General FAQs

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Â What is hydrous ethanol (hE)?Hydrous (or wet) ethanol is the most concentrated grade of ethanol that can be produced by simple distillation, without the further dehydration step necessary to produce anhydrous (or dry) ethanol. Hydrous ethanol (also sometimes known as azeotropic ethanol) is typically from 186 proof (93% ethanol, 7% water) and 192 proof (96% ethanol, 4% water). Â Â What is the difference between hydrous ethanol and anhydrous ethanol?Hydrous ethanol, in technical terms, is a binary homogeneous mixture of ethanol and water in such a ratio that its composition cannot be changed except through e.g. azeotropic distillation, adsorptionÂ (molÂ sieves) and membrane separation. This is because an azeotropic liquid such as an ethanol/water mixture, when boiled, yields vapor with the same ratio of constituents as the original mixture. Thus, once the ethanol concentration reaches 96% through simple distillation, the vapor from the boiling mixture is also 96%, withÂ water comprising the remainder. Further distillation is therefore ineffective, and an additional costly, energy-consuming dehydration process must be employed to achieve the lower water percentage (less than 1%) of anhydrous (or absolute) ethanol. Both hydrous and anhydrous ethanol have proven applications by themselves as automotive and aviation fuels. However, anhydrous ethanol has traditionally been specified in most countries when ethanol is blended with gasoline, due to concerns about the presence of water in ethanol/gasoline fuel formulations, particularly the potential for phase separation between the ethanol-water and the gasoline portions.Â Â What is the new discovery about hydrous ethanol?For the first time, HE Blends is demonstrating how hydrous ethanol can, in actuality, be used for ethanol/gasoline blending in place of anhydrous ethanol, when a minimum ethanol percentage and proper fuel formulation practices are maintained. In effect, this work revises and updates past common technical understandings of the fuel formulation properties of hydrous versus anhydrous ethanol, and the water tolerance of ethanol/gasoline blends applying hydrous ethanol. Once fully proven and accepted, this discovery means that all production of ethanol for fuel applications can eventually transition to less costly, more energy-efficient and environmentally effective hydrous ethanol, eliminating the extra processing and handling steps necessary to satisfy todayâ€™s anhydrous ethanol specifications.Â How did the hydrous ethanol blending discovery come about?Process Design Center was investigating means of improving process technologies used for ethanol dehydration, leading its researchers to explore and advance the science of water tolerance of ethanol/gasoline mixtures and the conditions under which phase separation occurs. In principle, a liquid-liquid extraction column can be used to extract ethanol from an ethanol-water mixture into a gasoline stream. This presumes that the two liquids can be totally separated, but researchers found this was not the case with hydrous ethanol. In the top of the extractor, the densities of the two liquids were similar and took a long time to completely disengage, which led to prohibitively large extractor volumes that were operationally too expensive. An idea immediately surfaced: If we canâ€™t get the water out, then letâ€™s see if we can leave it in! The further investigation that followed revealed previously undocumented aspects of ethanol-water-gasoline fuel blending properties, and unrealized potential to advance ethanol production and use. So, what appeared to be a show-stopper for better methods ofÂ ethanol extraction turned into an opportunity for hydrous ethanol/gasoline blending.Â Â What about hydrous ethanol for higher-percentage applications of ethanol as motor fuel?Hydrous ethanol becomes even more practicable as the ethanol percentage increases, such as in formulating E85 (85% ethanol, 15% gasoline). Indeed, straight hydrous ethanol (without a gasoline component) is already being applied directly as a motor fuel in Brazil, and as an aviation fuel. Thus, a transition to hydrous ethanol should include its use for higher blends such as E85 (where anhydrous ethanol also continues to be specified), as well as for lower-percentage ethanol/gasoline blends.Â What is the patent coverage related to the hydrous ethanol discovery? HE Blends has been granted international patent WO 2006/137725 A1 covering its invention and discovery of the practicability of hydrous ethanol as a gasoline blending component. This patent covers ethanol/gasoline blends with from 1% to 50% (by weight) ethanol and from 1% to 10% (by weight) water content. Use of hydrous ethanol for higher percentage blends such as E85 is also subject to additional patent coverage. HE Blends is applying this international patent overage as part of overall efforts to introduce and commercialize hydrous ethanol/gasoline blending in worldwide markets.Â What testing has been performed of hydrous ethanol as a gasoline blending component?HE Blends, in collaboration with other European organizations, has completed initial vehicle tests confirming that, with proper practices, hydrous ethanol can be blended effectively with gasoline without phase separation or other problems. An unmodified Volkswagen Golf 5 FSI was operated successfully on hE15 (15% hydrous ethanol blended with gasoline), meeting European exhaust emission standards in testing conducted by the Netherlands research organization TNO Automotive and by SGS Drive Technology Center of Austria. HE Blends continues to operate and monitor several company vehicles on hE15, with favorable results. Besides confirming the effectiveness of hydrous ethanol for gasoline blending in actual vehicle trials, these initial tests have shown measurable increases in volumetric fuel economy, indicating higher thermodynamic efficiencies resulting from hydrous ethanol.Â What further testing and demonstration of hydrous ethanol is being undertaken or planned?A major engine and vehicle testing program by FEV Motorentechnik GmbH / RWTH Aachen University Germany is scheduled to begin in 2008, with funding from the Dutch and German governments. This program will evaluate and verify the fuel operational characteristics of hydrous ethanol in comparison to anhydrous ethanol over a wide range of blending percentages with gasoline. In addition to providing definitive evidence of hydrous ethanolâ€™s practicability as a gasoline blending component, this test program will, for the first time, establish the efficiencies of hydrous versus anhydrous ethanol used in various percentages as gasoline blending components, and determine the optimum (most efficient) blending percentages. Additional testing and demonstration programs with hydrous ethanol are being planned or considered in Europe, Africa, North and South America and elsewhere.Â What are the potential benefits of implementing hydrous ethanol?Substituting hydrous ethanol for current applications of anhydrous ethanol stands to advance the overall ethanol fuel option in a number of ways, including:

significantly reducing ethanol plant capital and production costs and increasing production volumes, by eliminating the final dehydration step; reducing the energy input requirements for ethanol processing, which will also add to the greenhouse gas benefits and other environmental advantages of ethanol; eliminating the need for separate storage and handling of two grades of ethanol (hydrous and anhydrous), and easing the burden of distribution system practices necessary to maintain anhydrous ethanol specifications; and finally, the potential for higher engine operating efficiencies.Â What are the remaining steps to commercial introduction of hydrous ethanol?Changes to current ethanol fuel specifications to allow for the higher water percentage of hydrous ethanol are the key step necessary to allow the commercial introduction of hydrous ethanol as a substitute for anhydrous ethanol for gasoline blending. In reality, such revisions of prevailing fuel standards will require the understanding and acceptance of hydrous ethanol on the part of major stakeholders, including automakers, fuel suppliers, and regulatory bodies. This should prove easier and faster in some markets where hydrous ethanol is already a familiar commodity and where all gasoline contains a minimum percentage of ethanol. Other markets will require a longer transition prior to hydrous ethanol becoming the worldwide standard for ethanol production and use.