Update: Fuel Quality for Ethanol Plants

Fuel Ethanol Laboratory Conference

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Just a bit about me....

1994: Started at largest distillery in the world.
2000: Transferred to largest corn processing plant in the world.
2007: Worked for ethanol trade association.
2015: KMoore Consulting formed.
2018: Building global markets.
Ethanol’s Value to Air Quality

- Valuable octane increase.
- Valuable sulfur dilution.
- Valuable benzene dilution.
- Valuable volume extension.
- Valuable greenhouse gas reductions.
Points in Today’s Presentation

• Importance of ASTM International, Global Fuel Specifications.

• How ethanol markets are impacted by ASTM and other standards.

• Fuel Ethanol Quality issues.

• Know your process! Know your product!

• Market Development.
ASTM and Ethanol

- ASTM Standards are important to all of us!
  - Ethanol industry posting improved participation and attendance.
  - D02 Main Committee has 2,500 members.
  - Ethanol industry has ~50 members.

- Commercial contracts typically reference consensus standards for motor fuels such as ASTM D4806 for denatured fuel ethanol.

- International specs based on ASTM.
ASTM: How do I get involved?

• Stakeholder involvement
  – Two face-to-face meetings per year, voting rights throughout the year.
• Balanced stakeholder input. Producer not more than User + General Interest.
• Level of participation is up to you.
• Unlimited committee memberships.
• Starts with $75 annual membership

• Very active efforts at ASTM D02, E48.
• Developing succession plan to bring ethanol stakeholders into leadership.
• Government agencies must adopt consensus standards when available.
• Advancing our industry goals with standards, methods, specifications.
ASTM D02 Efforts

• D7795 will be the only acidity test method in ethanol specifications. Already removed D1613 from D4806.
• D5501 specific gravity adjustment.
• Improve significant figures in D381.
• Copper in D4806, DRA discussions (future).

<table>
<thead>
<tr>
<th>Property</th>
<th>Limit</th>
<th>Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethanol, % by volume, min</td>
<td>92.1</td>
<td>D5501</td>
</tr>
<tr>
<td>Methanol, % by volume, max</td>
<td>0.5</td>
<td>D5501</td>
</tr>
<tr>
<td>Solvent-washed gum content, mg/100 mL, max</td>
<td>5.0</td>
<td>D381</td>
</tr>
<tr>
<td>Water, % by volume (% by mass), max</td>
<td>1.0 (1.26)</td>
<td>E203, E1064, or D7923</td>
</tr>
<tr>
<td>Inorganic Chloride, mg/kg (mg/L), max</td>
<td>6.7 (5)</td>
<td>D7319 or D7328</td>
</tr>
<tr>
<td>Copper, mg/kg, max</td>
<td>0.1</td>
<td>D1688</td>
</tr>
<tr>
<td>Acidity (as acetic acid CH₃COOH) mg/kg, (% by mass) [mg/L], max</td>
<td>70 (0.0070) [56] (Note 2)</td>
<td>D7795, D6423</td>
</tr>
<tr>
<td>pHHe</td>
<td>6.5 to 9.0</td>
<td>D2622, D3120, D5453, or D7039</td>
</tr>
<tr>
<td>Sulfur, mg/kg, max</td>
<td>30.</td>
<td>D7318, D7319, or D7328</td>
</tr>
<tr>
<td>Existent sulfate, mg/kg, max</td>
<td>4</td>
<td>D7318, D7319, or D7328</td>
</tr>
</tbody>
</table>
ASTM E48 Bioenergy and Industrial Chemicals from Biomass

• Development of Standards and Specifications supporting the commercial activity of bioenergy, biomass conversion:
  – Many methods on biomass characterization.
  – Standard Practice for Determination of Converted Fraction of Starch and Cellulose co-fermentation.
  – Undenatured ethanol specification development.
International Analysis of Ethanol

• Careful review of international analytical specifications and test methods ensures appropriate analysis.
• Many times ASTM International Standard Test Methods (STM) are referenced.
  • If you are using an ASTM STM and the international specification is not, then equivalence must be demonstrated.
  • ASTM D6708 is a great tool to help with this demonstration.
• Some countries with a standards organization develop their own methods.
  • Netherlands has NEN, EU has CEN, Brazil has ABNT, Canada has the CGSB.
• Identify the referee method to ensure awareness of fuel quality resolution.
**ASTM - D02 Ethanol Related Specifications**

D4806 – Denatured Fuel Ethanol Specification
D4814 – “Gasoline” Specification
D5798 – Ethanol Flex Fuel Specification
D7794 – Mid Level Ethanol blends Practice
D8011 – Natural Gasoline
D8076 – 100 RON (High Octane Fuel)
D8181 - Microemulsion

There are 38 ASTM standards included in this price! And the compilation is updated weekly- so you keep on top of all of the latest test methods, specifications!
Keeping up the Ethanol Presence!

