Technical FAQs

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Â What are the characteristics of azeotropic ethanol & dehydration processes?Azeotropic ethanol is a binary homogeneous mixture of ethanol and water in such a ratio that its composition cannot be changed except through azeotropic distillation (dehydration). This is due to the fact that when an azeotrope is boiled, the resulting vapor has the same ratio of constituents as the original mixture of liquids. For example, once the ethanol to water concentration reaches 96.4% through simple distillation, the vapor from the boiling mixture is also 96.4%. This is due to the fact that the boiling temperature of the binary azeotrope is below that of pure ethanol. Further distillation is therefore ineffective.Â Anhydrous (also commonly referred to as absolute) ethanol is a monohydric primary alcohol with less than 1% water. It melts at - 117.3 Â°C and boils at 78.5 Â°C. In contrast to anhydrous ethanol, azeotropic ethanol containing 95% ethanol and 5% water boils at 78.15 Â°C. Ethanol is miscible (i.e., mixes without separation) with water in all proportions.Â Energy and capital intensive azeotropic dehydration technologies such as material separation agents (benzene and other aromatics), mol sieves, and membranes are commonly utilized to reduce water content to less than 1% in order to meet ASTM specifications for anhydrous ethanol in the US. The most common dehydration method is the use of molecular sieves which simply absorb water from azeotropic ethanol. This breaks the azeotrope and increases the ethanol concentration to greater than 96.4%. The remaining water can then be removed through further distillation to achieve up to 200 proof ethanol (less than 1% water). The sieve is then heated to remove the water and reused. This elaborate azeotropic dehydration process requires drying ethanol twice which is inefficient. It results in increasing production costs and emissions.Â Â Can simple distillation economically produce 96% ethanol concentrations?In Brazil, the majority of ethanol biorefineries utilize sugar cane feedstocks and conventional distillation columns to produce 95% ethanol. Though most corn to ethanol biorefineries in the US produce 92-93% ethanol, this could be increased to 95-96% ethanol by simply increasing the efficiency of fractionation distillation columns similar to what Brazil producers are already doing. However, the potential opportunity to utilize less than 95-96% ethanol concentrations is technologically feasible and economically attractive, particularly for lower and midlevel blends. Â Extensive engine testing of E100 anhydrous and hydrous fuels containing 7-20% water have been compared. Hydrous ethanol with 93% ethanol and 7% water performs efficiently in automobile and high performance aviation engines. According to automobile and aviation fuel tests for midlevel to high level blends, 4-7% water in hydrous ethanol can actually enhance thermodynamic efficiency of internal combustion engines. This is particularly true for fuel injected turbocharged engines which capitalize on using oxygenated fuels (hydrous ethanol) with higher compression ratios and higher latent heat of vaporization. This results in increasing engine horsepower, engine torque, and fuel efficiency. Hydrous ethanol also reduces emissions. (Society of Automotive Engineers, 2007; Green Car Congress, 2008; The Case for Ethanol: Baylor University Institute of Air Science; Ford Lincoln Turbocharged MKR; GM-Saab BioPower FFV Turbocharged Engines).Â Â Hence, azeotropic ethanol blends containing at least 93% ethanol could be sufficient for midlevel gasoline blends from hE10 to hE30 without affecting engine performance. For these blends, fuel efficiency could actually be increased in comparison with anhydrous blends and neat gasoline. Tests have been performed which indicate that fuel efficiency of high-level hydrous ethanol blends containing optimal water content are slightly superior to anhydrous ethanol blends due to waterâ€™s higher latent heat of vaporization (Society of Automotive Engineers, 2007; Green Car Congress, 2008; The Case for Ethanol: Baylor University Institute of Air Science). Depending on the denaturant and gasoline used in hE85 blends, fuel efficiency could be improved (vs. anhydrous ethanol) utilizing less than 7% water in hydrous ethanol. Tests would need to be performed to determine optimal fuel efficiency of midlevel and high level blends correlated with water content.