt.
Due to policies and market fluctuation, DME price had been experiencing climbing—falling—escalating slowly—falling—climbing between 2007-2010.
Overview of DME Production in China

DME Production Technology in China

- One-step Process
  - (Tsinghua, DLCP, etc.)
  - No industrialized operation

- Two-step Process
  - (Industrialized facilities in operation)

- Liquid phase process technology
  - (China Energy)

- Gas phase process technology
  - (ENN, etc.)
Main Features of ENN DME Technology

(1) Proper process flow: Feedstock methanol splits into two flows to the different heat exchange systems and recovers the system heat at multi-levels, flexible heat exchange, high heat utilization and very low energy consumption.

(2) Catalyst with hydration resistance and anti-carbon deposition: Low light-off temperature, good low temperature activity, high selectivity and good stability. The reaction light-off temperature is 220°C, per-pass conversion ≥80% and its lifespan ≥24 months.

(3) Heat exchange reactor: Efficiently lower the feedstock inlet temperature. The methanol vapor inlet temperature is 160~200°C, around 40~80°C lower than that of adiabatic reactors, uniform the bed temperature distribution, smaller side reactions, high capacity and the MHSV is up to 1.6h⁻¹.

(4) High efficient separation & recovery technology: Ensure the product quality, lower wastewater COD, reduce the emissions, methanol consumption, cost and protect the environment.

(5) Low-carbon and environmental protection. Both exhaust gas and process wastewater are recovered for reutilization. No emissions.

(6) Combination of fuel-grade DME and aerosol-grade DME. Comparing with two separate technologies.

<table>
<thead>
<tr>
<th>Methanol (t/tDME)</th>
<th>Steam (t/tDME)</th>
<th>Electricity (kWh/tDME)</th>
<th>Treated wastewater COD (mg/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.397~1.40</td>
<td>0.65~0.70</td>
<td>11~16</td>
<td>20~40</td>
</tr>
</tbody>
</table>
Content

1. Overview of DME Production in China
2. Introduction of DME Standardization in China
3. Introduction of Issued DME Standards
Introduction of DME Standardization in China

Issued National standards and Industry Standards

Year

2007
“Dimethyl ether” HG/T 3934——2007
“Dimethyl ether for city gas” CJ/T 259——2007

2008
“Dimethyl ether household fuel” NY/T 1673——2008

2009
“Technical requirements for special equipments of dimethyl-ether vehicles” QC/T 813——2009
“Mounting requirements of special equipment for dimethyl-ether vehicles” QC/T 814——2009
“Quick-insert Filling Receptacle of DME Vehicle” QC/T 815——2009

2010
“Dimethyl ether for city gas” GB 25035——2010

2011
“Dimethyl ether for motor vehicle fuel” GB/T 26605——2011

2012

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Introduction of DME Standardization in China

Issued Provincial Standards

- “Liquefied petroleum gas and dimethyl ether blend gas” DB37/T 1697—2010---Shandong Province
- “Design and construction code of wholly assembled dimethyl ether vehicle refilling station” DB31/465 - 2009---Shanghai
- “Liquefied petroleum gas and dimethyl ether compound fuel” DB50/ 338-2009—Chongqing
Content

1. Overview of DME Production in China

2. Introduction of DME Standardization in China

3. Introduction of Issued DME Standards
Introduction of Issued DME Standards

1. National Standard - 1

- **Name:** “Dimethyl Ether for City Gas” GB 25035——2010
- **Effective date:** July 1st, 2011
- **Scope:** this standard stipulates the requirements, test method, inspection rules, label, package, transportation and storage of dimethyl ether for city gas. This standard is applicable to dimethyl ether for city gas for residential, commercial and industrial users.

