



WATER SOLUBLE POLYMER

***ISOBAM***

**KURARAY CO.,LTD.**



## “ISOBAM” is

ISOBAM is the trade name of an alternative copolymer of isobutylene and maleic anhydride developed by KURARAY using their POVAL® (polyvinyl alcohol) technology.

ISOBAM is an alkali water soluble polymer with outstanding characteristics which have never been acquired by conventional water soluble polymers such as polyvinyl alcohol and cellulose derivatives.

ISOBAM is a white powder in appearance. It is generally used as a water soluble polymer reacting with sodium hydroxide, ammonia and amine.

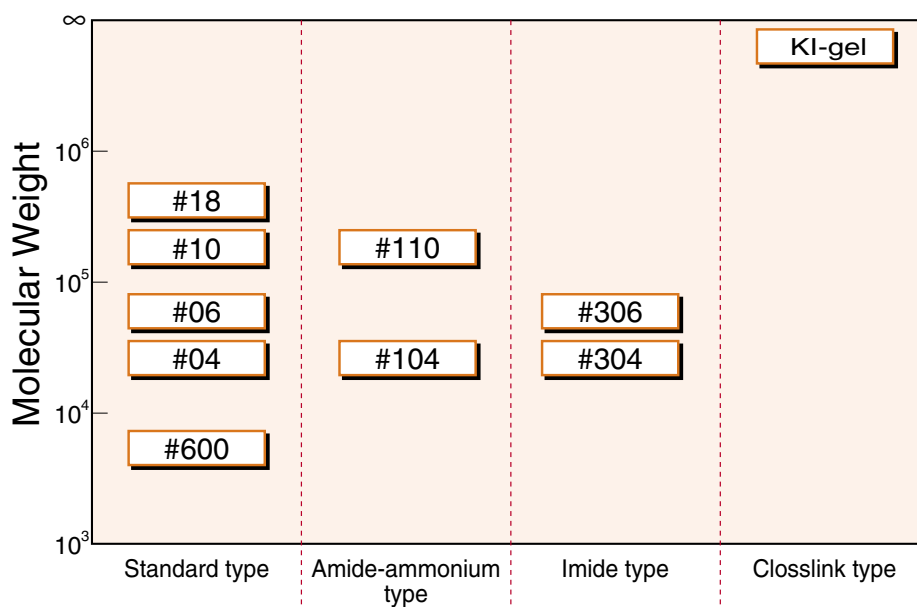
Various useful reactants are obtained by the reaction of ISOBAM with alcohol, amine and epoxy compounds. These can be applied to resins and plastics.

### ■ Applications

- **Adhesives**
  - SBR emulsion type
  - Polyvinyl acetate type
- **Protective colloids**
  - Vinyl acetate
  - Acryloyl monomer
  - Vinyl chloride
  - Micro-capsule for pressure sensitive paper
- **Binders**
  - Binder for ceramic powder
  - Binder for solid catalyst
- **Metal processing oils**
  - Lubricant for forging
  - Hardening agent for steel
- **Super absorbent polymers**
  - Chemical pocket heater
  - Sealing materials
- **Dispersants**
  - Water-reducing agent for cement
  - Scale inhibitor
  - Dispersing agent for pesticide
  - Water soluble paint
- **Coating for papers**
  - Coating agent for thermal paper
- **Plastic modifications**



## Grades of “ISOBAM”



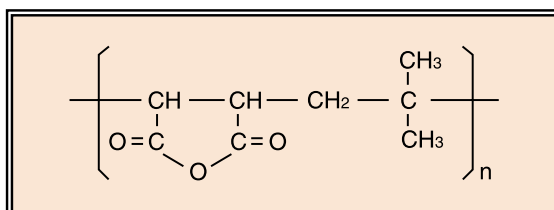
## Physical properties of “ISOBAM”