Â Â What is the energy value for anhydrous vs. hydrous ethanol blends?Though there is a 34% difference in energy content (HHV/LHV) between ethanol and gasoline, hybrid fuels consisting of midlevel ethanol blends actually increase the fuel efficiency of gasoline. This is due largely to oxygenated hydrocarbons. Research is currently being conducted to more fully understand this phenomena and determine optimal fuel efficiency for midlevel ethanol-gasoline blends (oxygenated hydrocarbons) which are being utilized in both legacy (non-flex fuel) and flex fuel vehicles (FFVs) in Europe and Brazil.Â Â Table 1. LHV & HHV for Hydrocarbon FuelsÂ Â Â Oxygenated renewable hydrocarbonsÂ Petroleum hydrocarbonÂ Hydrous ethanol(4% H2O)Anhydrous ethanol(<1% H2O)Unleaded reg. gasoline(<1% H2O)ValueBtu/galMJ/galMJ/ltBtu/galMJ/galMJ/ltBtu/galMJ/galMJ/ltLHV74,04078.1220.6476,33080.5321.28119,550126.1333.32HHV81,99486.5122.8584,53089.1823.56127,960135.0035.66Source: http://www.eere.energy.gov/afdc/fuels/properties.htmlÂ Â Notice that in Table 1 there is a 10% difference between HHV and LHV for ethanol fuels, and a 7% difference for gasoline. The HHV (gross energy or caloric content) of a fuel is defined as the amount of heat released by a specified quantity (initially at 25Â Â°C) once it is combusted and the products have returned to a temperature of 25Â Â°C. The HHV takes into account the latent heat of vaporization of water in the combustion products, and is useful in calculating heating values for fuels. This includes improvements in thermodynamic efficiency of internal combustion engines. Since the latent heat of vaporization is higher for water and ethanol than it is for neat gasoline components, this explains why there is a larger variance between HHV and LHV for oxygenated hydrocarbons (ethanol blends). Â The difference between two heating values depends on the chemical composition of the fuel. In the case of pure carbon or CO2, both heating values are almost identical, the difference being the sensible heat content of CO2 between 150 Â°C (302 Â°F) and 25 Â°C (77 Â°F). Sensible heat exchange causes a change of temperature. In contrast, latent heat is added or subtracted for phase changes at constant temperature. An example is heat of vaporization.Â For hydrocarbons the difference depends on the hydrogen content of the fuel. Hydrous ethanol blends (oxygenated hydrocarbons) lower engine operating temperatures due to cooling of intake fuel mixture with 3-6% more water and increasing heat of vaporization when compared to anhydrous ethanol. The result is more efficient combustion, cooler running engines, lower exhaust temperatures, and increased longevity of engine life. The water contained in hydrous ethanol blends also reduces NOx emissions.Â In addition to the effects of higher water content in hydrous ethanol, ethanol increases compression ratios and decreases engine knocking (detonation). Essentially, both water and ethanol increase the octane level of the fuel mixture. The octane number is a measure of the resistance of a fuel to auto-ignition. It is also defined as a measure of anti-knock performance of a gasoline or gasoline component such as hydrous ethanol. Higher octane levels contribute to enhancing the thermodynamic efficiency of combustion engines, which subsequently increases fuel efficiency. The increase in total engine efficiency results in optimizing fuel efficiency for both ethanol and gasoline. Theoretically, this would allow for achieving a Btu rating somewhere between LHV and HHV for oxygenation of hydrocarbon chains. Midlevel blends of ethanol and gasoline, i.e. hybrid fuels, are actually more fuel efficient and higher in energy (LHV/HHV) than neat gasoline.Â Â What is the optimal blend level for hydrous ethanol and gasoline?â€œPrevious assumptions held that ethanol's lower energy content directly correlates with lower fuel economy for automobiles. Those assumptions were found to be incorrect. Instead, the new research strongly suggests that there is an â€˜optimal blend levelâ€™ of ethanol and gasoline - most likely E20 or E30 - at which cars will get better mileage than predicted based strictly on the fuel's per-gallon Btu content. The 2007 flex-fuel Chevrolet Impala utilized in midlevel blends testing revealed a 15% increase in fuel efficiency using the Highway Fuel Economy Test (HWFET) for E20 in comparison with unleaded regular gasoline. For the same vehicle, the highway fuel economy was greater than calculated for all tested blends, with an especially high peak at E20. The new study, cosponsored by the US Department of Energy (DOE) and the American Coalition for Ethanol (ACE), also found that mid-range ethanol blends reduce harmful tailpipe emissions.