DME in China and ENN DME Technology

Li Jinlai  Yan Xingan
ENN Group

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Content

1. ENN Group Clean Energy Strategy
2. DME Development and Application in China
3. ENN New Energy-saving DME Technology
4. DME Opportunity and Challenge
ENN Group Clean Energy Strategy

Mission:
- Innovation of clean energy development
- Improvement of living environment
- Enhancement of life quality

Vision: To become a respectable world-class energy corporation

Premise: Innovating clean energy

Purpose: Improving living environment; enhancing life quality

C economy + Intelligence

Intelligent technology

CO₂ recycling business + intelligent technology

Usher in an era of clean energy

C-cycle

Coal-based clean energy

(CHO)₂ + H₂O → CO₂
ENN has constructed a clean energy value chain from upper, middle to down stream.
ENN Methanol Production

XinNeng Energy Company in Inner Mongolia

A project of 600kt/y Methanol in Daqi of Inner Mongolia
ENN Methanol Production

XinNeng FengHuang (TengZhou) Energy Company  A 720kt/y methanol project
DME Technology System

- Gasification
- UCG
- COG
- CBM

Energy production
Energy conversion
Energy logistics
Energy distribution

MeOH

DME Catalysis Tech
DME Process Tech
DME Separation Tech
DME Burning Tech
DME Application Tech
DME Equipment Tech
Delivery Distribution Blending Tech

Logistics

Customer:
- Household fuel
- Vehicle fuel
- Industrial fuel
- LPG blending
- Pipeline gas
- Vehicle fuel
- Power machine
- Cutting welding
- Refrigeration

State Key Laboratory of Coal-based Low Carbon Energy
Content

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Long Distance Nature Gas Pipeline in China
DME Market Overview

DME/LPG blending accounts for almost 90%, no modification is required for the existing cooking stove with reasonable blending ratio.

Substitution for diesel, 10 DME buses are in operation in Shanghai

Used as fuel for industrial boiler, kiln and cutting gas.

Used as aerosol and refrigerant

Household fuel

Vehicle fuel

Industrial fuel

Chemicals
**DME factory distribution and capacity in China**

Total capacity: 13Mt/a (operation & plan)

- **74%**
- **26%**

**Factory: 6** capacity: 3.9Mt/a
**Factory: 8** capacity: 2.2Mt/a
**Factory: 5** capacity: 2.3Mt/a
**Factory: 1** capacity: 0.3Mt/a
**Factory: 3** capacity: 0.5Mt/a
**Factory: 3** capacity: 0.17Mt/a
**Factory: 5** capacity: 0.1Mt/a
**Factory: 2** capacity: 1.3Mt/a
**Factory: 1** capacity: 0.1Mt/a
**Factory: 1** capacity: 0.2Mt/a
**Factory: 1** capacity: 0.1Mt/a
DME for Aerosol propellant and Refrigerant

Aerosol propellant

- Good dissolubility for oily/water substance
- Stable and low vapor pressure
- Environment-friendly (no greenhouse effect and evaporation of organic compounds)

- Environment-friendly / non-toxic
- Low boiling point high vaporization heat
- Replace R12 R22 & R134a

Refrigerant
DME/LPG Blending Test

DME/LPG cooking trial

<table>
<thead>
<tr>
<th>group</th>
<th>sample</th>
<th>Efficiency% measured</th>
<th>Efficiency% Ave</th>
<th>Flue gas %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>LPG(10%C3+90%C4)</td>
<td>56.1</td>
<td>55.85</td>
<td>O₂, CO, NOₓ</td>
</tr>
<tr>
<td></td>
<td></td>
<td>55.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>80%LPG(10%C3+90%C4)+20% DME</td>
<td>57.9</td>
<td>58.35</td>
<td>7.52, 0.018, 0.005</td>
</tr>
<tr>
<td></td>
<td></td>
<td>58.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>LPG(25%C3+75%C4)</td>
<td>57.7</td>
<td>57.1</td>
<td>7.47, 0.0117, 0.0054</td>
</tr>
<tr>
<td></td>
<td></td>
<td>56.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>80%LPG(25%C3+75%C4)+20% DME</td>
<td>58.1</td>
<td>57.85</td>
<td>8.87, 0.0221, 0.0043</td>
</tr>
<tr>
<td></td>
<td></td>
<td>57.6</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