	Molecular weight *	Appearance	Grading distribution	Density (g/cm <sup>3</sup> )	Melting point	Packed specific gravity (g/cm <sup>3</sup> )	Volatile portion (%)
ISOBAM-600	5,500 ~ 6,500	Powder	—	1.3	None	0.4 ~ 0.7	≦ 5
ISOBAM-04	55,000 ~ 65,000	Powder	12 ~ 200 mesh ≧ 88%	1.3	None	0.3 ~ 0.5	≦ 4
ISOBAM-06	80,000 ~ 90,000	Powder	12 ~ 200 mesh ≧ 88%	1.3	None	0.3 ~ 0.5	≦ 4
ISOBAM-10	160,000 ~ 170,000	Powder	12 ~ 200 mesh ≧ 88%	1.3	None	0.3 ~ 0.5	≦ 4
ISOBAM-18	300,000 ~ 350,000	Powder	12 ~ 200 mesh ≧ 88%	1.3	None	0.3 ~ 0.5	≦ 4
ISOBAM-104	55,000 ~ 65,000	Powder	12 ~ 200 mesh ≧ 88%	1.3	None	0.3 ~ 0.5	—
ISOBAM-110	160,000 ~ 170,000	Powder	12 ~ 200 mesh ≧ 88%	1.3	None	0.3 ~ 0.5	—
ISOBAM-304	55,000 ~ 65,000	Powder	12 ~ 200 mesh ≧ 88%	1.3	None	0.3 ~ 0.5	—
ISOBAM-306	80,000 ~ 90,000	Powder	12 ~ 200 mesh ≧ 88%	1.3	None	0.3 ~ 0.5	—
KI-GEL	∞	Powder	20 mesh ≧ 95%	1.3	None	0.6 ~ 0.9	—

\* Weight- average molecular weight



## Standard type of “ISOBAM”



CAS NO. 26426-80-2

TSCA Registered

Differing from conventional water soluble polymers, ISOBAM is used by reacting with alkali.

These alkali solutions can be easily modulated from low viscosity to high viscosity and from acidity to alkalinity.

Standard type of ISOBAM is used as binders with excellent heat resistance, and hardness.

Also Standard type has an excellent dispersing effect with high functionality of the carboxyl group which is aligned side by side in the molecule.

### ■ ISOBAM-600

ISOBAM-600 is the lowest molecular weight of all ISOBAM, with approximately 6,000 of molecular weight.

ISOBAM-600 is used as a dispersing agent and surface active agent.

Main applications	Characteristics etc ...
<ul style="list-style-type: none"> <li>■ Water-reducing agent for cement</li> </ul>	<ul style="list-style-type: none"> <li>■ Effective to use as solid.</li> <li>■ Delayed action by dissolving in cement.</li> </ul>
<ul style="list-style-type: none"> <li>■ Scale inhibitor</li> </ul>	<ul style="list-style-type: none"> <li>■ Function as chelator of metal ion in water. ( Ca<sup>++</sup>, Mg<sup>++</sup> )</li> </ul>
<ul style="list-style-type: none"> <li>■ Dispersing agent for pesticide</li> </ul>	<ul style="list-style-type: none"> <li>■ When dispersed into water, it collapses gradually.</li> </ul>



## ■ ISOBAM-04,06,10,18

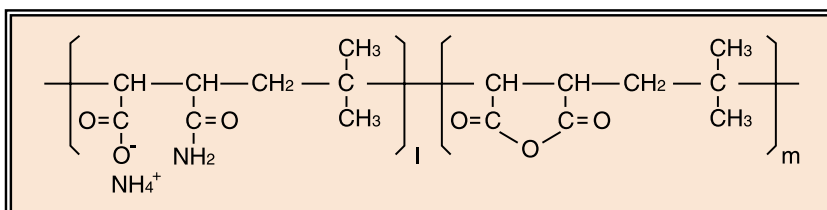
These grades have molecular weight, ranges from middle to high.

With features such as hardness and toughness, they are mainly used as binders and protective colloids.

Main applications	Characteristics etc ...
<ul style="list-style-type: none"> <li>■ Protective colloid of polymerizing emulsion</li> </ul>	<ul style="list-style-type: none"> <li>■ Add hardness and tackiness to polyvinyl acetate adhesive.</li> <li>■ Add high viscosity to acrylic emulsion.</li> </ul>
<ul style="list-style-type: none"> <li>■ Emulsion type of adhesive for woods and papers</li> </ul>	<ul style="list-style-type: none"> <li>■ SBR emulsion type of adhesive.</li> <li>■ Function as dispersant for inorganic filler.</li> <li>■ None formaldehyde adhesives.</li> </ul>
<ul style="list-style-type: none"> <li>■ Water based binders for ceramic powders</li> </ul>	<ul style="list-style-type: none"> <li>■ Moderate decomposition.</li> <li>■ No ash.</li> <li>■ Improvement of strength of raw compound.</li> </ul>
<ul style="list-style-type: none"> <li>■ Coating agent for thermal paper</li> </ul>	<ul style="list-style-type: none"> <li>■ Water resistance together with polyvinyl alcohol.</li> </ul>
<ul style="list-style-type: none"> <li>■ Micro-capsule for pressure sensitive paper</li> </ul>	<ul style="list-style-type: none"> <li>■ Maintaining capsule hardness.</li> <li>■ Excellent emulsifying dispersion property.</li> </ul>
<ul style="list-style-type: none"> <li>■ Lubricant for forging</li> <li>■ Hardening agent for steel</li> </ul>	<ul style="list-style-type: none"> <li>■ Maintaining viscosity.</li> <li>■ Moderate decomposition resistance property.</li> <li>■ Excellent membrane construction to surface of metal.</li> <li>■ Moderate cooling curve.</li> </ul>



## Amide-ammonium salt type of “ISOBAM”



CAS.NO. 52032-17-4

TSCA Under making application to TSCA

### ■ ISOBAM-104,110

ISOBAM-104 and 110 are Amide-ammonium salt types of ISOBAM. These are ammonium modified products based on Standard type ISOBAM.