â€• (American Coalition for Ethanol, 2007; DOE AFDC Intermediate Ethanol Blend Research)Â Â Other studies reveal that E25 may provide optimal fuel efficiency for ethanol-gasoline blends.Â â€œAs known, ethanol has lower calorific value, higher latent heat of vaporization andhigher stoichiometric fuelâ€“air ratio than gasoline. As a result of such properties, it canproduce a cooling effect on intake charge. Therefore, engine volumetric efficiency can rise.Although the leaning effect on intake charge and the lower calorific value of ethanol, thecylinder pressure and temperature may increase due to both improving combustion andhigher volumetric efficiency when gasolineâ€“ethanol blends are used. Research indicates that ethanol addition to gasoline up to 25% raises combustion pressure. Increasing cylinder pressure can result in higher mean indicated work and the mean indicated pressure; therefore, engine power output and thermal efficiency may also increase. Improvements in combustion also result in higher combustion temperatures. Burned gas temperatures at the beginning of combustion were calculated approximately as the adiabatic flame temperature by neglecting the heat losses. For this reason, temperatures predicted at 10Â° before top center (TC) are higher and close to those predicted at TC. Combustion temperatures calculated at each piston position reached a maximum for the blend of 25 vol% ethanol (Bayraktar, 2006).â€•Â Subject to conducting parallel tests with hydrous and anhydrous ethanol blends, the same theories should be true for midlevel hydrous ethanol blends. According to fuel tests in Europe, hydrous ethanol blends exceed the fuel efficiency of anhydrous ethanol blends. This recently discovered phenomena for hybrid fuels appears to be due to the benefits of oxygenation and heat of vaporization in conjunction with capitalizing on the change in chemical and physical properties which occur as a result of combining water, ethanol, and gasoline. When appropriately combined in hybrid fuels, the chemical reactions of these compounds optimize the efficiency at which internal combustion engines operate. For hydrous ethanol blends, this is accomplished primarily through the total heat of vaporization resulting from combining ethanol and water, which effectively increases NEG. Essentially, the lower energy content of hydrous ethanol is counteracted by increasing engine performance due to higher heat of vaporization of ethanol and water in comparison with neat gasoline and anhydrous blends.Â Â Â What is latent heat of vaporization and how does it relate to hydrous ethanol?Also referred to as enthalpy of vaporization, (symbol Î”vH), the heat of vaporization or heat of evaporation, is the energy required to transform a given quantity of a substance, such as water and ethanol, into gaseous forms. It is measured at the normal boiling point of the substances. Enthalpy of vaporization can be viewed as the energy required for overcoming the intermolecular interactions in hydrous ethanol blends.Â The heat of vaporization values for the water and ethanol contained in hydrous ethanol blends (oxygenated hydrocarbons) are substantially higher than that for the hydrocarbon components of gasoline. The molecules in liquid water are held together by relatively strong hydrogen bonds, and its enthalpy of vaporization, 40.65Â kJ/mol, is more than five times the energy required to heat the same quantity of water from 0Â Â°C to 100Â Â°C (cpÂ = 75.3Â JÂ Kâˆ'1Â molâˆ'1).Â Â When discussing latent heat of vaporization, it i to understand the difference between latent heat and sensible heat. When utilizing these terms, we are talking about two different types of effects that can be produced by heat, not about two different types of heat. The three basic physical states of all matter are solid, liquid, and gas (or vapor). The physical state of a substance is closelyÂ relatedÂ toÂ the distanceÂ between molecules.Â AsÂ aÂ generalÂ rule,Â the molecules are closest togetherÂ inÂ solids, farther apart in liquids, a farthest apart in gases. Each time water changes physical state, energy is involved. In the vapor state, water molecules are very energetic. The molecules are not bonded with each other, but move around as single molecules. The heat used in the phase change from a liquid to a gas is called the latent heat of vaporization. We say it is "latent" because it is being stored in the water molecules to later be released during the condensation process. We can't sense latent heat as it does not raise the temperature of water molecules.