Methanol in Energy - Applications & Experience

Gil Dankner
Chairman, Dor Group

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The Dor Group Experience

Methanol as a Clean Alternative Fuel for

- Steam Boilers
- Power Plants
- Transportation
Steam Boilers Converted to Methanol
Methanol for Steam Boilers

CO mg/dscm

Nox mg/dscm

Total Particles mg/ Nm³

SO₂ mg/dscm

Particles mg/ Nm³
Gas Turbine (GT)
Methanol firing
Dor and Israel Electric Company (IEC) developed Methanol application for power plants

Converted a Pratt & Whitney 50 MW Gas Turbine Unit in Eilat from Diesel to 100% Methanol firing.
Methanol for Gas Turbines

Advantages

Significant reduction of emissions

- NOx - by 75%
- SOx - by 100%
- Particle by 80%

Results

- Comply with “clean air law” requirements.
- Performance not effected.
- Low cost fuel system retrofit methanol firing.
- Economically favorable where natural gas is not available.
- Utilizing existing infrastructure.
Methanol for Gas Turbines

Filter Comparison

<table>
<thead>
<tr>
<th>Diesel</th>
<th>Methanol</th>
</tr>
</thead>
</table>

[Images of filters for Diesel and Methanol]
So... Why are we here?

Opportunities & Challenges for Methanol
Opportunities

1. Price
2. Safety
3. Regulation
4. Market share
5. Environment
Methanol vs Diesel vs Gasoline vs LPG

Scenario:
Methanol, Diesel, Gasoline - leakage from a tank creating a pool fire in an area of 100 sq. meters.

LPG – leakage develops to tank explosion (BLEVE).

COMPARISON OF RISK RANGES (METERS)
METHANOL VS DIESEL VS GASOLINE VS LPG

- Methanol: 15 meters
- Diesel: 38 meters
- Gasoline: 45 meters
- LPG: 316 meters
Regulation

2 AMERICAN STANDARDS:

13
Market share

FFV - Flexible Fuel Vehicle

GEM – Gasoline, Ethanol & Methanol mixtures

- FFV Vehicles can use up to 85% Ethanol / Methanol.
- FFVs are marketed worldwide.
- M70 blends tested in Flexible Fuel Vehicle (FFV).
- There are 20 Million FFV in the US
Environment - Emissions

<table>
<thead>
<tr>
<th>Type</th>
</tr>
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<tbody>
<tr>
<td>95RON</td>
</tr>
<tr>
<td>E10</td>
</tr>
<tr>
<td>M56</td>
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</table>
Challenges

1. Death due to air pollution
2. Increasing number of Vehicles
3. Oil Cartel
4. Car manufacturer restrictions
Challenges

Each year, **1.25 Million** people are killed on roadways around the world.
Polluted air causes 5.5 Million deaths a year
Increasing number of vehicles

1.5 Billion Vehicles today – expected to almost **double** by 2040

This research looks at the development growth of transport.
Source: REUTERS/Toby Melville TM/MD
Cartel & Lobby

- The consumer has limited knowledge
- Oil & Car industries prefer that we keep it that way
- Massive political Lobby
- Low credibility (Diesel Gate)

Main Vehicle Manufacturers

OIL CARTEL

- Esso
- Royal Dutch Shell (Anglo-Dutch)
- Anglo-Persian Company (APOC)
- Standard Oil Co. of New York (Socony)
- Standard Oil of California (Socal)
- Gulf Oil
- Texaco
**Car manufacturers restriction**

**Existing Restrictions**

**Chevrolet – Car Owner’s Manual**

Notice: This vehicle was not designed for fuel that contains methanol. Do not use fuel containing methanol.

**BMW – Car Owner’s Manual**

Fuels containing up to and including 10% ethanol or other oxygenates with up to 2.8% oxygen by weight – that is, 15% MTBE or 3% methanol plus an equivalent amount of co-solvent – will not void the applicable warranties respecting defects in materials or workmanship.