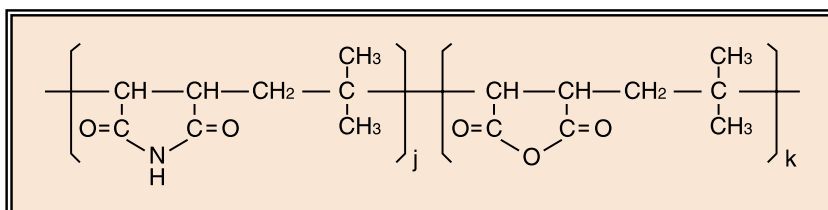
They have features of Standard type of ISOBAM and are soluble in water.

The pH of aqueous solution shows neutral.

Main applications	Characteristics etc ...
<ul style="list-style-type: none"> <li>■ Binder for ceramic powder</li> </ul>	<ul style="list-style-type: none"> <li>■ Water soluble.</li> <li>■ No ash.</li> </ul>
<ul style="list-style-type: none"> <li>■ Binder for solid catalyst</li> </ul>	<ul style="list-style-type: none"> <li>■ Good activation.</li> <li>■ Not easily broken for solid catalyst.</li> </ul>
<ul style="list-style-type: none"> <li>■ Water soluble paint</li> </ul>	<ul style="list-style-type: none"> <li>■ Dispersion properties.</li> <li>■ Excellent membrane construction.</li> <li>■ Suitable for under coatings.</li> </ul>
<ul style="list-style-type: none"> <li>■ Aromatic</li> </ul>	<ul style="list-style-type: none"> <li>■ Jelly type aromatic.</li> <li>■ Hardness and heat resistance together with crosslinking agent at room temperature.</li> </ul>



## Imide type of “ISOBAM”



CAS NO. 89360-06-5  
TSCA Under making application to TSCA.

### ■ ISOBAM-304,306

ISOBAM-304 and 306 are Imide types of ISOBAM. These are imide degenerated products based on Standard type ISOBAM.

They have the features of Standard type ISOBAM and are water resistance and heat resistance.

Main applications	Characteristics etc ...
<ul style="list-style-type: none"> <li>■ Protective colloid for polymerizing VAc.</li> </ul>	<ul style="list-style-type: none"> <li>■ Add water resistance and hardness to adhesive of polyvinyl acetate.</li> </ul>
<ul style="list-style-type: none"> <li>■ Emulsion type of adhesive for wood</li> </ul>	<ul style="list-style-type: none"> <li>■ SBR emulsion type and polyvinyl acetate.</li> <li>■ Good water resistance.</li> <li>■ Good initial tackiness.</li> <li>■ Non formaldehyde adhesives.</li> <li>■ Instantaneous adhesion by uniting hydrogen bond utilizing imide group and aldehyde.</li> </ul>



## Crosslink type of “ISOBAM”

CAS NO. 39612-00-5

TSCA Under making application to TSCA

Crosslink type of “ISOBAM” is produced by both ISOBAM solution and crosslinking agent.

### ■ KI-GEL

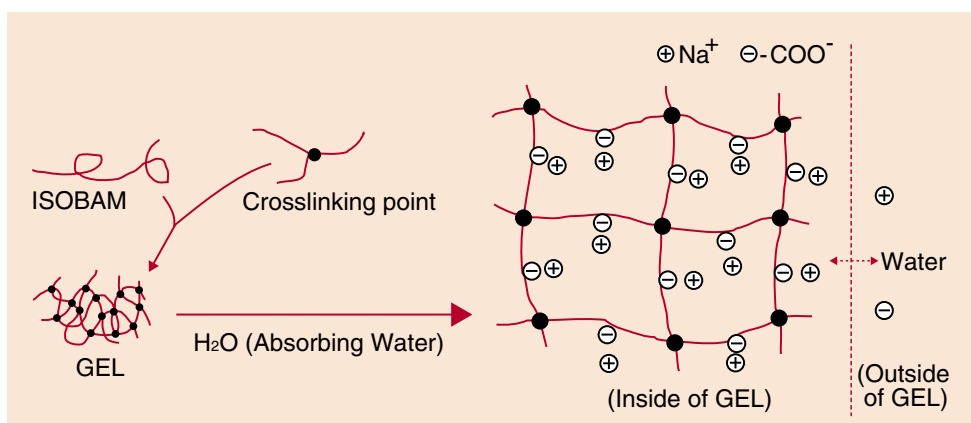
KI-GEL is the trade name of Crosslink type of ISOBAM.