### Quality Requirements of Dimethyl Ether for City Gas

<table>
<thead>
<tr>
<th>Item</th>
<th>Indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td>DME mass percentage/%</td>
<td>≥99.0</td>
</tr>
<tr>
<td>Methanol mass percentage/%</td>
<td>&lt;1.0</td>
</tr>
<tr>
<td>Water mass percentage/%</td>
<td>≤0.5</td>
</tr>
<tr>
<td>Copper strip corrosion / grade</td>
<td>No more than 1</td>
</tr>
</tbody>
</table>
Introduction of Issued DME Standards

1. National Standard - 2
- **Name:** “Dimethyl Ether for Motor Vehicle Fuel” GB/T 26605—2011
- **Effective date:** November 1st, 2011
- **Scope:** this standard stipulates the requirements, test method, inspection rules and label, package, transportation, storage and safety of dimethyl ether for motor vehicle fuel. This standard is applicable to dimethyl ether for motor vehicle fuel produced by methanol gas phase or liquid phase dehydration process, or straightly synthesized from syngas. The product can be used as feedstock for motor vehicle fuel.

### Quality Requirements of Dimethyl Ether for Motor Vehicle Fuel

<table>
<thead>
<tr>
<th>Item</th>
<th>Indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td>DME mass percentage/%</td>
<td>≥ 99.5</td>
</tr>
<tr>
<td>Methanol mass percentage/%</td>
<td>≤ 0.3</td>
</tr>
<tr>
<td>Water mass percentage/%</td>
<td>≤ 0.03</td>
</tr>
<tr>
<td>Total sulfur/% (as S)</td>
<td>≤ 0.0005</td>
</tr>
</tbody>
</table>
Introduction of Issued DME Standards

2. Industry standard - chemical industry

- **Name:** “Dimethyl Ether” HG/T 3934——2007
- **Effective date:** October 1st, 2007
- **Scope:** this standard stipulates the requirements, test method, inspection rules and label, package, transportation, storage and safety of dimethyl ether. This standard is applicable to the production, inspection and sales of dimethyl ether produced by methanol gas phase or liquid phase dehydration process, or straightly synthesized from syngas, or recovery from the other production process. Type Ⅰ of this product is mainly used as industrial feedstock for propellant, foaming agent, refrigerant, chemical feedstock, etc. Type Ⅱ is mainly used as feedstock for household fuel, vehicle fuel and industrial fuel.

### Technical Requirements

<table>
<thead>
<tr>
<th>Item</th>
<th>Ⅰ</th>
<th>Ⅱ</th>
</tr>
</thead>
<tbody>
<tr>
<td>DME mass percentage/%</td>
<td>≥</td>
<td>99.9</td>
</tr>
<tr>
<td>Methanol mass percentage/%</td>
<td>≤</td>
<td>0.05</td>
</tr>
<tr>
<td>Water mass percentage/%</td>
<td>≤</td>
<td>0.03</td>
</tr>
<tr>
<td>Copper strip corrosion / grade</td>
<td>≤</td>
<td>—</td>
</tr>
<tr>
<td>Acidity (calculated by H₂SO₄)/%</td>
<td>≤</td>
<td>0.0003</td>
</tr>
</tbody>
</table>

Note: acidity test is required when type Ⅰ product is used as refrigerant.
Introduction of Issued DME Standards

2. Industry standard - agricultural industry

- **Name**: “Dimethyl Ether Household Fuel” NY/T 1637——2008
- **Effective date**: July 1st, 2008
- **Scope**: this standard stipulates the requirements, test method, inspection rules and label, package, transportation, storage and safety application measures of dimethyl ether as household fuel. This standard is applicable to DME fuel which is used either individually or by blending with LPG at a certain ratio.

