Important Commercial and Quality Considerations in Soybean Processing

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World Production of Major Oilseeds (Crop year 2006/2007)

<table>
<thead>
<tr>
<th>Oilseed</th>
<th>Million metric tons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soybeans</td>
<td>226.78</td>
</tr>
<tr>
<td>Rapeseed</td>
<td>46.78</td>
</tr>
<tr>
<td>Cottonseed</td>
<td>43.77</td>
</tr>
<tr>
<td>Peanut</td>
<td>31.59</td>
</tr>
<tr>
<td>Sunflower</td>
<td>30.54</td>
</tr>
<tr>
<td>Others</td>
<td>16.04</td>
</tr>
<tr>
<td>Total</td>
<td>387</td>
</tr>
</tbody>
</table>

Other 4%
World Production of Soybeans By Origin
(Crop year 2006/2007)

Source: Official statistics, USDA estimates
World Soybean Export
(Crop year 2006/2007)

Source: Official statistics, USDA estimates
Middle East Imports
(Crop year 2006/2007)

Source: Official statistics, USDA estimates
### USDA Grading Standards for Soybeans

<table>
<thead>
<tr>
<th>Grade</th>
<th>Test weight Lb/ Bu</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Damaged kernel</td>
<td>Soybeans of other colors %</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Heat damaged %</td>
<td>Total damaged %</td>
</tr>
<tr>
<td>US No 1</td>
<td>56</td>
<td>0.2</td>
<td>2.0</td>
</tr>
<tr>
<td>US No 2</td>
<td>54.0</td>
<td>0.5</td>
<td>3.0</td>
</tr>
<tr>
<td>US No 3</td>
<td>52</td>
<td>1.0</td>
<td>5.0</td>
</tr>
<tr>
<td>US No 4</td>
<td>49</td>
<td>3.0</td>
<td>8.0</td>
</tr>
</tbody>
</table>

U.S. Sample grade: comprised of beans with lower quality

Specifications may be added for oil, protein and moisture in contracts.
**Processing Quality Factors**

- **Soybean quality**
  - Compositional attributes
  - Physical attributes

- **Processing efficiency**
  - Rate of deterioration
  - Rate of extraction
  - Energy use
  - Utility use
  - Solvent and material losses
**Soybean Quality Effects**

**Significance of soybean quality:**
- Processing yield
- Quality of final products
- Processing requirements - conditions
- Operating cost - profit

**Upgrading quality factors:** Oil and protein.

**Downgrading quality factors:** Moisture, damage, foreign material, splits and beans of other color.

**Minimum quality requirements:**
- Meeting the quality standards for final products
## Effects of Soybean Quality Factors

<table>
<thead>
<tr>
<th>Quality Factor</th>
<th>Affected Factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-Hydratable phosphatides</td>
<td>a, b, c, d, e, g</td>
</tr>
<tr>
<td>Free Fatty Acid</td>
<td>c, d, e, f, h</td>
</tr>
<tr>
<td>Iron/Metal Content</td>
<td>e, f, g</td>
</tr>
<tr>
<td>Lower yield</td>
<td>g</td>
</tr>
<tr>
<td>Total gums</td>
<td>b, d</td>
</tr>
<tr>
<td>Oxidation Products</td>
<td>d</td>
</tr>
<tr>
<td>Pigments</td>
<td>f</td>
</tr>
<tr>
<td>Storability</td>
<td>h</td>
</tr>
<tr>
<td>Heat Damaged</td>
<td>a, b, c, d, e, f, g</td>
</tr>
<tr>
<td>Damaged Beans</td>
<td>a, b, c, d, e, f, g</td>
</tr>
<tr>
<td>Foreign Material</td>
<td>c, d, f, g, h</td>
</tr>
<tr>
<td>Splits</td>
<td>a, b, c, d, e, g, h</td>
</tr>
<tr>
<td>Soybeans of other colors</td>
<td>f</td>
</tr>
<tr>
<td>Moisture</td>
<td>a, b, c, e, g, h</td>
</tr>
</tbody>
</table>

*Effects of Soybean Quality Factors*
<table>
<thead>
<tr>
<th>Component</th>
<th>Average %</th>
<th>Mean %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil</td>
<td>18 - 22</td>
<td>19.5</td>
</tr>
<tr>
<td>Protein</td>
<td>34.5 - 37</td>
<td>35</td>
</tr>
<tr>
<td>Carbohydrate</td>
<td>22.5</td>
<td></td>
</tr>
<tr>
<td>Fiber</td>
<td>5 - 6</td>
<td></td>
</tr>
<tr>
<td>Ash</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Moisture</td>
<td>11 - 13</td>
<td></td>
</tr>
<tr>
<td>Hulls</td>
<td>7 - 8</td>
<td></td>
</tr>
</tbody>
</table>