On contact with water, it rapidly absorbs water in the amount of 200 times its own weight.

Once absorbed, minimal water is released even under a pressured condition.

Excellent durability against heat, good stability in both hot water and cold water.

Main applications	Characteristics etc ...
<ul style="list-style-type: none"> <li>Chemical pocket heater</li> </ul>	<ul style="list-style-type: none"> <li>Good stability in holding water.</li> <li>Good water release property as heated.</li> </ul>
<ul style="list-style-type: none"> <li>Sealing materials</li> </ul>	<ul style="list-style-type: none"> <li>Mixing gel powder into rubber or TPE.</li> <li>Good dispersion properties, higher expansion pressure and high durability for rubber or TPE.</li> </ul>

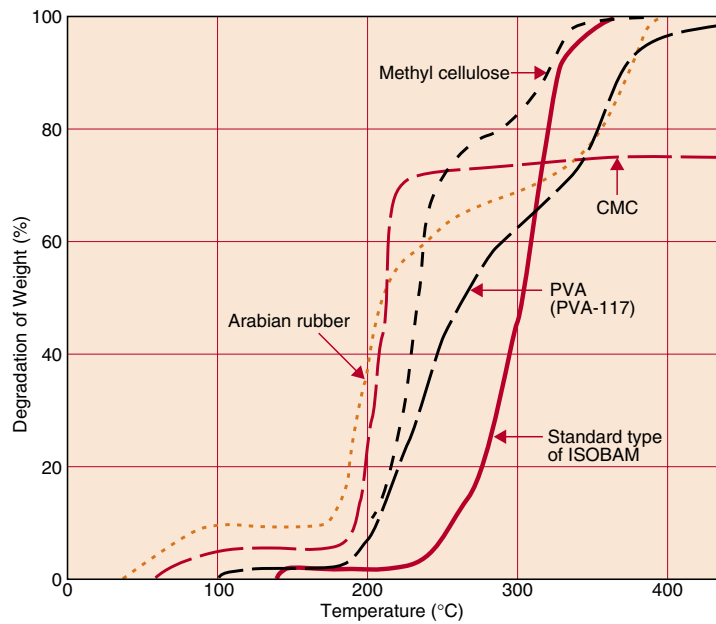




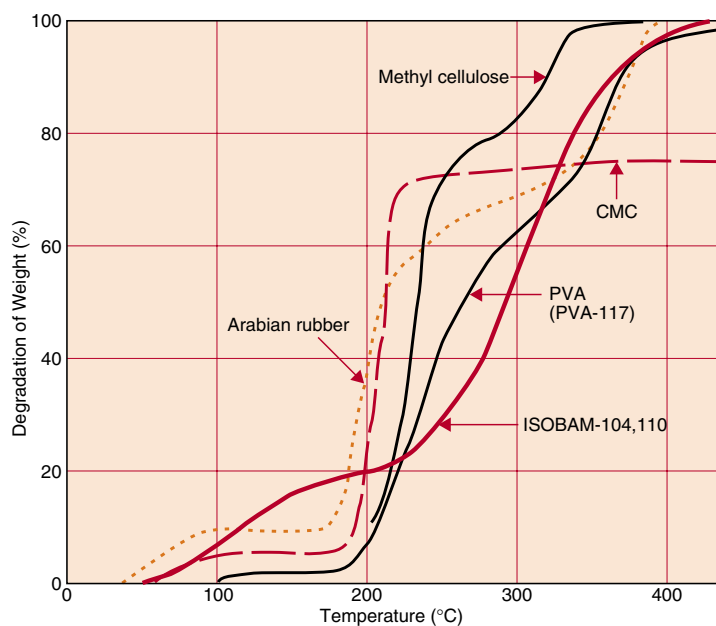


## Basic characteristic of “ISOBAM” (Tested by KURARAY)

### ■ Decomposition properties of Standard type of ISOBAM compared with other polymers (Thermal gravity analysis, Heat-up rate 5 °C/min)