Â Â When heat flow to a substance is not reflected in aÂ temperature increase in that substance, theÂ energy is being usedÂ to increaseÂ theÂ distanceÂ between the molecules of the substance and to change it from a solid to a liquid or from a liquid to a gas. You might say that latent heat is the energy price that must be paid for a change of state from solid to liquid or from liquid to gas. The energy is not lost. It is merely stored in the substance as internal energy. In accordance with the laws of thermodynamics, the energy price is repaid, so to speak, when the substance changes back from gas to liquid (condensation) or from liquid to solid (freezing), since heat flows from the substance (i.e. water and ethanol) during these changesÂ of state.Â Â Â Â Â Â Â Â Â Â Â Â Â Â Â Â Figure 1. Illustra in relation to sensible heat.Â Â In addition to the strong hydrogen bonds contained in water molecules, the polarity of the OH groups contained in ethanol molecules can form hydrogen bridges causing relatively strong attractive forces between molecules in liquid phases. Upon vaporization of hydrous ethanol as a fuel, the distance between the water and ethanol molecules increase such that molecular interactions including physical properties are disrupted. This process accumulates a certain amount of latent (stored) energy. During combustion of these vapors, this explains why the heat of vaporization of hydrous ethanol blends is so much higher than that of regular gasoline components and non-alcohol oxygenates like methyl tertiary butyl ether (MTBE) which do not contain OH groups (non-alcohols). High heat of vaporization values are typical for water and alcohols including hydrous ethanol and hydrous ethanol blends (oxygenated hydrocarbons). Compare the differences in values listed for alcohols and water listed in Table 2.Â Â Â Â Â Table 2. Heat of Vaporization Values for Common SubstancesÂ CompoundMolecular WeightHeat of vaporization (kJÂ mol-1)Heat of vaporization (kJÂ kg-1)Ammonia17.023.41374Butane58.122.4385Ethanol46.138.8842Gasoline100-11534.95 - 40.2304 - 350Methane16.08.2511Methanol32.035.31102Propane44.118.8426Phosphine34.014.6429Water18.040.72259Source: Jo Sijben, senior consultant, www.process-design-center.comÂ The molar mass of gasoline is an estimate and will vary with gasoline composition. Notice that the values in kJ/kg listed for ethanol, methanol and water are over 2.5 times higher than gasoline, and substantially higher than that of methane. Since water is valued higher than ethanol, the combined heat of vaporization value for hydrous ethanol would be valued slightly higher than anhydrous ethanol which contains 3-6% less water.Â According to Baylor University, â€œas far as safety and performance is concerned, hydrous ethanol is a slightly better fuel [than anhydrous ethanol] in every respect (except specific fuel consumption since water does not provide any caloric content). Small quantities of water absorbed in the fuel result in a slight increase in power caused by the higher latent heat of vaporization of the fuelâ€¦. (The Case for Ethanol: Baylor University Institute of Air Science).â€• Baylor Universityâ€™s Institute of Air Science has extensively tested hydrous ethanol containing up to 20% water. No noticeable change in performance of aviation piston engines was noticed for using up to 7% water for E100. For these experiments, it appears that water was merely added to anhydrous ethanol to develop hydrous ethanol fuels. Â Dr. Max Shauck, director of Baylor Universityâ€™s Institute of Air Science conducted the first Trans-Atlantic flight using ethanol in 1989. Since 2004, over 800,000 hours of flights, primarily for crop dusters, have been logged using ethanol. Other than a 10-20% loss of range due to the compression ratio utilized, the Institute of Air Science states that â€œethanol is cleaner burning, produces more power, improves detonation resistance, and burns cooler and smoother, thus extending engine life. Additionally, it is considerably more economical than navgas, a fourth of the cost of navgas in Brazil and half the cost in the states, and requires only simple engine modifications for use in aircraft engines. And once an aircraft is converted, it can use either fuel or any combination of the two (The Future of Aviation Fuels, Baylor University)."