**Soybeans Used for Processing**

US yellow grade 2 - Soybean composition
Processing Effects

- Receiving and storage conditions.
- Preparation and Extraction methods.
- Operating variables.
- Type and efficiency of the equipment being used.
- Quality control management.
- Plant maintenance.
- Experience.
# Effect of Processing Steps on Crude Oil Quality

<table>
<thead>
<tr>
<th>Process</th>
<th>Influencing Factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Handling (breakages)</td>
<td>a, b, c, h, g</td>
</tr>
<tr>
<td>Bean Storage (t/ T/ M)</td>
<td>a, b, c, d, g</td>
</tr>
<tr>
<td>Bean drying (t/ T)</td>
<td>c, d, f</td>
</tr>
<tr>
<td>Conditioning (t/ T/ M)</td>
<td>a, b, d, e</td>
</tr>
<tr>
<td>Solvent extraction (t/ T/ M)</td>
<td>a, d, c, g</td>
</tr>
<tr>
<td>Solvent stripping (t/ T/ P)</td>
<td>a, d, f</td>
</tr>
<tr>
<td>Crude oil storage (t/ T/ M)</td>
<td>c, d, e</td>
</tr>
</tbody>
</table>

*t = time, T = temperature, M = moisture, P = absolute pressure*
Avoid breakages in the beans and contamination with foreign materials.

Remove the foreign material and splits prior to storage.

Control the storage conditions of moisture, temperature, hermetic and aeration.

Check the grain conditions regularly for sign of deterioration (off-odors, moldy condition, discoloration, heating, and presence of live insects).
Process Requirements and Operating Conditions
(receiving, handling, storage)
Soybean Conditioning Prior to Storage

Weighing and receiving → Short-term storage → Pre-Cleaning → Drying at 60-70°C → Long term storage

Non-metallic materials to mill feed → Trash separation → Broken beans-to process

To Atmosphere

Dust → Fines → Overs → Hulls

To preparation
Quality Maintenance of Soybeans During Processing
(Soybean preparation and oil extraction steps)

- Use continuous and rapid processing methods. The crushing equipments should be capable to produce a high yield of quality oil.
- Prevent interruptions in operations.
- Remove the foreign material from the beans.
- Dry the beans at optimum combination of temperature and time.
- Inactivate enzymes by proper conditioning of cracked soybeans. (correct Mst/ T/ t combination)
- Control the moisture and temperature of flakes sent to the extractor.
- Avoid overheating in the desolventizing steps.
Process Requirements and Operating Conditions (cleaning, drying, tempering)

- **Long term storage**
- **Cleaning** < 0.5 % FM
- **Drying** 60-70 C' to 10-11 % M.
- **Tempering** 48-72 hrs 10 % M.
- **To Atmosphere**
- **To cracking**

Diagram shows the flow of materials through different stages of processing, including cleaning, drying, and tempering.
Process Requirements and Operating Conditions (cracking, conditioning, flaking)

- **Weighing**
- **Cracking**: 4-8 pieces, 10-11% M
- **Dehulling**: 10% M
- **Conditioning**: SB in < 12.5% M, out = 10-11% M, process: 65-70°C, 20-30 minutes.
- **Flaking**: 10-11% M (0.25-0.35 mm)
- **Hulls**
- **Flakes reaching the extractor at 55-60°C**

**Soy in**

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**Diagram Note**: The diagram shows a process flow where soy is weighed, cracked, dehulled, conditioned, and flaked. The process requirements and operating conditions are specified for each step.
**Process Requirements and Operating Conditions**
(solvent extraction and desolventizing)

**DTDC**
- Slight vacuum
- 55-60 °C
- 40-60 min.
- Sl. vacuum

**Flakes in**

**Vent gases**

**Extractor**
- 57 °C
- 430-460 mm Hg

**1st Evaporator**
- 96-110 °C
- 460-550 mm Hg

**2nd Evaporator**
- 99-100 °C max.
- 710-720 mm Hg

**Striper**

**W. separator**

**Solvent**

**Crude oil**

**Vent gases**
Crude Oil Storage

- Purify the extracted crude oil from fines and solid impurities prior to storage.
- Fill the tank completely from the bottom to reduce the contact with air.
- Keep the oil below critical temperature, moisture and storage time to avoid deposits and oil degradation.
- Provide food grade inert coating to prevent contacts with iron.
Crude Oil Quality

Basic quality parameters for good quality crude soybean oil

- Moisture < 0.2 %
- Peroxide value < 5 meq/ kg
- Anisidine value < 3
- 5-10 % of total phosphatides as NHP
- 20-40% of the FFA will be removed by degumming
Thank You