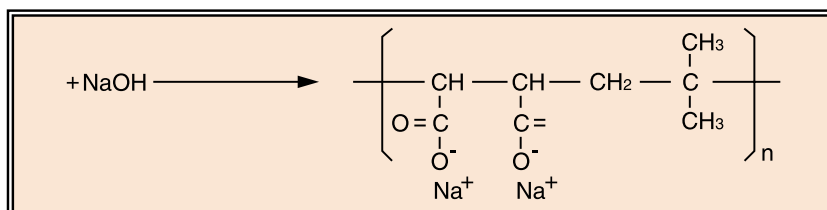


### ■ Decomposition properties of ISOBAM-104 and 110 compared with other polymers (Thermal gravity analysis, Heat-up rate 5 °C/min)





## ■ Neutralization of ISOBAM



### Definition for Degree of Neutralization( $\alpha$ )

If all carboxyl groups are neutralized, it's defined as  $\alpha=1$

### pH of Alkali Solution

Can be controlled by changing alkali and degree of neutralization.

The following pH range can be obtained by using NaOH and Ammonia.

NaOH	pH=3~12
Ammonia	pH=3~10

## ■ Method for Dissolving ISOBAM (Formulation)

Table 1 shows the required alkali quantity to dissolve 100 parts of ISOBAM powder for complete neutralization. (neutralization degree = 1)

Table 1: The amount of alkali quantity (unit : g)

	NaOH	NH <sub>3</sub>
ISOBAM-04,06,10,18	51.88	22.05
ISOBAM-600	50.96	21.66
ISOBAM-304,306	27.40	11.60

Case 1: Preparation of ISOBAM-04 with NaOH for 20% solid concentration.

( $\alpha = 0.8$ )  
 ISOBAM-04 : 100 g  
 NaOH :  $51.88 \times 0.8 = 41.50$  g  
 Distilled water :  $(100 + 41.50) \div 0.20 - (100 + 41.50) = 566.00$ g

Case 2: Preparation of ISOBAM-304 with 25%-ammonia solution for 15% concentration of ISOBAM

concentration of ISOBAM. ( $\alpha = 0.6$ )  
 ISOBAM-304 : 100 g  
 Ammonia solution :  $11.60 \times 0.6 \div 0.25 = 27.84$  g  
 Distilled water :  $(100 \div 0.15) - (100 + 27.84) = 538.83$  g

### Process for a dissolving ISOBAM

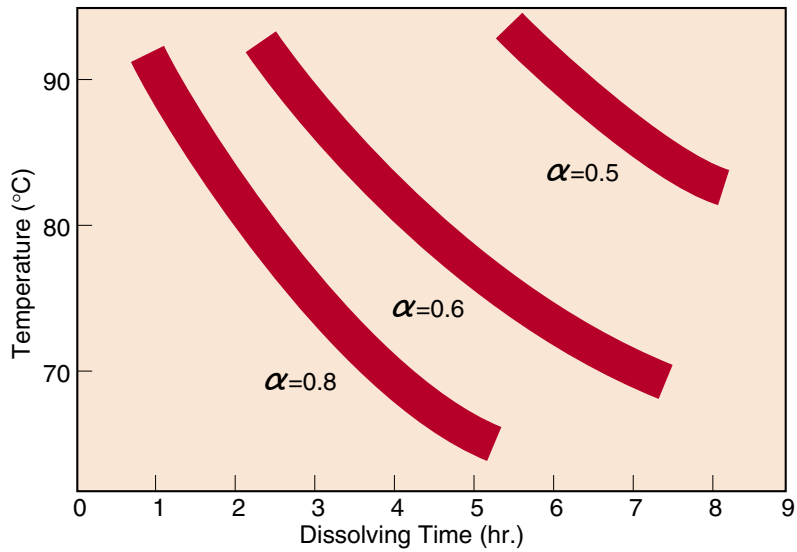
- ① Place ISOBAM gradually into the required alkali solution in a vessel. To avoid bumping, it is desirable to put vessel in cooling bath such as a "waterbath".
- ② Dissolve for 4 to 5 hours at 90 to 100 °C with stirring.
- ③ Cool the vessel to room temperature, replenish the vessel with the amount of water that has been lost during dissolving.

※ In case of using ammonia aqueous solution for dissolving, it is desirable to dissolve in closed vessel such an "autoclave" to avoid an ammonia smell.

