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EVALUATION OF ANTIOXIDANTS ON STABILITY-RELATED PROPERTIES OF BIODIESEL: EFFECT OF ANTIOXIDANT CHEMICAL STRUCTURE ON ANTIOXIDANT PERFORMANCE

J. Andrew Waynick[1], William E. Moehle[2], Vince Gato,[2] and Steven R. Westbrook [3]

[1]NCH Corporation, 2730 Carl Road, Irving, TX 75062 USA
[2]Albemarle Corporation, Gulf States Road, Baton Rouge, LA 70821-0341 USA
[3]Southwest Research Institute, P. O. Drawer 28510, San Antonio, TX 78228-0510 USA

The effect of nine antioxidants of known chemical structure was evaluated in a soy-based, additive-free B100 that had poor stability but was otherwise ASTM D6751 compliant. The nine antioxidants evaluated included four non-functionalized phenolics, three functionalized phenolics, and two amine-based antioxidants. Each of these additives was added to the B100 at both 1,000 ppm and 2,000 ppm. The additive-free B100 and the 18 additized B100 samples were evaluated according to five stability-related tests: Rancimat (EN 14112), modified D2274 total insolubles, modified D2274 iso-octane insolubles, Post-D2274 Total Acid Number (TAN), and Post-D2274 Peroxide Value (PV). Results of the additized fuels were compared against the additive-free B100, both before and after D2274 stressing, as appropriate. These five test variables were also cross-correlated to reveal more information concerning the performance of the nine antioxidants.

Results indicated that the best overall antioxidants were two non-functionalized phenolics, MBDTBP [4,4'-methylenebis(2,6-di-tert-butylphenol)] and BHT (butylated hydroxytoluene). Another phenolic, DTBP (2,6 di-tert-butylphenol) as well as one functionalized phenolic, DTBDMAC (2,6-Di-tert-butyl-alpha-dimethylamino-p-cresol, which is a tertiary amine modified phenolic) and one amine-based antioxidant, PDA (phenylene diamine) also gave good performance. The amine-based nonylated diphenylamine (NDPA) was completely ineffective in inhibiting D2274 total and iso-octane insolubles or in reducing Post-D2274 TAN and PV. All additives that gave low D2274 total insolubles also gave low iso-octane insolubles. Additives that gave the best performance in the D2274 test also gave the lowest Post-D2274 TAN values. Rancimat induction period (IP) did not in general correlate well with any other variable. However, all additives that imparted very high Rancimat IP also gave excellent modified D2274 results.