The safe and reliable use of hydrous ethanol in aircraft in the US and Brazil illustrates the improved performance and fuel efficiency available for use in automobile engines. This is particularly true for low and midlevel blends which do not require engine modifications while substantially improving fuel efficiency. Vaporization of liquids with a higher heat of vaporization leads to vapors with lower temperature, provided no extra heat is present in the vaporization chamber. Hence, the engine fuel intake is cooler and subsequently, so is the exhaust of an unmodified engine. In summary, increasing engine performance via oxygenated hydrocarbons, such as hydrous ethanol blends, appears to translate into higher thermodynamic efficiency.Â

Â Is water injection a proven technology for improving engine performance?Similar to the benefits of using hydrous ethanol blends, many water injection systems for high performance engines use a mixture of water and alcohol (approximately 50/50). The water provides the primary cooling effect for air and fuel injection mixtures due to its great density and high heat absorption properties. Water instantly reduces air intake charge temperatures by 50-200 plus Â°F. This provides a substantially cooler and denser air charge for greater expansion of power within the combustion chamber. Â It is becoming quite common to find engine builders using 91-93 octane gasoline combined with water/alcohol injection to support engines well over 1000+ horsepower. One top engine builder in the industry has already made upwards of 1700+ horsepower with a ProCharger supercharger carbureted big block Chevrolet on 93 octane regular unleaded gas using 100% water injection.Â Â How can hydrous ethanol reduce fuel and vehicle costs?Eliminating ethanol drying could provide most biorefineries with a reduction in production costs, which should be equivalent to a lower rack price for ethanol.Â The 4% increase in volume of hydrous ethanol produced would substantially increase net profits for biorefineries. In addition, the reduction of energy consumption at the biorefinery would make ethanol production more sustainableâ€"by 10-30% depending on the drying technology utilized by the biorefinery.Â Â Â What about fuel efficiency beyond midlevel (hE20/hE30) blends?Ethanol (E100) consumption in an engine is approximately 34% higher than that of gasoline (the energy per volume unit is 34% lower). However, higher compression ratios in an ethanol-only engine allow for increased power output and better fuel economy than would be obtained with lower compression ratios. In general, ethanol-only engines are tuned to give slightly better power and torque output compared to gasoline-powered engines. Â In FFVs, the lower compression ratio requires tunings that provide the same output when using either gasoline or hydrated ethanol. The water contained in hydrous ethanol could provide a significant performance advantage over anhydrous blends such as E85. FFV technology and engines designed specifically for hydrous ethanol could provide optimal engine efficiency and fuel performance surpassing that of conventional gasoline engines.Â â€œOngoing work with methanol- and ethanol-fueled engines at the EPAâ€™s National Vehicle and Fuel Emissions Laboratory has demonstrated improved brake thermal efficiencies over the baseline diesel engine and low steady state NOx, HC and CO, along with inherently low PM emissions. In addition, the engine is expected to have significant system cost advantages compared with a similar diesel, mainly by virtue of its low-pressure port fuel injection (PFI) system. While recognizing the considerable challenge associated with cold start, the alcohol-fueled engine nonetheless offers the advantages of being a more efficient, cleaner alternative to gasoline and diesel engines.â€• (Brusstar et al, 2002; Edwards, et al, 2006) HE Blends indicates that hydrous ethanol blends may actually reduce problems associated with cold starting issues.Â Â Are there advantages of using hE85/hE90 over anhydrous E85?For maximum use of ethanol's benefits, a much higher compression ratio (12-13) should be used. This would render that engine unsuitable for gasoline use with conventional internal combustion engines which require a compression ratio of 9-10. When ethanol fuel availability allows high-compression ethanol-only vehicles to be practical (or possibly via flexible fuel technology), the fuel efficiency of such engines should be equal or greater than current gasoline engines. However, since the energy content (by volume) of ethanol fuel is less than gasoline, a larger volume of anhydrous ethanol fuel (151%) would still be required to produce the same amount of energy. Â By enhancing engine performance via the water contained in hydrous ethanol, fuel consumption and emissions could actually be reduced in comparison with anhydrous ethanol utilized in gasoline blends including E85 to E100 ethanol fuels. There have been studies performed on comparing performance levels for hydrous and anhydrous ethanol blends/fuels in spray injected turbocharged engines which document the performance and emissions advantages for utilizing hydrous ethanol (Society of Automotive Engineers, 2007; Green Car Congress, 2008).