Biodiesel Specification in Indonesia

Tatang H Soerawidjaja
President of Indonesian Association of Bioenergy Scientists and Technologists (IABEST), Member of Indonesian Academy of Science (AIPI), Member of National Technical Committee on Biofuel Standard, Faculty Member of Study Program Bioenergy Engineering and Chemurgy - Faculty of Industrial Technology – Institut Teknologi Bandung (ITB)

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In August 2013, the Indonesian government (through Energy and Mineral Resources Ministerial Decree No. 23/2013) decided that by 2016, the biodiesel blend level in automotive diesel fuel must already reach 20%.

To implement this policy, the National Technical Committee on Biofuel Standard then conducted numerous stakeholders’ meetings and organized the needed tests to improve the then existing biodiesel specification (SNI 7182 - 2012) and thus formulating a new quality standard that would allow the 20%-vol blend level of biodiesel.

The result of this activity is the present national specification (or quality standard) : SNI 7182-2015.
<table>
<thead>
<tr>
<th>No.</th>
<th>Test Parameter</th>
<th>Unit</th>
<th>2015 Limit</th>
<th>2012 Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>01.</td>
<td>Density 40 °C</td>
<td>kg/m³</td>
<td>850 – 890</td>
<td>850 – 890</td>
</tr>
<tr>
<td>02.</td>
<td>Kinematic viscosity at 40 °C</td>
<td>mm²/s (cSt)</td>
<td>2.3 – 6.0</td>
<td>2.3 – 6.0</td>
</tr>
<tr>
<td>03.</td>
<td>Cetane number</td>
<td>-</td>
<td>Min. 51</td>
<td>Min. 51</td>
</tr>
<tr>
<td>04.</td>
<td>Flash point (closed cup)</td>
<td>°C</td>
<td>Min. 100</td>
<td>Min. 100</td>
</tr>
<tr>
<td>05.</td>
<td>Cloud point</td>
<td>°C</td>
<td>Max. 18</td>
<td>Max. 18</td>
</tr>
<tr>
<td>06.</td>
<td>Copper strip corrosion (3 hrs, 50 °C)</td>
<td>-</td>
<td>Number 1</td>
<td>Number 1</td>
</tr>
<tr>
<td>07.</td>
<td>Carbon residue in :</td>
<td>%-mass</td>
<td>Max. 0.05</td>
<td>Max. 0.05</td>
</tr>
<tr>
<td></td>
<td>- Original sample</td>
<td></td>
<td>Max. 0.3</td>
<td>Max. 0.2</td>
</tr>
<tr>
<td></td>
<td>- or 10 % residue of distillation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>08.</td>
<td>Water and sediment</td>
<td>%-volume</td>
<td>Max. 0.05</td>
<td>Max. 0.05</td>
</tr>
<tr>
<td>09.</td>
<td>90 %-distillation temperature</td>
<td>°C</td>
<td>Max. 360</td>
<td>Max. 360</td>
</tr>
<tr>
<td>10.</td>
<td>Sulfated ash</td>
<td>%-mass</td>
<td>Max. 0.02</td>
<td>Max. 0.02</td>
</tr>
</tbody>
</table>
### Biodiesel specification in Indonesia (SNI 7182-2015, cont.)

<table>
<thead>
<tr>
<th>No.</th>
<th>Test Parameter</th>
<th>Unit</th>
<th>Limit</th>
<th>2012 Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>11.</td>
<td>Sulfur</td>
<td>mg/kg</td>
<td>Max. 50</td>
<td>Max. 100</td>
</tr>
<tr>
<td>12.</td>
<td>Phosphorous</td>
<td>mg/kg</td>
<td>Max. 4</td>
<td>Max. 10</td>
</tr>
<tr>
<td>13.</td>
<td>Acid value</td>
<td>mg-KOH/g</td>
<td>Max. 0.5</td>
<td>Max. 0.6</td>
</tr>
<tr>
<td>14.</td>
<td>Free Glycerol</td>
<td>%-mass</td>
<td>Max. 0.02</td>
<td>Max. 0.02</td>
</tr>
<tr>
<td>15.</td>
<td>Total Glycerol</td>
<td>%-mass</td>
<td>Max. 0.24</td>
<td>Max. 0.24</td>
</tr>
<tr>
<td>16.</td>
<td>Methyl ester content</td>
<td>%-mass</td>
<td>Min. 96.5</td>
<td>Min. 96.5</td>
</tr>
<tr>
<td>17.</td>
<td>Iodine Value</td>
<td>g-I2/100 g</td>
<td>Max. 115</td>
<td>Max. 115</td>
</tr>
<tr>
<td>18.</td>
<td>Oxidative Stability:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Rancimat Induction Period</td>
<td>minute</td>
<td>Min. 480</td>
<td>Min. 360</td>
</tr>
<tr>
<td></td>
<td>- or Petro-Oxy Induction Period</td>
<td></td>
<td>Min. 36</td>
<td>Min. 27</td>
</tr>
<tr>
<td>19.</td>
<td>Monoglyceride</td>
<td>%-mass</td>
<td>Max. 0.8</td>
<td>-</td>
</tr>
</tbody>
</table>
Improvements over the 2012 specification

