Azeotropic Volatility Behavior of Hydrous Ethanol Gasoline Mixtures

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In the United States, the ethanol blended in our fuels is anhydrous or 200 proof, which requires an additional energy intensive process to produce due to the binary azeotrope which is formed at proportions of 95.6/4.4 mass % ethanol/water at 1 atm. To avoid this added expense, there is interest to blend gasoline with hydrous ethanol mixed in these azeotropic proportions to be used as a renewable or partially renewable fuel. To evaluate the effect of the added water, a few studies have shown that improved efficiencies and pollutant reduction can be achieved when blending hydrous ethanol into our petroleum based fuels. In order to fully utilize the potential of hydrous ethanol blended fuels, research is needed to characterize these mixtures including the effects on relevant physical and combustion properties. Using an improved distillation method, the ongoing study explores the effect of blending hydrous ethanol with gasoline (in azeotropic proportions) on the volatility of the complex fluid. Results demonstrate a unique boiling behavior with the hydrous ethanol/gasoline mixtures. For samples consisting of 75–85 % hydrous ethanol by volume, the initial boiling temperatures were found to be nearly 10 ℃ lower than those of either ethanol or gasoline alone as a result of a complex azeotrope formed with the water, ethanol, and compounds found within the gasoline. The distilled fluid is sampled during the experiment, and the distillate compositions are determined using gas chromatography techniques. The composition has allowed for the identification of the azeotropic mixtures responsible for the reduction of boiling temperatures and the determination of the effect of hydrous ethanol on relevant thermo-chemical properties, including the enthalpy of combustion.