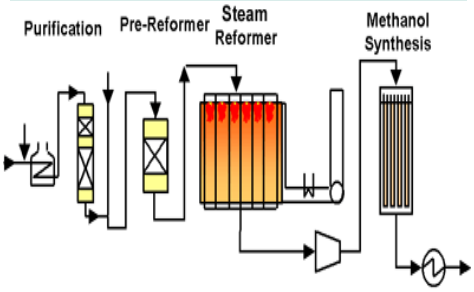
Methanol Fuel Blending - Q&A

What is Methanol?

Also known as wood alcohol, methanol is a convenient liquid fuel made from natural gas, coal or renewable resources. Methanol is a basic building block for hundreds of essential chemical commodities that touch our daily lives including building materials, plastic packaging, paints and coatings, even windshield wash fluid. Methanol can also be used as a transportation fuel, as a hydrogen carrier fuel for fuel cell technologies, and a fuel for electric power generation. With the chemical structure CH_3OH methanol is the simplest alcohol, with the *lowest carbon content and highest hydrogen content of any liquid fuel.*

How is Methanol Produced?

Most methanol is made from the steam reformation of natural gas. Mega-methanol plants producing 5,000 tons of methanol per day, or 1.8 million tons per year (600 million gallons) are now operating. Methanol is also produced through coal gasification. Coal is still an important supply of energy, especially electricity production, in many European countries, with major coal producing areas in parts of Germany, Poland, Ukraine and Russia. Methanol can be produced from a wide range of renewable feedstocks. In the Netherlands, BioMCN converts crude glycerin—a residue from processing vegetables and animal fats—into advanced second generation bio-methanol. In Iceland, Carbon Recycling International is building a plant utilizing CO_2 flue gas and electricity from a geothermal power plant to make renewable methanol for vehicles and trucks on the island nation. These renewable feedstocks for methanol production largely come from waste streams, creating the ability to produce biofuels without competing with food products. In addition, this will increase the competitiveness of the European forest sector with the pulp and paper industry creating new revenues and an estimated one million jobs. Furthermore, the gasification of biomass to methanol is both very efficient (50-70% energy efficiency) and highly productive (one ton of wood can yield more than 700 liters of methanol).



The Methanol Production Process

In 2010, over 48 million metric tons (16 billion gallons) of methanol was consumed around the globe which is roughly equivalent to global ethanol fuel demand. In 2011, global demand is expected to reach over 51.5 million metric tons (17 billion gallons).

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Is Methanol A Reliable Transportation Fuel?

From the mid-1980s to the late-1990s, methanol flexible fuel vehicles (FFVs) capable of running on any combination of methanol and gasoline (up to M-85, a blend of 85% methanol and 15% unleaded gasoline) in the same tank, were sold in the U.S. and Europe. From this experience, we know the incremental cost to provide flexible fuel capability to a new car is just €30- €100, while the cost to install a methanol fueling pump is €40,000 or less. A truly flexible fuel vehicle would be "A-85" or "GEM" capable, able to run on gasoline, ethanol (E-85) or methanol (M-85) in any combination. A GEM or alcohol compatible FFV would offer significant benefits in fuel diversity, price competition and consumer choice. U.K.-based Lotus recently unveiled its Trifuel Exige 270E concept car, using a supercharged Toyota engine capable of running on petrol, ethanol or methanol fuel. Sweden's Volvo Group has demonstrated a fleet of seven trucks equipped with "carbon-neutral" engines capable of running on alternative fuels, including methanol. Volvo provides its highest rating of all the alternative fuels to methanol and DME produced from black liquor in terms of: climate impact; energy efficiency; land use efficiency; fuel potential; and fuel costs.

Low level methanol fuel blends were introduced in the Federal Republic of Germany in 1968 with use of 2% methanol/2% TBA blends, reaching general use around 1977. The German government set a limit of 3% methanol. During the 1980s and through much of the 1990s, most gasoline in Europe contained a small percent of methanol, usually 2-3%, along with a cosolvent alcohol. A "common directive" of the European Economic Community (EEC, a predecessor to the European Union - EU) authorized alcohol blending in gasoline starting in 1988, including a low level that member countries were required to allow and a higher level that could be allowed by member countries with labeling on pumps. France authorized such higher level blends, but their use did not become widespread. In Sweden, where oxygenates were allowed up to 3 wt% oxygen, methanol was also allowed up to 2%. The current EU standard, EN 228, as last revised in 2004, allows up to 3% methanol to be used, with a requirement for a cosolvent ("stabilizing agent").

Lotus Trifuel Exige

"For car companies and the motorist, the use of sustainable alcohols like synthetic methanol requires relatively few changes to the vehicle. It can also use the current fuel distribution infrastructure, which is a huge advantage for suppliers."