### Technical Specifications of DME Household Fuel

<table>
<thead>
<tr>
<th>Item</th>
<th>Indicators</th>
<th>First grade</th>
<th>Second grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>DME/% (m/m)</td>
<td>≥</td>
<td>99.0</td>
<td>98.0</td>
</tr>
<tr>
<td>Methanol/%(m/m)</td>
<td>≤</td>
<td>0.6</td>
<td>1.2</td>
</tr>
<tr>
<td>Moisture/% (m/m)</td>
<td>≤</td>
<td>0.4</td>
<td>0.8</td>
</tr>
<tr>
<td>Residue/mL/100mL</td>
<td>≤</td>
<td>0.7</td>
<td>1.4</td>
</tr>
<tr>
<td>Copper strip corrosion / grade</td>
<td>≤</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>C3-C4 hydrocarbon /% (m/m)</td>
<td></td>
<td>0～0.2(report)</td>
<td>0～0.4(report)</td>
</tr>
</tbody>
</table>
Introduction of Issued DME Standards

2. Industry standard - vehicle industry 1

- **Name:** “Technical Requirements for Special Equipments of Dimethyl-ether Vehicles” QC/T 813—2009
- **Effective date:** April 1st, 2010
- **Scope:** this standard stipulates the requirements to special equipment of DME vehicles. This standard is applicable to special equipment used in DME vehicles at a rated working pressure of 2.0 MPa.

**Special equipment:** a complete fuel system, consisting of fuel storage parts, delivering parts and control parts, which is installed particularly on the vehicles for vehicle DME.

**Fuel supply system at least includes:** Liquefied DME cylinder (or cylinder group) for vehicles; check valve; 80% metering valve; level gauge; relief valve; supply valve; DME feed pump; DME primary filter and secondary filter; filling receptacle; rigid pipe & coupling; flexible pipe & coupling; overflow valve (pressure regulator); vibration-resisting pressure gauge; solenoid valve; wiring harness.

**Also can include:** airtight box; gas pipe pressure relief valve; pressure transmitter or pressure relay; temperature transmitter; fuel pump and wire conduit of liquid level transmitter; cooler; manifold; manual stop valve; accumulator; equalizing pipe of gas phase and equalizing pipe of liquid phase (for cylinder group); leaking alarm device.
Introduction of Issued DME Standards

2. Industry standard - vehicle industry 2

- **Name:** “Mounting Requirements of Special Equipment for Dimethyl-ether Vehicles” QC/T 814——2009
- **Effective date:** April 1st, 2010
- **Scope:** this standard stipulates the requirements, test method, inspection rules and label of mounting special equipment for DME vehicles. This standard is applicable to vehicles fueled by DME.

**Mounting requirements:**

- Do not reduce the strength and rigidity of vehicle frame, DME cylinder should be in good shape without abrasion, every part should be firmly installed without loosening and falling off due to vibration and jounce;
- No leaking for the DME system;
- The distance between every part and exhaust pipe should be greater than 75mm. When the distance is between 75mm to 200mm, a firmed insulation guard board should be installed;
- Filling metering valve and level gauge shall be accurate and reliable. Valves and pipes shall be convenient for maintenance.
Introduction of Issued DME Standards

2. Industry standard - vehicle industry 3

- **Name:** “Quick-insert Filling Receptacle of DME Vehicle” QC/T 815——2009
- **Effective date:** April 1st, 2010
- **Scope:** This standard stipulates the requirements, test method, inspection rules and label, package, transportation, storage and factory files of quick-insert filling receptacle of DME vehicle. This standard is applicable to fuel filling receptacle of DME vehicles at a rated working pressure of 2.0 MPa and ambient temperature of -40℃~+85℃.

**Requirements:**

The requirements have been made on the basic type, size, composition, material, dustproof, tightness, heat resistance, compatibility, oxygen-resistance aging, corrosion resistance, hydrostatic strength, vibration resistance, durability and flow.
### Introduction of Issued DME Standards

**3. Provincial standard - Chongqing**

- **Name:** “Liquefied Petroleum Gas and Dimethyl Ether Compound Fuel” DB50/ 338-2009
- **Effective date:** December 1st, 2009
- **Scope:** this standard stipulates the technical indicators, test method, inspection rules, package, transportation, label, sign, safety technology manual, storage and refilling of LPG and DME blends. This standard is applicable to the LPG and DME compound fuel within the administrative region of Chongqing.

