Simultaneous Determination of Fatty Acids and Oil Glycerides in Biofuels

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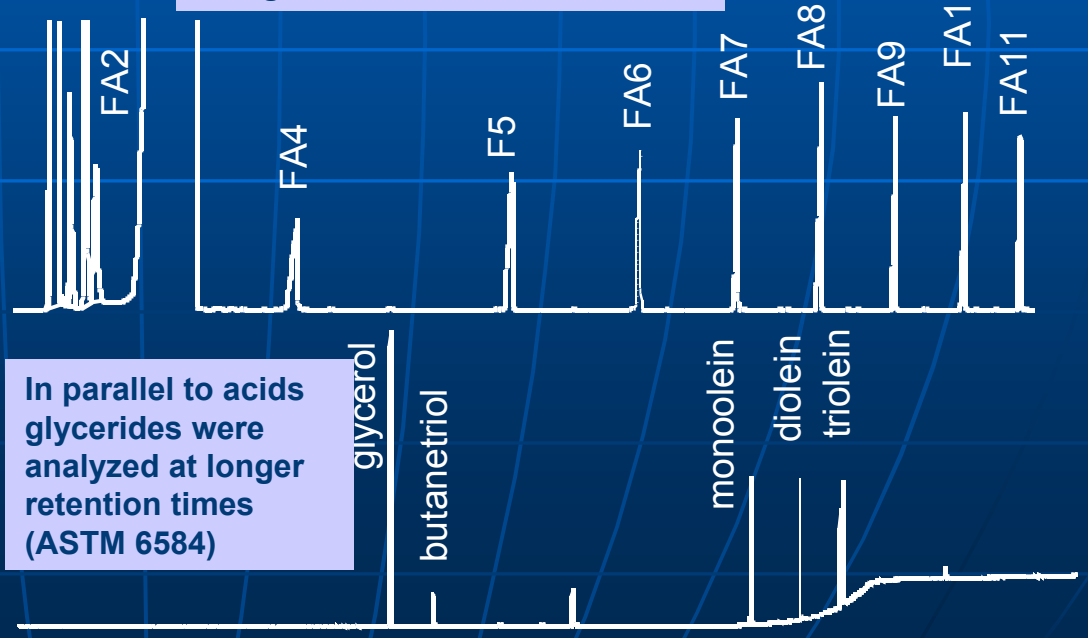
Biofuels are products of chemical or thermal transformations of crop oils. The common issue frequently encountered in production of biofuels is incomplete transformation of oils glycerides and formation of fatty acids decreasing the quality of the biofuels.

ASTM methods employ gas chromatography (GC) for glyceride & glycerol analysis. Acidity is simply evaluated by the titration.

However such results do not provide sufficient data for future fuel developments.

In this work REU student Bonnie Die participated on initial development of the method for simultaneous determination of glycerides and fatty acids in biofuels.

GC determination of fatty acids (FA) as trimethylsilyl derivatives using HT DB-1 GC column.



In parallel to acids glycerides were analyzed at longer retention times (ASTM 6584)

TPD-and FTIR-based Measures of Catalyst Acidity

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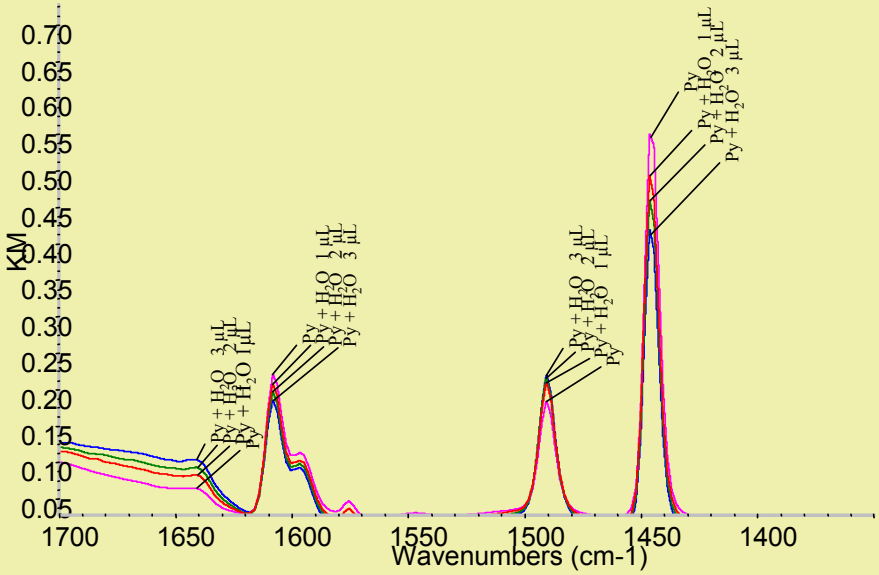
TPD results of IPA, ammonia, and pyridine revealed the presence of both Brønsted and Lewis acid sites on commercially available (SZ-I) and lab synthesized (SZ-II) sulfated zirconia. The effect of water on the acidity of SZ was determined by co-adsorption experiments, where H_2O was adsorbed either before (H_2O/Probe) or after the probe molecule (Probe/H_2O). IPA TPD results showed no increase in Brønsted acidity with hydration, contrary to the traditional interpretation of DRIFTS experiments.

TPD results of all basic probes on SZ-I showed that water displaces previously adsorbed molecules from weak Lewis sites. Pre-adsorption of water produces sites that bind ammonia weakly on some sulfated zirconia surfaces.

DRIFTS experiments agreed with the traditional interpretation of conversion of Lewis sites to Brønsted sites with hydration. However, these results disagreed with TPD results which show no increase in Brønsted acidity with added H_2O. SZ-I also lacked IR peaks attributed to Brønsted sites, but showed no difference in Brønsted acidity during TPD as compared to SZ-II. Thus, different types of analyses of catalyst acidity can yield significantly different conclusions regarding the acidic characteristics of a catalyst.

Amount desorbed (μmol g cat-1) in ammonia, pyridine, and IPA TPDs performed on SZ-II.

Species ↓ / Experiment →	No H_2O	Probe/ H_2O	H_2O/Probe
Ammonia	250 ± 30	200 ± 10	210 ± 10
Pyridine	120 ± 20	100 ± 20	110 ± 20
IPA	90 ± 20	80 ± 10	70 ± 10
Propene(IPA)	60 ± 3	60 ± 3	60 ± 4



DRIFTS spectra on adsorption of pyridine/H2O on SZ-I after adsorption of 1μL water every hour.