New Insights in Gasoline Blending: Hydrous E15

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If water is added to gasoline a rapid disengagement into two liquid phases occurs, resulting in a lower water layer and an upper gasoline layer. The presence of a separate water layer is generally known to be harmful to systems for fuel storage and distribution, car fuel tanks and related systems.

Low ethanol blends (e.g. E2 or E5) containing small amounts of water, behave similar and form a two-phase liquid system (see ternary diagram). Hence, the use of anhydrous (dry) ethanol for blending seems to be obvious. But dry ethanol is hygroscopic, is able to pick up water, e.g. from the distribution system or from the air humidity. Therefore refineries prefer the production of ETBE (ethyl-tert.-butyl-ether) from ethanol and blend ETBE instead of ethanol in gasoline. High ethanol blends (e.g. E85 or E90) are clearly in the homogeneous, single liquid area (see ternary diagram) and have no water problem.

The new insights are that within very narrow compositional ranges, a motor fuel composition containing water, ethanol and gasoline (ternary mixture) can be obtained substantially without phase separation. This motor fuel contains preferably at least 15 weight% of ethanol (E15) and will contain about 1 weight% of water. In this apparently homogeneous liquid mixture no phase boundary can be detected by vision and it thus meets the specification ‘clear and bright’. The water content results from blending hydrous ethanol, close to its azeotropic composition, in gasoline. This essentially is a break-through invention in science that has many economic and ecologic advantages.

One of the reasons why blending of ethanol for automotive purposes is being promoted is because it has a positive net energy balance: the energy content of a ton of ethanol is higher than the energy requirement to produce this ton. This advantage becomes even bigger for hydrous ethanol, because the energy-intense last process step for full dehydration is not needed. This results in extra energy savings in the order of 30% in ethanol production. A second advantage is economic in nature. The production cost savings by switching from anhydrous to hydrous ethanol are in the order of 0.05 to 0.10 EUR per liter ethanol. Thirdly, because the technologically advanced last drying steps can be skipped, decentralized ethanol production becomes possible that results in significant logistical cost savings. Furthermore, it has major implications for developing countries where small factories may well be set up ‘at the farm’.

Even though low ethanol blends are currently considered, one should move up to at least E15.

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