Â â€œAutomaker to produce hydrous ethanol engines: according to a 2008 announcement, Dongfeng Motor Corp. of China has completed its initial research on the use of hydrous ethanol in automobiles. The new engines would use 65% hydrous ethanol which could save up to 60% of energy compared with producing the same amount of pure ethanol. The company plans to set up an ethanol-fueled car production plant by end-2008 (F.O. Lichts World Ethanol & Biofuels Report Vol.6, No.9/10.01.2008, p. 171).â€•Â Â Do automobile manufacturers support the use of hydrous ethanol?In general, auto manufacturers do not support either midlevel anhydrous or hydrous ethanol blends for use in legacy vehicles (non-FFVs) which have not been â€œofficially tested and approvedâ€• for engine performance, durability and emissions. Auto manufacturers have invested heavily in FFV technology and they would obviously prefer to sell FFVs which have already been tested rather than risk problems resulting from using midlevel anhydrous or hydrous ethanol in non-FFVs. For these reasons, auto manufacturers will void warranty on legacy vehicles when untested/unapproved midlevel ethanol blends are utilized.Flexible fuel vehicles (FFVs) are capable of operating on gasoline, E85 (85% ethanol, 15% gasoline), or any mixture of both. FFVs qualify as alternative fuel vehicles (AFVs) under the Energy Policy Act of 1992 (EPAct). They also qualify for AFV tax credits and can provide emissions benefits (DOE AFDC Alternative & Advanced Vehicles). Sales of FFVs entitle US auto manufacturers to Corporate Average Fuel Economy (CAFE) credits which provide manufacturing and marketing advantages.Though the ethanol industry is rapidly expanding, there are significant issues to resolve pertaining to further fuel testing of ethanol blends, wide-scale blending and distribution, short term supply demand issues pertaining to increasing RFS and blending rates, and consumer purchases of FFVs. Hence, it seems unlikely that the global transportation industry can make the jump from 10% to 85% or higher blends with anhydrous ethanol. Use of midlevel hydrous ethanol blends which can be efficiently utilized in legacy vehicles, appears to be a necessary approach in addition to utilizing FFVs for achieving sustainable renewable fuel consumption for all vehicles. European and Brazil auto manufacturers are currently utilizing midlevel ethanol blends, including hydrous ethanol, in legacy vehicles.Â Â Can FFV and small engines run on hydrous ethanol?All internal combustion engines and FFVs can run on hydrous ethanol blends. Theoretically, the 4% increase in water content for hydrous ethanol could increase fuel efficiency in comparison with using anhydrous ethanol blends in either unleaded gasoline or in FFV engines. A significant economical advantage of using hydrous ethanol is the ability to utilize this fuel efficiently in any internal combustion engine including small engines and 2-stroke engines. Subject to verification, hydrous ethanol could lower emissions for small engines and two cycle engines. Complying with emissions standards is a major concern for increasing ethanol blends for the small engine industry.Â Â Does hydrous ethanol damage engine seals?Extensive use of hydrous ethanol blends in Europe and Brazil reveal no damage to engine seals. In regards to safety and performance, Baylor University has concluded that â€œthere is no danger associated with water injection in an engine when using anhydrous ethanol [or hydrous ethanol from water absorption of anhydrous ethanol] as a fuel. Practical evidence of this characteristic of ethanol is the use of anhydrous ethanol in automobiles as a drying agent for fuel tanks in which water is suspected (The Case for Ethanol: Baylor University Institute of Air Science).â€•Â Â What are the overall benefits of using hydrous ethanol?The advantages pertaining to the discovery of hydrous ethanol stem primarily from the avoided capital and reducing operation and energy costs by eliminating the energy intensive dehydration process for the hydrous-to-anhydrous ethanol step. A 3-6% product volume increase is achieved while reducing energy consumption and costs. In summary, a transition from anhydrous to hydrous ethanol for gasoline blending is expected to make a significant contribution to ethanolâ€™s cost-competitiveness, fuel cycle net energy balance, and greenhouse gas emissions profile.