Session 3: Experience Standardizing Ethanol as a Cooking and Appliance Fuel

Lusaka Workshop
November 1, 2018
Brady Seals
NEARLY 3 BILLION PEOPLE COOK WITH SOLID FUELS
4.3 MILLION DEATHS PER YEAR
LINKED TO AIR POLLUTION VIA SOLID FUEL COOKING
BURNING TRADITIONAL BIOMASS FUELS LIKE WOOD AND CHARCOAL IS A MAJOR DRIVER OF DEFORESTATION
More than 80% of urban households use charcoal as their main cooking fuel.

In Africa, already 38% of the population lives in urban areas, and the UN estimates that this number will rapidly rise to 50% by 2040.
1 billion people in Sub-Saharan Africa

475 million people live in urban areas and that population will double over the next 25 years.

80% of the urban areas (380 million people) are cooking with solid fuel.
CLEAN RENEWABLE ETHANOL FUEL

- Ethanol fueled cookstoves address these issues
- Approximately 80,000 stoves distributed in over ten countries
- Very few ethanol standards specifically for ethanol as a cooking and appliance fuel
GOALS

• Create a standard based on performance parameters which will:
  • Protect the consumer from purchasing sub-par quality fuel
  • Prevent ethanol as a cooking fuel from being consumed
  • Identify ethanol as a cooking fuel from other types of ethanol
  • Provide a benchmark for the classification of a new product
• One of the largest voluntary standards developing organizations in the world
• Representation from more than 150 countries
• National standards based on ASTM in 75 nations
• Over 34,000 members
• Over 12,700 ASTM standards operate globally
• Standards used voluntarily
Global Operations

• One of the world’s largest Standards Developing Organizations - global reach

• Embraces all the principles of the World Trade Organization’s Agreement on Technical Barriers to Trade
  1. Transparency
  2. Openness
  3. Consensus
  4. Relevance
  5. Coherence
  6. Development dimension

• Works across political, cultural and geographic borders

• Trusted for market relevance and technical quality

• The choice for many global industries – 47% outside
<table>
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<th>ASIA</th>
<th>EUROPE</th>
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ASTM & ZAMBIA

- MOU signed in 2004 with ZABS
- Since then, ZABS has cited over 200 ASTM standards in their work
- Since ZABS is an MOU partner, anyone in Zambia can join as a member free of charge
  - Simple 1 page application

Global Solutions to Common Problems
ASTM membership is open to direct participation globally

Known for Technical Quality and Market Relevance
ASTM process keeps the science in, and politics out

Solve Problems Expert to Expert
Collaborate in an open, transparent, and inclusive process
ASTM PROCESS

Equal Voice, Equal Vote

• Openness
• Consensus based
• Balance between Producers and Users/General Interest
• One official vote per “voting Interest”
• But all members can vote
• All negatives are addressed
1. Choose Committee
   • E48 Committee (Bioenergy and Industrial Chemicals from Biomass)

2. And Subcommittee
   • E48.05 Subcommittee (Biomass Conversion)

3. Task group assembled (members)
   • Comprised of 32 members representing various areas related to:
     o production of ethanol
     o regulatory implications of denatured ethanol
     o packaging and transportation of ethanol
     o safe handling of alcohol fuels
     o international distribution of ethanol

4. Met virtually seven times in 2015 over a 5 month period
   • (2 in-person meetings every year at ASTM – Dec/June)
THE ETHANOL COOKING FUEL STANDARD

Keywords:

- appliance fuel
- cooking fuel
- denatured ethanol
- ethanol fuel
- stove fuel
SCOPE

1.1 Denatured fuel for cooking and/or appliance fuel

1.2 Not to preclude observance of other regulations (federal, state, local)

** Not addressing regulatory compliance

1.3 Denatonium benzoate required in addition to any other denaturants

** Deterrent to consumption of fuel. Amounts must meet min/max levels in spec table

1.4 Colored dye also required. Must meet min/max levels in spec table

** Visual indicates that the product is not potable

1.5 Values stated in SI units regarded as standard. No other measurement units included

1.6 Does not purport to address all safety concerns, if any, associated with use.
REFERENCED DOCUMENTS

ASTM Standards
- D381
- D4057
- D4177
- D4306
- D4815
- D5854
- D7795
- E203
- E300
- E1064