**Notes**

Your individual vehicle

On purchasing your BMW, you have decided in favor of a model with individualized equipment and features. This Owner’s Manual describes all models and equipment that BMW offers within the same group.

We hope you will understand that equipment and features are included that you might not have chosen for your vehicle. You can easily identify any differences with the aid of the asterisk * used to identify all optional equipment and accessories.

If your BMW features equipment which is not described in this Owner’s Manual such as a car radio or telephone, Supplementary Owner’s Manuals are enclosed. We ask you to read these manuals as well.

**Status at time of printing**

BMW pursues a policy of continuous, ongoing development conceived to ensure that our vehicles continue to embody the highest quality and safety standards combined with advanced, state-of-the-art technology. For this reason, the features described in this Owner’s Manual could differ from those on your vehicle. Nor can errors and omissions be entirely ruled out. You are therefore asked to appreciate that no claims can be recognized on the basis of the data, illustrations or descriptions in this Owner’s Manual.

**For your own safety**

**Fuels**

Use unleaded gasoline only. Fuels containing up to and including 10% ethanol or other oxygenates with up to 2.8% oxygen by weight – that is, 15% MTBE or 3% methanol plus an equivalent amount of co-solvent – will not void the applicable warranties respecting defects in materials or workmanship. Field experience has indicated significant differences in fuel quality – volatility, composition, additives, etc. Among gasoline offered for sale in the United States and Canada. The use of poor quality fuel may result in driveability, starting and stalling problems, especially under certain environmental conditions, such as high ambient temperature and high altitude. Should you encounter driveability problems which you suspect could be related to the fuel you are using, we recommend that you respond by switching to a recognized high-quality brand. Failure to comply with these recommendations may result in unscheduled maintenance. Obey all applicable safety rules when handling gasoline.
Reduce the share of crude oil in Israel's transportation sector by 30% by 2020 and by 60% by 2025.

For the Full directive please click here.
Securing a Clean Future

M15 – Promoted by Dor

A Newly approved Fuel Standard in Israel

Foreword

This Israeli Standard, SI 90 part 4, is based on the Israeli Standard SI 90 part 2 *Automotive gasoline - Unleaded gasoline* (which adopts the European Standard EN 228 *Automotive fuels - Unled petrol - Requirements and test methods*, with national modifications and additions).

This Standard is part of a Standard series dealing with automotive gasoline. The Standards in this series are the following:

SI 90 part 2 – Automotive gasoline: Unleaded gasoline

SI 90 part 4 – Automotive gasoline: Methanol-gasoline (petrol) fuel blend composed of 85% unleaded gasoline (petrol) and 15% methanol (M15)
M15

M15 & The Future of Automotive

- Joint Venture with Fiat Chrysler on M15.
## FCA Emission Test Results

<table>
<thead>
<tr>
<th>Type</th>
<th>95 RON</th>
<th>M15</th>
<th>Improvement %</th>
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</thead>
<tbody>
<tr>
<td>HC mg/km</td>
<td>37</td>
<td>24.5</td>
<td>33.78</td>
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<tr>
<td>CO mg/km</td>
<td>241.5</td>
<td>228.5</td>
<td>5.38</td>
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<tr>
<td>CO2 g/km</td>
<td>134</td>
<td>132</td>
<td>1.49</td>
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<tr>
<td>Nox mg/km</td>
<td>19</td>
<td>18.5</td>
<td>2.63</td>
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<tr>
<td>NMHC mg/km</td>
<td>10</td>
<td>6</td>
<td>40.00</td>
</tr>
<tr>
<td>PM mg/km</td>
<td>1.36</td>
<td>1.1</td>
<td>19.12</td>
</tr>
</tbody>
</table>
Methanol Solution for Transportation

M100 – The Future for Diesel Trucks

M100 – a 100% methanol solution to replace diesel fueled trucks
Methanol - Advantages

✓ Lower Price per Calorie
✓ Lower Emissions
✓ Safer Liquid Fuel
✓ Energy Efficiency, High Octane
✓ A solution for internal combustion engines
✓ Utilize existing infrastructure
✓ Creation of local employment opportunities
Thank you!