Â Â Â Is hydrous ethanol currently being utilized?Hydrous ethanol blends have passed stringent European Union (EU) standards according to independent laboratory validations conducted by TNO Automotive (The Netherlands) and SGS Drive Technology Center (Austria). HE15 in a standard VW Golf 5 FSI meets EU4 exhaust emission limits without engine optimization. The SGS Group is a global leader and innovator in inspection, verification, testing and certification services. Â In addition, TNO Automotive has been investigating state-of-the-art low blend ethanol fuels, looking at the information available regarding engine performance and exhaust emissions. The focus was on the differences between hydrous and anhydrous ethanol for low-ethanol gasoline blends. Component testing studies were conducted at SGS and TNO for CO, HC, NOx, and fuel consumption (CO2). These European test results may be utilized to assist with obtaining EPA waivers for midlevel hydrous ethanol in North America. 100% hydrous ethanol blends (HE100) are currently being utilized in German manufactured auto engines and other manufactured engines including FFVs in Brazil and Sweden.Â Â Is further R&D of hydrous ethanol being conducted?Further research and validation work is ongoing. HE Blends is continuing test programs worldwide, including operation and testing of vehicles with hydrous ethanol/gasoline blends. Independent research regarding technological and economical benefits of hydrous ethanol are currently ongoing in the Netherlands, US, Switzerland, Indonesia, Australia, Malawi and other countries. Expanded testing and in-use demonstration programs by HE Blends are intended to satisfy ethanol stakeholders worldwide of the effectiveness of hydrous ethanol for gasoline blending and facilitate the approval and market introduction of hydrous ethanol for gasoline blending. Efforts are currently being focused on conducting parallel testing of midlevel anhydrous and hydrous ethanol blends in the US for increasing the RFS (renewable fuels standard) and blending rates. Germany and The Netherlands are jointly conducting evaluations of hydrous and anhydrous ethanol for engine GHGE in addition to improving fuel efficiency.Â Â Â Â How will hydrous ethanol contribute to the success of ethanol and renewable energy?Rapid expansion of the ethanol industry is creating global supply/demand issues. In some geographical areas, like the US for example, supply is outgrowing demand. This is having a negative effect on the price of ethanol for producers and sustainability of the ethanol industry. Due to emissions and durability testing requirements, ethanol producers are having difficulty with assessing the economic and environmental impacts of midlevel anhydrous ethanol blends on current auto engines in order to increase blending rates and the RFS. In contrast to higher percentage anhydrous ethanol blends, hE15 and higher blends can be utilized in legacy vehicles (existing auto engines) as well as FFVs. Once parallel testing has been conducted for midlevel and E85/HE85 anhydrous and hydrous ethanol blends, further fuel efficiency and emissions testing may not be necessary.Â In addition to raising blending rates and the RFS, the high price of corn and competition between food and fuel is squeezing profit margins of ethanol producers, resulting in global inflation of fertilizers, and reducing food supplies for staple food products including rice, corn, potatoes and wheat. Hydrous ethanol blends could reduce some of this inflationary pressure by increasing efficiencies of production.Â Â A 3-6% increase in ethanol production accompanied by a decrease in energy costs, plus an increase in fuel efficiency, will help to increase ethanol sales and profit margins for ethanol producers. Existing gasoline pipelines will be able to utilize midlevel hydrous ethanol blends as a much more compatible blendstock. This will dramatically reduce transportation costs by allowing petro-refineries and blenders to leverage existing infrastructures for distribution of hydrous ethanol.Â New turbocharged engines designed for ethanol only, FFV, and ethanol hybrid vehicle technologies allow for utilizing hydrous ethanol in E85 and E100 fuels in conjunction with electric power to provide unprecedented power, fuel efficiency and emissions reductions. Such combinations can substantially reduce and eventually eliminate dependence on fossil fuels.Â Â Â