Introduction of AAM Technology License

Bio Chemical Dept.
Personal Care Material Div.
Health Care Business Sector

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1. Basic Information on MCI’s Acrylamide (AAM)
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   1-2. Brief Introduction of MCI’s AAM
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2. Introduction of MCI’s AAM technology
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3. What MCI can offer…
Acrylamide (AAM, CH$_2$=CH-CONH$_2$) is consumed mainly in the production of polyacrylamide (PAM).

PAM is expected to be consumed mainly for following industries and applications:
1. Industrial & Municipal - for wastewater treatment
2. Pulp & Paper – for paper strength resin
3. Oil & Gas – for Enhanced Oil Recovery (EOR)

AAM has been produced by Chemical process, but Mitsui Chemicals Inc. (MCI) is producing AAM by patented innovative Bio-process with our epoch-making Bio Catalyst.
1-2. Brief Introduction of MCI’s AAM

Water-soluble monomer
Produced by bio-enzyme method
(High purity & Low environmental load)
Stable supply from 2 domestic sites

■ Application
  Polymer Coagulant for wastewater treatment
  Paper Strength Resin
  EOR (Enhanced Oil Recovery)

■ Specification
  Purity 50% Water Solution
  40% Water Solution
  pH 6.5~7.1 etc

■ Packing
  50% Water Solution (ISO Container, Lorry, IBC Container)
  40% Water Solution (200KG Drum, Lorry)

■ Others
  Achievements in Licensing of Bio-enzyme method Production Technology
MCI has been producing AAM for 40 years since 1972, and MCI’s process is reliable and cost competitive!

<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
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<tbody>
<tr>
<td>1972</td>
<td>Commercialized Chemical process at Mobara Factory in Japan</td>
</tr>
<tr>
<td>1974</td>
<td>Commercialized Chemical process at Osaka Works in Japan</td>
</tr>
<tr>
<td>2002</td>
<td>Commercialized Bio-process at Yongsan Mitsui Chemicals* in Korea</td>
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<tr>
<td></td>
<td>*A subsidiary of MCI</td>
</tr>
<tr>
<td>2009</td>
<td>Converted from Chemical process to Bio-process at Mobara Factory in Japan</td>
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<tr>
<td>2010</td>
<td>AAM Bio-technology License to Black Rose Industries</td>
</tr>
<tr>
<td>2012</td>
<td>Converted from Chemical process to Bio-process at Osaka Works in Japan</td>
</tr>
<tr>
<td>2013</td>
<td>AAM Bio-technology License to Kemira OYJ</td>
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2-1. Introduction of MCI’s AAM Process

1. Catalyst
   High-activity bio catalyst enables low consumption rates of raw materials and utilities

2. Reaction
   Reaction at room temperature and common pressure.
   Extremely high conversion rate w/ high selectivity of AN

3. Purification
   Bio catalyst is removed by efficient filtration process
   Low wastewater

4. Product
   50% purity AAM can be directly obtained w/o any concentration process
Charm Points

1. **Low Investment & Running Cost**
   with simple continuous process

2. **Low Environmental workload**
   with lower GHG emission

3. **High Efficiency**
   Profitable even starting w/ 5,000MT/y

4. **High Scalability**
   Easy to scale out the capacity

5. **High Performance**
   50% AAM can be directly obtained
# 2-3. Introduction of MCI’s Bio Catalyst

<table>
<thead>
<tr>
<th>Item</th>
<th>Value</th>
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</thead>
<tbody>
<tr>
<td>Catalyst Activity</td>
<td>Please ASK!</td>
</tr>
<tr>
<td></td>
<td>We are confident!</td>
</tr>
<tr>
<td>Catalyst Consumption rate</td>
<td></td>
</tr>
<tr>
<td>Solid Content</td>
<td>9 ~ 17 Wt.%</td>
</tr>
<tr>
<td>Number of Living Cell</td>
<td>Zero</td>
</tr>
</tbody>
</table>

**Delivery**
- 20 ft/ 40 ft Reefer container
- Store under – 25 degree C

**Package**
- 245 mm * 245 mm * 385 mm per 20 liter container
3. What MCI can offer

MCI can offer either or both of following solutions.

1. License of AAM Process Technology
   - MCI can grant a license of whole AAM manufacturing technology
   - Partial technology license may also be considered depending on request

2. Sale of Bio Catalyst
   - You may use the high-activity bio catalyst with your existing equipment
   - MCI can give a sample for your evaluation with NDA execution

MCI can support your Feasibility Study on 1 & 2 above.
Please contact following PIC for further information and any request.

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Looking forward to Future Collaboration!!
Thank you.