TERMINOLOGY

Denatured ethanol – ethanol made unfit for beverage use by the addition of toxic or noxious materials

Higher alcohols – aliphatic alcohols of general formula $C_nH_{2n+10}H$ with $n$ being 3 to 8

Hydrocarbon – those components in an ethanol hydrocarbon blend containing only hydrocarbon and carbon
WORKMANSHIP

• Should be visually free from sediment and suspended matter

• Should be free of any adulterant or contaminant that can render the material unacceptable for applications

• Additives beyond denaturants and colorants discouraged. Higher molecular weight additives can create issues with combustion or lead to deposits.

• Monitoring the fuel using Test Method D381 can determine if additives have been added. Can provide early indication of contamination.

• Care should be taken when selecting and choosing colorant. Not all colorants are soluble in ethanol.

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**TABLE 1: Denatured Ethanol Cooking and Appliance Fuel Specifications**

<table>
<thead>
<tr>
<th>Property</th>
<th>Units</th>
<th>Limit</th>
<th>Min/Max</th>
<th>Test Method</th>
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<tbody>
<tr>
<td>Ethanol</td>
<td>volume %</td>
<td>90</td>
<td>Min</td>
<td>D5501</td>
</tr>
<tr>
<td>Water</td>
<td>volume %</td>
<td>10</td>
<td>Max</td>
<td>E203 or E1064</td>
</tr>
<tr>
<td>Higher Alcohols</td>
<td>volume %</td>
<td>2</td>
<td>Max</td>
<td>D4815</td>
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<tr>
<td>(C₃-C₆)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hydrocarbon*</td>
<td>volume %</td>
<td>1</td>
<td>Max</td>
<td>Documented Addition D7795</td>
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<tr>
<td>Acidity (as acetic acid)</td>
<td>mg/Kg</td>
<td>40</td>
<td>Max</td>
<td>Documented Addition</td>
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<tr>
<td>Denatonium Benzoate</td>
<td>mg/Kg</td>
<td>10–20</td>
<td>Min–Max</td>
<td>Documented Addition</td>
</tr>
<tr>
<td>Colored Dye</td>
<td>mg/Kg</td>
<td>10</td>
<td>Max</td>
<td>Documented Addition</td>
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</tbody>
</table>

*The hydrocarbons approved for use under this specification are as follows: gasoline, unleaded gasoline, natural gas, heptane, or rubber hydrocarbon solvent.
SAMPLING, CONTAINERS, AND SAMPLE HANDLING

- User strongly advised to review all intended test methods prior to sampling. Important to understand sampling technique, proper containers, and special handling required of samples.
- Correct sampling procedures critical to obtain representative sample.
  - Automatic method sampling tests are provided.
  - Correct sample volume and appropriate container selection are important decisions that can impact test results.
    - References to tests are included.
- Sample size = minimum of 1 liter recommended
- Lot size = normally consist of the amount in the tanker compartment or other bulk container in which it is delivered. If this definition does not apply, definition should be agreed between supplier and purchaser.

TEST METHODS

- **Ethanol** – Test Method D5501
- **Water** – Test Methods E203 or E1064
- **Higher Alcohols** – Test Method D4815 or other suitable gas chromatography method
- **Acidity** – Test Method D7795
- **Solvent-Washed Gum Content** – Test Method D381, air jet apparatus
- **Documented Addition** – the process of providing written documentation on specific amount of a substance added
NEXT STEPS

• Other countries can consider adopting ASTM E3050 to ensure quality fuel reaches consumers.

• Individuals can become members of ASTM
  • Free ASTM membership for Zambia and other African countries
    • (MOU with ASTM)
Thank you!

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