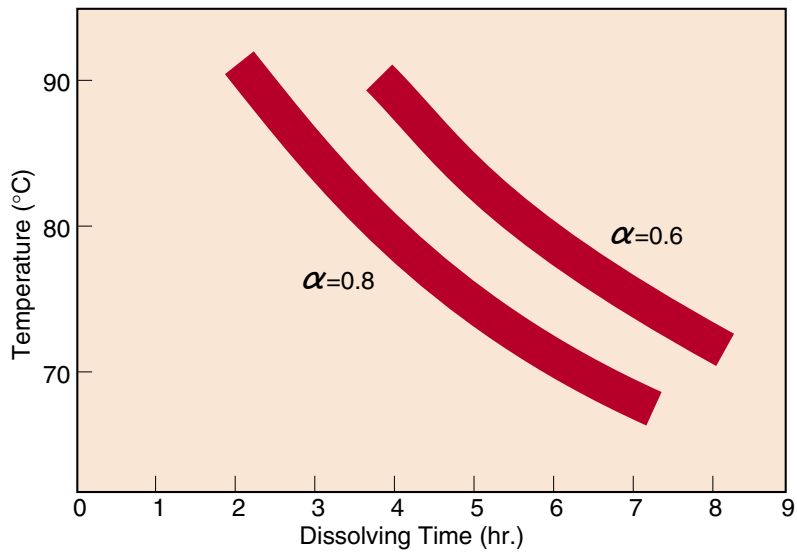


## ■ Dissolving speed of ISOBAM in a sodium hydroxide solution

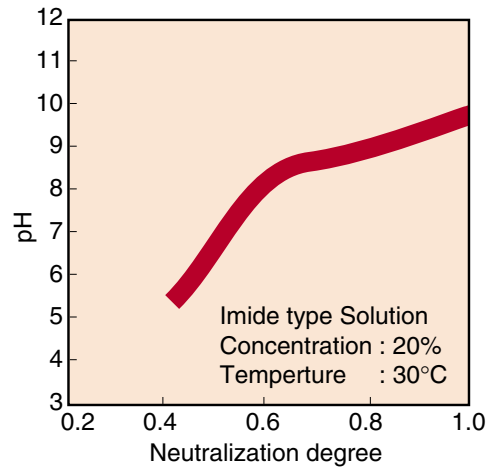
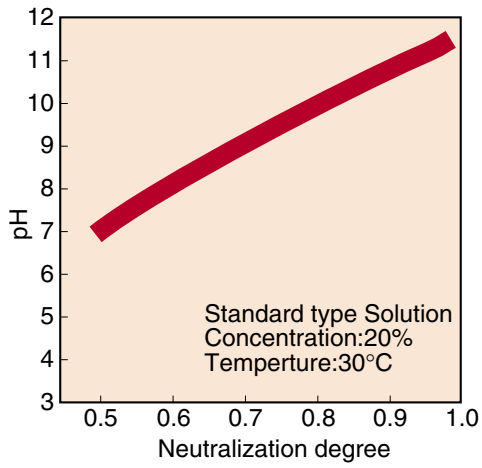
Neutralization degree of ISOBAM-10 : 0.5, 0.6 and 0.8  
Concentration : 20wt%  
Rotation speed of the stirrer : 120 r.p.m



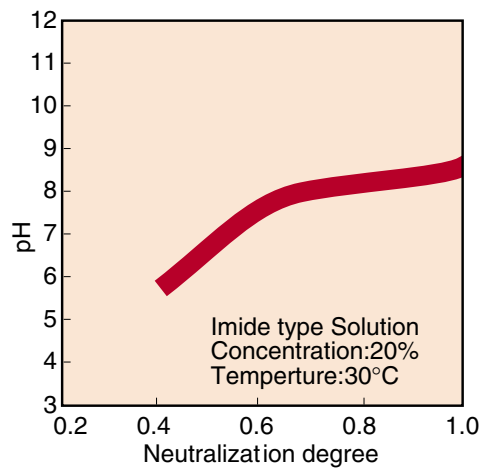
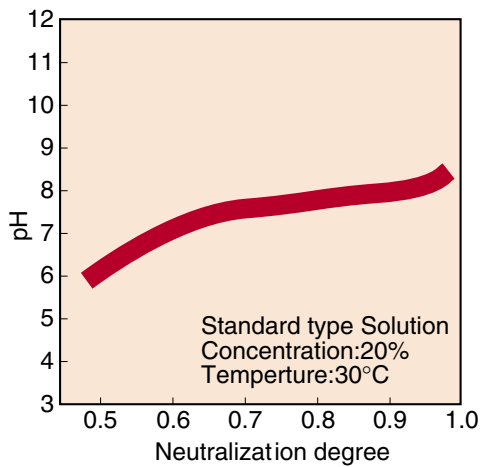
Neutralization degree of ISOBAM-304 : 0.6 , 0.8  
Concentration : 20wt%  
Rotation speed of the stirrer : 120 r.p.m