**Technical specifications:** the feedstock is LPG and DME for city gas. LPG quality shall conform to GB 11174D and the quality of DME for city gas shall conform to CJ/T 259.

#### Technical Specifications of LPG and DME Compound Fuel

<table>
<thead>
<tr>
<th>Item</th>
<th>Indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td>Content of DME in compound fuel%</td>
<td>≤ 20</td>
</tr>
<tr>
<td>Steam pressure (37.8), kPa</td>
<td>≤ 1380</td>
</tr>
<tr>
<td>Content of C₅ and above, %</td>
<td>≤ 1.0</td>
</tr>
<tr>
<td>Evaporated residue, ml/100ml</td>
<td>≤ 0.05</td>
</tr>
<tr>
<td>Copper strip corrosion (grade)</td>
<td>≤ 1</td>
</tr>
<tr>
<td>Free water</td>
<td>None</td>
</tr>
</tbody>
</table>
3. Provincial standard - Shanghai

- **Name:** “Code on Design and Construction of Integral-assembled Dmethyl Ether Vehicle Refilling Station” DB31/465 -2009
- **Effective date:** May 1st, 2010
- **Scope:** this standard is applicable to the design and construction of a new or reconstructed refilling station project.

*This standard refers to* the site selection, vehicle DME refilling process and facilities (DME storage tank, feed pump, DME dispenser, DME pipe system, emergency cut-off system), fire fighting facility and water supply & drainage, electrical device (power supply and distribution, anti-static, inspection and alarm system), other facilities (HVAC, buildings and landscape), project construction (general rules, material and equipment detection, civil engineering, process equipment installation, pipeline engineering, electrical instrument installation, anticorrosion engineering and delivery documents).
### Introduction of Issued DME Standards

#### 3. Provincial standard - Shandong province

- **Name:** “Liquefied Petroleum Gas and Dimethyl Ether Mixed Gas” DB37/T 1697—2010
- **Effective date:** February 1st, 2011
- **Scope:** This standard stipulates the technical requirements, test method, inspection rules and label, package, transportation, storage and safety of LPG and DME blend gas. This standard is applicable to the LPG and DME mixed gas within the administrative region of Shandong province.

**Technical specifications:** The feedstock is LPG and DME for city gas. LPG quality shall conform to GB 11174D and the quality of DME for city gas shall conform to CJ/T 259.

#### Technical Specifications of LPG and DME Mixed Gas

<table>
<thead>
<tr>
<th>Item</th>
<th>Indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td>DME mass percentage/ %</td>
<td>≤ 20</td>
</tr>
<tr>
<td>Steam pressure (37.8°C), kPa</td>
<td>≤ 1380</td>
</tr>
<tr>
<td>Mass percentage of C₅ and above / %</td>
<td>≤ 2.0</td>
</tr>
<tr>
<td>Mass percentage of evaporated residue/ %</td>
<td>≤ 0.05</td>
</tr>
<tr>
<td>Copper strip corrosion, grade</td>
<td>≤ 1</td>
</tr>
<tr>
<td>Water mass percentage/%</td>
<td>≤ 0.2</td>
</tr>
<tr>
<td>Odor</td>
<td>Special odor</td>
</tr>
</tbody>
</table>
Introduction of Issued DME Standards

Standards under Discussion

- “Standard on Liquefied Petroleum Gas and Dimethyl Ether Mixed Gas” - National Standard
- “Standard on Cylinder Code for Liquefied Petroleum Gas and Dimethyl Ether Mixed Gas” - National Standard
- “Integrated Valve of Vehicle Dimethyl Ether Cylinder” - Industry Standard
- “Regulation on Dimethyl Ether Vehicle Type Approval Test” - Industry Standard
- “Liquefied Petroleum Gas and Dimethyl Ether Compound Fuel” - Guangdong provincial standard
- ……
Thank you!