



AAM Technology License and Biocatalyst “POLARASE™”

Bio Chemicals Department
Personal Care Materials Division

1. Basic Information on Acrylamide (AAM)
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3. What Mitsui Chemicals can offer...

Acrylamide (AAM, $\text{CH}_2=\text{CH}-\text{CONH}_2$) is a main raw material of polyacrylamide (PAM).

PAM is used mainly for following industries and applications:

1. Industrial & Municipal - for wastewater treatment
2. Pulp & Paper – for paper strengthening resin
3. Oil & Gas – for enhanced oil recovery (EOR)

AAM has been conventionally produced by chemical process, but Mitsui Chemicals are producing AAM by

Unique patented innovative bio-process with our epoch-making biocatalyst “POLARASE™”.

1-2. Mitsui Chemicals' AAM

Water-soluble monomer
Produced by bio-process
(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

Technology license of bio-process



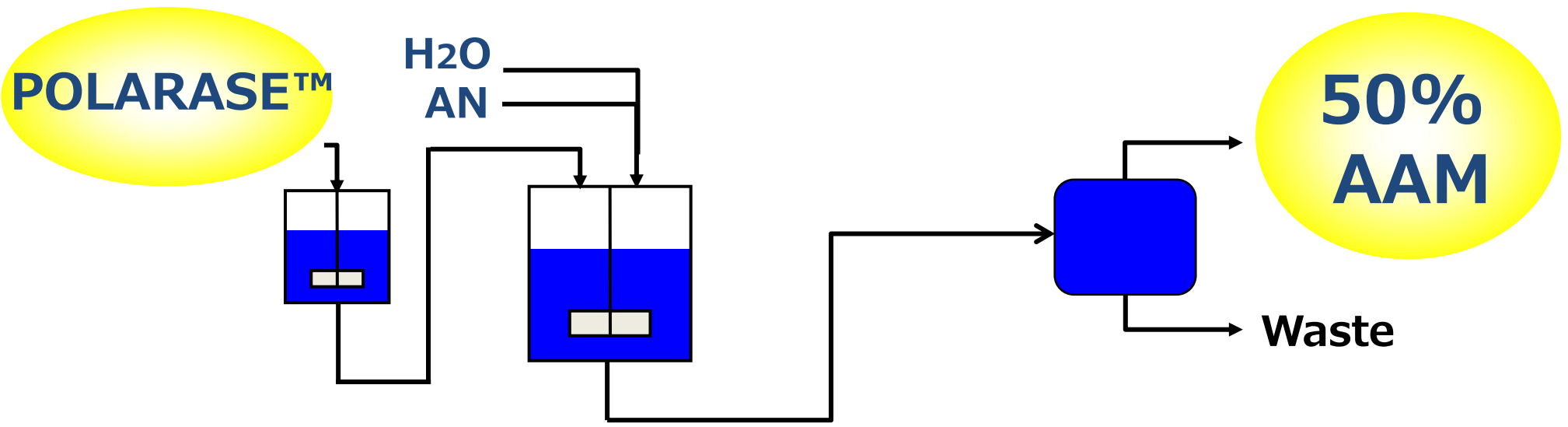
1-3. Mitsui Chemicals' AAM History



Mitsui Chemicals have been producing AAM for 40 years since 1972 by reliable and cost competitive process.

- | | |
|------|---|
| 1972 | Commercialization of chemical process at Mobara Factory in Japan |
| 1974 | Commercialization of chemical process at Osaka Works in Japan |
| 2002 | Commercialization of bio-process at Yongsan Mitsui Chemicals* in Korea
*a subsidiary of Mitsui Chemicals |
| 2009 | Conversion from chemical process to bio-process at Mobara Factory in Japan |
| 2010 | Technology license of bio-process to Black Rose Industries |
| 2012 | Conversion from chemical process to bio-process at Osaka Works in Japan |
| 2013 | Technology license of bio-process to Kemira OYJ |

2-1. Mitsui Chemicals' AAM Process



1. Biocatalyst

High-activity biocatalyst "POLARASE™"
->Low consumption rates of starting material and utilities

2. Reaction

Reaction at room temperature and ordinary pressure
->Extremely high conversion rate with high selectivity

3. Purification

Removal of biocatalyst "POLARASE™" by active carbon
->Low wastewater

4. Product

50% AAM solution directly obtained without any concentration process

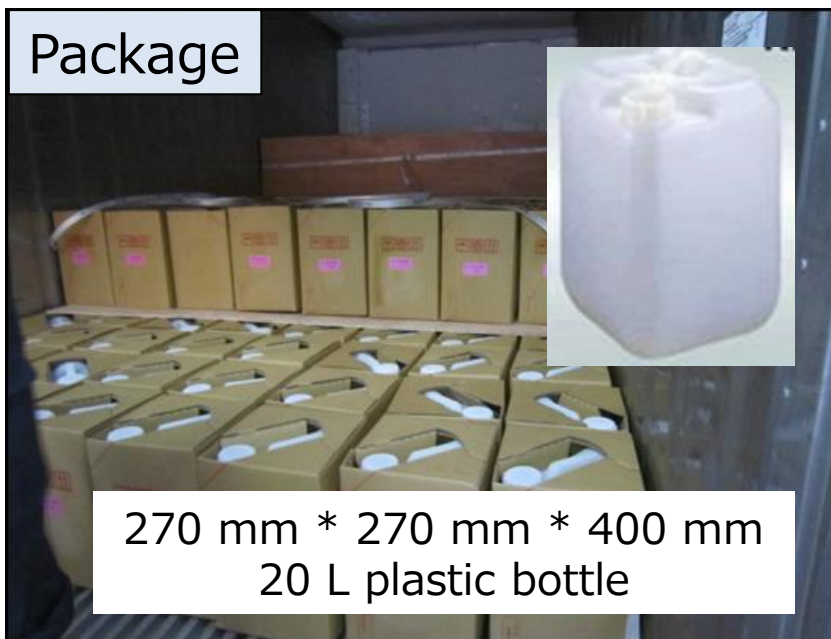
Attractive Features

1. Low Investment & Running Cost
with simple continuous process
2. Low Environmental Workload
with lower GHG emission
3. High Efficiency
Profitable even starting from 5,000MT/y
4. High Scalability
Easy to increase production capacity
5. High Concentration
50% AAM solution can be directly obtained

2-3. Mitsui Chemicals' Biocatalyst "POLARASE™"

Item	Value
Catalyst Activity	Please ASK! We are confident!
Catalyst Consumption Rate	
Solid Content	9 ~ 17 wt%
Number of Living Cell*	Zero

*transformants



3. What Mitsui Chemicals can offer



Mitsui Chemicals can offer the following solutions.

1. Technology License of AAM Bio-process
 - Whole AAM manufacturing technology
 - Partial technology license (depending on request)
2. Commercial Supply of Biocatalyst "POLARASE™"
 - POLARASE™ can be used in your existing facility.
 - Free sample is available for your first evaluation after NDA execution.

We can support your feasibility study of commercial production.

Please contact the following for further information.

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*Looking forward to
future collaborations!!
Thank you.*



Mitsui Chemicals