### ■ pH - Neutralization degree curve (NaOH solution)

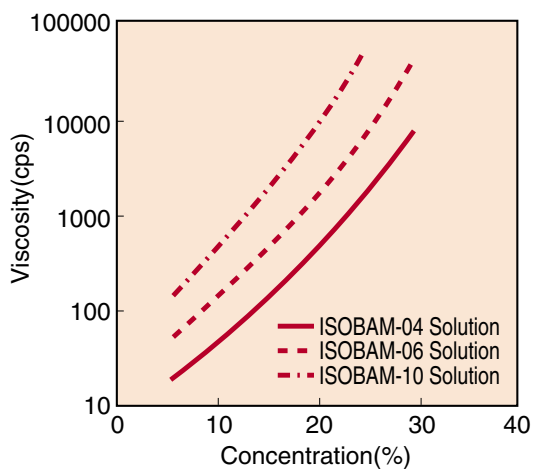


### ■ pH - Neutralization curve (NH<sub>4</sub>OH solution)

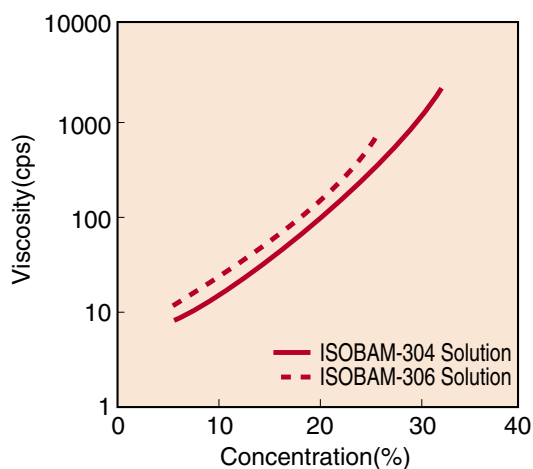




### ■ Viscosity-Concentration curve (NaOH solution)

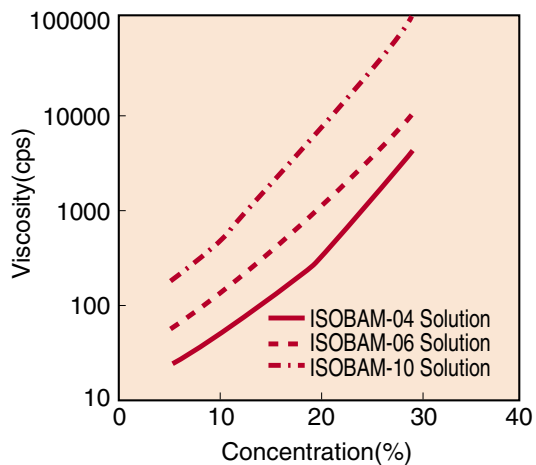


Standard type of ISOBAM  
(NaOH Solution.  $\alpha=0.8$ )

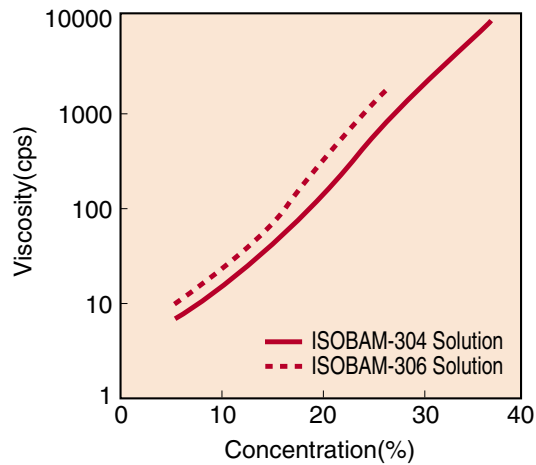


Imide type of ISOBAM  
(NaOH Solution.  $\alpha=0.6$ )