DME/LPG cooking trial in Shanghai, China

- Higher heat efficiency
- More cleaner fuel
- Substitute fuel
DME for Automotive

- Cleaner fuel / environment-friendly / energy saved
- Fuel cost advantage
- Engine manufacturing cost advantage
DME for Aerosol propellant and Refrigerant

XinNeng (ZhangJiaGang) Energy Company

A 200kt/y DME project and 50kt/y aerosol-grade DME project
DME for industrial kiln and cutting gas

• Environment-friendly / non-toxic / safe / energy-saving
• Shorter time and higher cutting speed
• No cutting residues and sputtering
• Low impurities good for ceramics
• High temperature and heat value
## ENN New Energy-saving DME Technology

### ENN DME patent achievements and honor

<table>
<thead>
<tr>
<th>New DME Production Technology</th>
<th>ZL.2006101034373</th>
<th>Granted in Feb., 2008</th>
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<tbody>
<tr>
<td>A DME Catalyst and Preparation</td>
<td>ZL.2006101034369</td>
<td>Granted in Apr., 2008</td>
</tr>
<tr>
<td>A Process for Aerosol-grade DME Production</td>
<td>CN200810224761.X</td>
<td>Received app. No. in Dec., 2008</td>
</tr>
<tr>
<td>A Process for Two-stage DME production</td>
<td>CN200910084410.8</td>
<td>Received app. No. in May., 2009</td>
</tr>
<tr>
<td>A low temperature DME catalyst preparation and application</td>
<td>CN 201010170586.8</td>
<td>Received app. No. in May., 2010</td>
</tr>
</tbody>
</table>
## Features of new energy-saving DME technology

<table>
<thead>
<tr>
<th>Item</th>
<th>Technological advantage</th>
<th>Consumption</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>High effective heat ex-change network&lt;br&gt;five-level heat exchange to recover all the heat energy both in high and low level</td>
<td>Methanol (t/t)</td>
</tr>
<tr>
<td>2</td>
<td>New Catalyst&lt;br&gt;High selectivity; high conversion; low feed consumption; hydration resistance; high mechanical strength</td>
<td>Power (KWh/t)</td>
</tr>
<tr>
<td>3</td>
<td>Heat-exchange reactor&lt;br&gt;Low inlet temperature, low consumption; Even bed temperature, few side reaction; Smooth operation</td>
<td>Steam (t/t)</td>
</tr>
<tr>
<td>4</td>
<td>Environment protection&lt;br&gt;The process wastewater can be treated as make-up water of circulating water.</td>
<td>Wastewater</td>
</tr>
</tbody>
</table>
# High purity DME specification and technological features

<table>
<thead>
<tr>
<th>Production specification</th>
<th>scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>DME (％)</td>
<td>≥99.95</td>
</tr>
<tr>
<td>MeOH (ppm)</td>
<td>≤10</td>
</tr>
<tr>
<td>ethylene (ppm)</td>
<td>≤10</td>
</tr>
<tr>
<td>propylene (ppm)</td>
<td>≤10</td>
</tr>
<tr>
<td>Water (ppm)</td>
<td>≤50</td>
</tr>
<tr>
<td>Organic N (ppm)</td>
<td>≤5</td>
</tr>
</tbody>
</table>

- New technological process
- High-efficient energy-saved Engineering design
- New type absorption materials
- Complete analysis method
ENN New Energy-saving DME Technology

Service

1. Provide PDP, catalyst, reactor, preliminary and detailed design.

2. Provide the related technical support and service.

3. Provide the practice base.
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DME Opportunity and Challenge

Opportunity for DME development

1. The DME VAT was decreased to 13% on July 1st, 2008.
2. The oil and nature gas price was increased.
3. Some institutions developed the DME engine.
4. Some provinces passed DME/PLG blending local standards, such as Shandong province in July 2009, Chongqing municipality in December 2009 and Henan province in August 2010.

Challenges for DME development

1. More national standards and regulations are required, except “Dimethyl Ether” (HG/T 3934-2007) and “Dimethyl Ether for City Gas”(CJ/T 259-2007).
2. Some provinces forbid DME blending with LPG.
Thank you for your attention!