• Active participation in ASTM for standard and specification improvement, ensure presence of voters.

• Active participation in NCWM to ensure market access, no limitations on ethanol content, uniform requirements for E10 and E15.
Know Your Process!
Know Your Product!

• This session is a real example of how your process affects your fuel quality!
• Fuel quality incidents have caused numerous issues at plants, terminals, and consumer issues and rejection incidents with your customer and/or regulatory authority.
  – Costs time and money to your company.
  – Run the risk of losing customers and markets.
Filtration

- The cheapest, best line of defense. Drag Reducing Agent, Gasoline Detergent, Molecular Sieve Bead Dust, ...
- Let’s talk seriously about this!! If particulate gets to consumers, the cost starts in the $Millions.

Ethanol Flex Fuel

- Water limit is lower for D5798 Ethanol Flex Fuel than D4806 Denatured Fuel Ethanol.
- Rejections from customer and regulatory authority.
- Modifications to vol.%/ wt.% in D5798 underway.
Provide Good Customer Service!

• When a report of a concern with fuel quality is received, TAKE IT SERIOUSLY!
• Review plant operations and laboratory performance.
• Re-evaluate sample retain.
• Follow up with person with concern. Everyone’s fuel quality affects the industry, both the ethanol and oil industry.

Complete a thorough investigation. If there has been a fuel quality event: own it, correct it, and learn from it!
Industry Collaboration

Fuel Ethanol Technical Advisory Group (FETAG)

➢ Originally came together through ASTM
➢ Bigger opportunities for this group to collaborate
➢ No trade group ties
➢ Industry outreach and communication

Current Objectives

➢ ASTM “Know Before You Go” Webinar
➢ FEW Panel Discussion on topics impacting DFE
➢ Potential for Industry Led Research Efforts
U.S. Ethanol Export Destinations: How will this picture change over the next years?
Global Ethanol Specifications

• Each country, each state, each customer may have their own specifications.

• Pay close attention to the analytical methods.
  – Methods may appear identical, but must be proven.
  – Retail records of method equality.

• Pay close attention to the units of measure.
  – Watch volume vs. weight %
  – Similar to water limit of D4806 vs. D5798.

• Confirm with customer the data to be listed on the Certificate of Analysis.
## Comparison of Global Ethanol Specs

<table>
<thead>
<tr>
<th>Parameter</th>
<th>United States ASTM D4806</th>
<th>Canada CGSB 3.516</th>
<th>EU EN15376</th>
<th>China NG18</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethanol, % vol.</td>
<td>92.1</td>
<td>92.0</td>
<td>98.7</td>
<td>92.1</td>
</tr>
<tr>
<td>Methanol, % vol.</td>
<td>0.5</td>
<td>0.5</td>
<td>1</td>
<td>0.5</td>
</tr>
<tr>
<td>Water, % vol.</td>
<td>1.0</td>
<td>0.8</td>
<td>0.300</td>
<td>0.8</td>
</tr>
<tr>
<td>Acidity, mg/ kg</td>
<td>70</td>
<td>70</td>
<td>0.005% wt.</td>
<td>56</td>
</tr>
</tbody>
</table>
Thank you!

KMoore Consulting LLC, Email: fueltechservice@gmail.com, Phone: 309.275.9433
Importance of Fuel Quality

One tanker load (9,000 g) of denatured fuel ethanol makes 90,000 gallons of E10 gasoline.
Let’s say: Most consumers fill up with 15 gallons of E10, that’s 6,000 fill ups for consumers.
Math for railcar: 29,000 g makes 290,000 gallons of E10.
That’s 19,500+ consumers!

Estimate fuel usage time:
- Truckload used in <30 days.
- Railcar used in <60 days.
- Barge/ international used in >90 days.

Keep sample storage per the average transit time for product to get to the market and ensure there are no issues.