- Maximum limit of sulfur content decreased from 100 ppm w/w to 50 ppm w/w.
- Maximum limit of phosphorous content decreased from 10 ppm w/w to 4 ppm w/w.
- Maximum limit of acid value decreased from 0.6 to 0.5 mg-KOH/g.
- Minimum limit of Rancimat Induction Period increased from 360 minutes (6 hrs) to 480 minutes (8 hrs); correspondingly the minimum limit of Petro-Oxy Induction Period increased from 27 minutes to 36 minutes.
- A new quality parameter, monoglyceride content, is introduced and its maximum limit is set at 0.8 %-mass.
Preparation for the utilization of B30 in 2020

- Through Energy and Mineral Resources Ministerial Decree No. 12/2015, the government has recently decided that the biodiesel blend level in automotive diesel fuel will be increased to 30% starting in January 2020.

- Initial discussion and tests to implement this policy is underway.

- Preliminary study conducted by the Agency for Assessment and Application of Technology indicated that the maximum limit of monoglyceride content should be decreased to 0.6% - mass. Further study is ongoing.

- So far no complain is received on the minimum limit of oxidatif stability (perhaps because, in practice, the Rancimat Induction Period of Indonesian biodiesel is usually more than 10 hours, as the biodiesel is presently made using palm oil as raw material).

- R & D toward high performance biodiesel
# Properties of pure FAME

<table>
<thead>
<tr>
<th>Methyl ester</th>
<th>Iodine Value, I.V., g-I₂/(100 g)</th>
<th>Cetane Number</th>
<th>Melting Point, °C</th>
<th>Rancimat Induction Period, hrs.</th>
<th>Kinematic Viscosity at 40 °C, cSt.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laurate, Me-C12:0</td>
<td>0</td>
<td>58.2</td>
<td>3.7</td>
<td>&gt; 20</td>
<td>2.35</td>
</tr>
<tr>
<td>Myristate, Me-C14:0</td>
<td>0</td>
<td>70.0</td>
<td>17.1</td>
<td>&gt; 20</td>
<td>3.24</td>
</tr>
<tr>
<td>Palmitate, Me-C16:0</td>
<td>0</td>
<td>79.8</td>
<td>28.8</td>
<td>&gt; 20</td>
<td>4.35</td>
</tr>
<tr>
<td>Stearate, Me-C18:0</td>
<td>0</td>
<td>90.6</td>
<td>39.0</td>
<td>&gt; 20</td>
<td>5.66</td>
</tr>
<tr>
<td>Palmitoleate, Me-C16:1</td>
<td>94.6</td>
<td>50.0</td>
<td>-48.9</td>
<td>&gt; 2</td>
<td>3.07</td>
</tr>
<tr>
<td>Oleate, Me-C18:1</td>
<td>85.6</td>
<td>58.5</td>
<td>-19.5</td>
<td>≈ 14</td>
<td>4.42</td>
</tr>
<tr>
<td>Linoleate, Me-C18:2</td>
<td>172.4</td>
<td>40.2</td>
<td>-35</td>
<td>1.0</td>
<td>4.46</td>
</tr>
<tr>
<td>Linolenate, Me-C18:3</td>
<td>260.3</td>
<td>22.0</td>
<td>-57</td>
<td>0.2</td>
<td>3.11</td>
</tr>
</tbody>
</table>

Source: Phommavongsa (2012); except Rancimat Induction Periods, from Goto et al. (2008) and Moser (2009).

- Methyl oleate has more or less “optimum” properties: good cetane value, low melting point, proper viscosity, and good oxidation stability (Rancimat IP).
Methyl ester of polyunsaturated fatty acids (linoleate, linoleate) have catalytically detrimental effects on oxidation stability.

Boiling curves diesel versus biodiesels
[Krahl et.al. (2007)]

- An increasing boiling curve is beneficial for good fuel injection and combustion in the cylinder.
- Coconut methyl ester (CME) has the best boiling curve!
The ideal (or high performance) biodiesel?

- Do not contain methyl ester of polyunsaturated fatty acids (PUFA) : linoleate, linolenate, etc.
- Mainly consists of methyl oleate and methyl ester of saturated acids.
- The saturated fatty acid chain is preferably not normal/linear but methyl-branched (⇒ result in much lower pour/cloud point!).
- Contains some percentage of lauric oil methyl ester (coconut, palm kernel, babassu, etc).

- High performance : good cetane value, low cloud point, proper viscosity, excellent oxidation stability, and favorable boiling curve.
Research challenges

• Elimination of polyunsaturated fatty acid chains. Through extraction and/or hydrogenation (\(\rightarrow\) H-FAME) approach.

• Methyl branching (or isomerization) of the saturated fatty acid chains.

  ➔ Saturated fatty acid that contain methyl branch in the middle of the alkyl chain has a melting point 40 – 50 °C lower than the corresponding linear counterpart.
THANK YOU VERY MUCH

for your attention

tatanghs@che.itb.ac.id thsoerawidjaja@gmail.com