Geraint Castleton White

Head of Powertrain at Lotus Engineering

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China now leads the world in the use of methanol as an alternative transportation fuel, blending nearly one billion gallons of methanol in gasoline in 2007. Taxi and bus fleets are running on high methanol blends (M-85 to M-100), and retail pumps sell low level blends (M-15 or less) in many parts of the country. For more than a decade, leaders in coal-producing provinces (Xinjian, Shanxi, Shaanxi, Henan, Inner Mongolia, Beijing Shi, Hebei, Anhui, Guangdong and Sichuan) have been developing methanol fuel demonstration programs. These efforts have involved methanol producers, automakers, and academic institutions. In September 2006, eight leaders provided a report to the Chinese President Hu Jintao titled "Suggestion on Promoting Methanol Fuels to Replace Gasoline and Diesel Fuel." President Hu approved this "Suggestion" and directed the powerful National Development and Reform Commission (NDRC) to explore the use of methanol fuels. The NDRC now considers coal-based methanol to be a strategic transportation fuel, and has directed the development of national methanol fuel standards. The country's fastest growing independent automaker, Chery Automobile, has recently competed demonstration work on 20 methanol flexible-fuel vehicles – capable of operating on methanol or gasoline – now ready for full-scale production. Shanghai Maple Automobile has announced plans to build 50,000 methanol cars in 2008. Chang'an has introduced the methanol-fueled BenBen car. Greely Automotive has put its Haifeng methanol car into production. Shanghai-based Huapa Automotive has built a number of methanol fueled cars. Shanghai Automotive Industry Corporation, one of the big 3 automakers in China, is developing a number of methanol-fueled cars. In addition, a number of smaller companies are converting large numbers of cars to methanol operation.

What Are The Greenhouse Gas Emissions From A Methanol FFV?

Modern methanol plants convert between 73% to 78% of the energy contained in natural gas into methanol, as compared to refineries that convert closer to 90% of the energy of crude oil into gasoline. Methanol plants consume carbon dioxide (CO_2) in the production process. In fact, excess CO_2 from other industrial facilities can be fed into a methanol plant to increase production. According to the U.S. Energy Information Administration, the total wheel-to-wells greenhouse gas emissions for a gasoline vehicle is 10.71 moles of CO_2 per vehicle mile traveled

(weighted) as compared to 12.02 moles CO2 per VMT for methanol made from natural gas, and 13.88 moles CO2 per VMT for ethanol made from corn. For biomass-based methanol, CO2 emissions would be dramatically lower than that of gasoline fueled vehicles. In Equatorial Guinea, the Atlantic Methanol Company is producing 300 million gallons of methanol per year using 100 million cubic feet of methane gas per day that previously had been flared (pictured). Methane is a potent greenhouse gas, trapping more than 20 times more heat in the atmosphere than carbon dioxide.

What Are The Smog-Forming Emissions From A Methanol FFV?

Methanol fuel cuts emissions of nitrogen oxides and volatile organic compounds that form ground-level ozone or "smog." Methanol is much less reactive than gasoline in the atmosphere. Methanol's reactivity is dominated by the formation of formaldehyde. The risk from this one component of methanol engine emissions, which is controlled with a catalytic converter, must be measured against the dozens of known and suspected carcinogens in gasoline and diesel fuels. It should also be noted that formaldehyde is a component of gasoline emissions, and that secondary formation of formaldehyde from other elements of gasoline exhaust can lead to even greater formaldehyde formation than from the tailpipe emissions of an M-85 fueled vehicle. Work by the U.S. Environmental Protection Agency in the early 1990s demonstrated that formaldehyde emissions from vehicles running on neat methanol (M-100) could be reduced to levels meeting or approaching California's stringent Ultra Low Emission Vehicle (ULEV) emission targets using available heated catalytic converters.

Is Methanol A Safer Fuel Than Gasoline?

The greatest danger from the use of gasoline as a vehicle fuel is from fires. Gasoline fires in vehicles result in hundreds of deaths and millions of dollars in property damage each year. Methanol does not evaporate or form vapors as readily as gasoline does, and methanol vapors must be four times more concentrated in air than gasoline to ignite. Methanol burns 75% slower than gasoline, and methanol fires release heat at only one-eight the rate of gasoline. Methanol is inherently more difficult to ignite than gasoline, and much less likely to cause deadly or damaging

car fires if it does ignite. While methanol does burn with an invisible flame in bright, sun light conditions, burning materials other than fuel (such as engine oil, upholstery, paint, etc.) would produce both smoke and visible flames. When methanol fueled race cars experience an engine fire (pictured), pit crews pour on water and the driver heads back on to the track.

Methanol, like gasoline or diesel fuels, should never be ingested. Deaths have been reported from intake of as little as 13 ml. of gasoline. More often the untreated fatal range of ingestion is 120-300 ml. Methanol is only *slightly* more toxic than gasoline which has a fatal dose range of 25-90 ml. Human bodies contain methanol naturally, and it is found in many parts of our diet, including fresh fruit, vegetables, and fermented foods and beverages. Both methanol and gasoline can be absorbed through human skin. In the case of contact with skin, the response for both gasoline and methanol is the same: remove any contaminated clothing, and wash with soap and water for 15 minutes. Spill-free methanol fueling nozzles have been developed by Sweden's Identic that will prevent consumers from having the ability to come into contact with methanol fuel.

Is methanol more environmentally benign?

An increase in the production, transportation, storage, and use of methanol would increase the potential for accidental releases to the environment. Relative to gasoline, methanol is safer and more environmentally benign fuel. The physical and chemical properties of methanol help to define the fate and transport of this fuel. Methanol is readily biodegradable under both aerobic (oxygen present) and anaerobic (oxygen absent) conditions. The half-life of methanol (the time required for 50% reduction in mass) in soil, surface water and groundwater is just 1-7 days. By comparison, the half-life for benzene (a toxic gasoline constituent) in groundwater is 10-730 days. Methanol is used extensively in wastewater treatment plants to accelerate the biodegradation of nitrogen to protect sensitive aquifers and waterways.

Methanol Spill Free Nozzle