Introduction of AAM Technology License

Bio Chemical Dept.
Personal Care Material Div.
Life & Healthcare Solutions Business Sector
1. Basic Information on MCI’s Acrylamide (AAM)
   1-1. General Information on AAM
   1-2. Brief Introduction of MCI’s AAM
   1-3. MCI’s AAM History

2. Introduction of MCI’s AAM technology
   2-1. Introduction of MCI’s AAM Process
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   2-3. Introduction of MCI’s Bio Catalyst

3. What MCI can offer…
1-1. General Information on Acrylamide (AAM)

**Acrylamide (AAM, CH2=CH-CONH2)** 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>
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<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>
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<tr>
<td>2009</td>
<td>Converted from Chemical process to Bio-process at Mobara Factory in Japan</td>
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<td>2010</td>
<td>AAM Bio-technology License to Black Rose Industries</td>
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<tr>
<td>2012</td>
<td>Converted from Chemical process to Bio-process at Osaka Works in Japan</td>
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<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.

Bio catalyst
H2O
AN
50%
AAM
Waste
2-2. Strengths of MCI’s AAM Technology

**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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<tbody>
<tr>
<td>Catalyst Activity</td>
<td>Please ASK!</td>
</tr>
<tr>
<td>Catalyst Consumption rate</td>
<td>We are confident!</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 fill out Contact Form for further information and any request.

*Select “Acrylamide” under Products
Looking forward to Future Collaboration!!
Thank you.