### ■ Viscosity-Concentration curve (NH<sub>4</sub>OH solution)



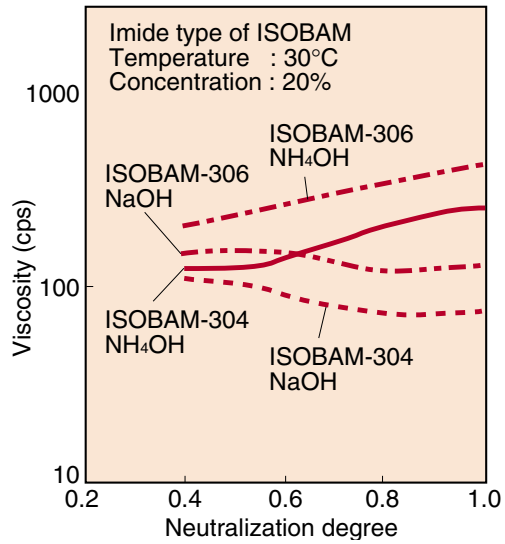
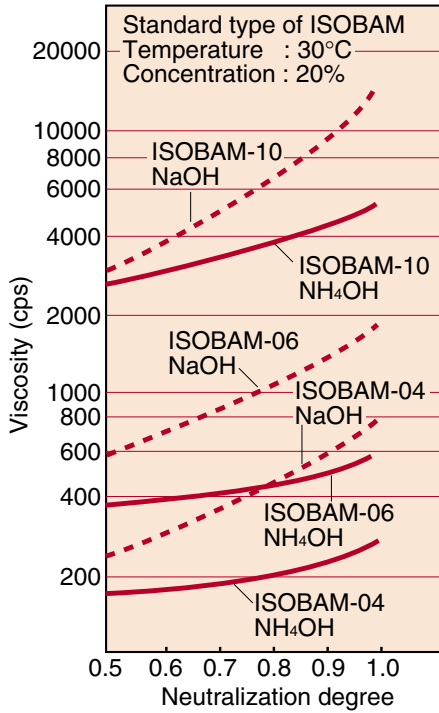
Standard type of ISOBAM  
(NH<sub>4</sub>OH Solution.  $\alpha=0.8$ )



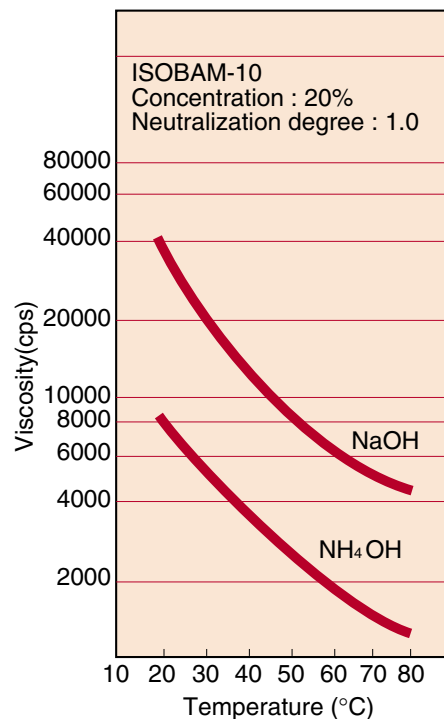
Imide type of ISOBAM  
(NH<sub>4</sub>OH Solution.  $\alpha=0.6$ )



## ■ Viscosity - Neutralization degree curve



## ■ Viscosity - Temperature curve





## ■ Mixing property of ISOBAM solution and metal compound

Metal compound \ Solution type	Sodium hydroxide $\alpha = 0.8$	Ammonia $\alpha = 0.8$	Sodium acetate $\alpha = 1.0$	Ammonium acetate $\alpha = 1.0$
Ca(OH) <sub>2</sub>	○	×	×	×
Mg(OH) <sub>2</sub>	○	○	○	○
Co(OH) <sub>2</sub>	○	○	○	○
Mn(OH) <sub>2</sub>	○	○	○	○
Al(OH) <sub>3</sub>	○	○	○	○
Fe(OH) <sub>3</sub>	○	○	○~△	○~△
Ni(OH) <sub>2</sub>	○	○	○	○
Zn(OH) <sub>2</sub>	○	○	△~×	△~×
Ba(OH) <sub>2</sub>	○	○	○	○~△
ZnO	○	○	○	○
Al <sub>2</sub> O <sub>3</sub>	○	○	○	○
Sb <sub>2</sub> O <sub>3</sub>	○	○	○	○

Mixing quality : ○— favorable  
 △— poor  
 ×— bad

## ■ Mixing property of ISOBAM with other polymers

Alkali for dissolving ISOBAM	NaOH				NH <sub>4</sub> OH			
	1:3		3:1		1:3		3:1	
Mixing ratio (ISOBAM:polymer)								
State of the mixture	Solution	dried Film	Solution	dried Film	Solution	dried Film	Solution	dried Film
Casein	△	△	○	△	○	△	△	△
Denatured starch	○	○	○	○~△	○	○	○	○
Phenol resin	○	○~△	○	×	○	○~△	○	×
CMC	○	○~△	○	○	○	○	○	○
PVA	○	○~△	○	○	○	○	○	○~△
Polyacrylic soda	○	○	○	○	○	○	○	○
Polyacryl amide	○	○~△	○	○	○	○	○	○
Copolymer of styrene & maleic anhydride	○	○	○	○	○	○	○	○

Mixing quality : ○— favorable  
 △— poor  
 ×— bad

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