

# Mitsui Bulk ABS Process

## Continuous Bulk Polymerization



**MITSUI CHEMICALS, INC.**



**TOYO ENGINEERING CORP.**

Mitsui Chemicals, Inc. (Mitsui), and Toyo Engineering Corporation (TEC) offer many kinds of styrenic polymer processes such as General Purpose Polystyrene (GPPS), High Impact Polystyrene (HIPS), Styrene Acrylonitrile Copolymer (SAN) and Acrylonitrile Butadiene Styrene Polymer (ABS).

These unique processes were originally researched and developed by Mitsui, Japan's pioneer in styrenic polymer production. Recognizing its preeminent performance and originality, the Japan Society of Chemical Engineers selected the Mitsui PS process to receive its award for process innovation, in 1968 for the GPPS process and in 1989 for the ABS process.

Since their original development by Mitsui, they have been continually improved through the joint research and development work of Mitsui and TEC to maintain process competitiveness. As a result, Mitsui/TEC styrenic polymer processes have been adopted in more than 40 plants around the world.

Mitsui/TEC provide licenses and basic engineering packages for these processes as a licensor, and are also able to offer engineering, procurement and construction services.

# Mitsui Bulk ABS Process

## Continuous Bulk Polymerization

### Process Features

In contrast to some other batchwise emulsion polymerization processes, the Mitsui Bulk ABS Process provides a CONTINUOUS BULK POLYMERIZATION PROCESS using dry rubber as a raw material. This process was developed by Mitsui through constant basic research work in the areas of kinetics and process engineering in the field of high viscous materials.

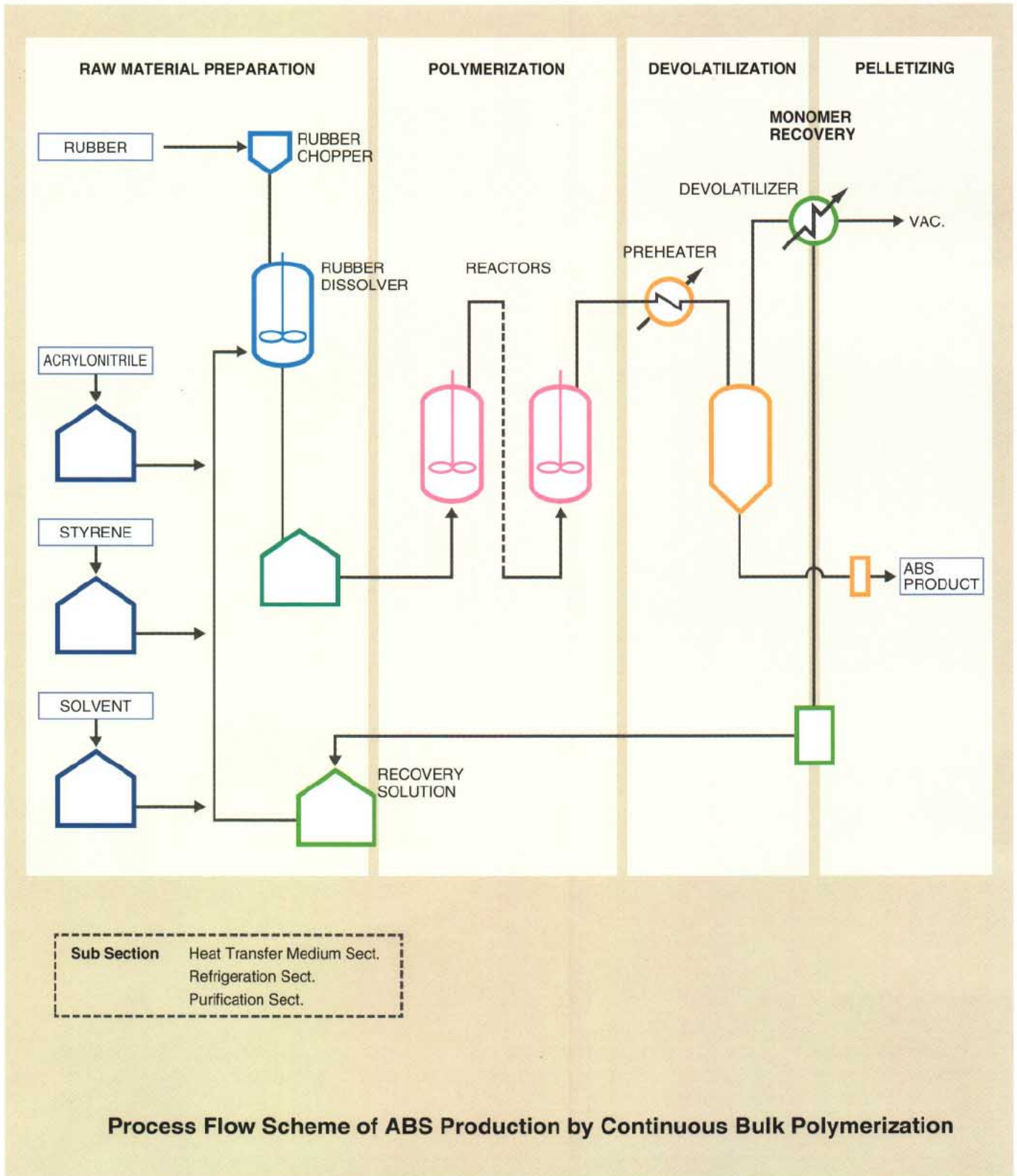
The main features of the Mitsui Bulk ABS process are:

- 1) Low consumption of raw materials, chemicals and utilities.
- 2) High product quality - excellent color with high stability.
- 3) Simple process and compact plant layout.
- 4) Easy operation.
- 5) Environmentally-sound (low emission) and proven safety.
- 6) Excellent economy.



## Process Description

Rubber blocks are crushed into small pieces which are then sent to a rubber dissolver containing prepared styrene, acrylonitrile, recycled monomer and a small amount of solvent. Polymerization takes place in specially designed continuous reactors and is initiated by a special initiator. The polymerization product, a highly viscous solution, is transferred to a devolatilizer through a preheater. Here, volatile components are separated from the polymer solution by evaporation under vacuum. The polymer at the bottom of the devolatilizer is continuously sent by a polymer pump to a pelletizing section. The volatile matter from the top of the devolatilizer is recovered as recycled monomer.



## Raw Materials and Utilities Consumption

Consumption of raw materials and utilities required to produce 1,000kg of ABS Polymer (Medium Impact, MT-N) under normal operation; (based on 60,000 T/Y).

Item	Expected Figures
<b>Raw Materials</b>	
(1) Styrene, acrylonitrile monomer, rubber, etc.	1005.5kg
(2) Others	4.3kg
<b>Utilities</b>	
(1) Electric Power	440kWh
(2) Circulating Cooling Water ( $\Delta T=6.0^{\circ}\text{C}$ )	190ton
(3) Fuel Gas	$400 \times 10^3 \text{Kcal}$

## Product Quality

Mitsui Bulk ABS Process can produce the following basic types such as High Stiffness and Medium Impact. Both types are suitable for applications such as housings for office automation equipment or home appliances, automotive parts, and building materials. The physical properties of the resins are very stable thanks to the continuous polymerization process and because an emulsifier is not used. This new process also maintains the resin's natural color so that subsequent coloring is easy and uniform.

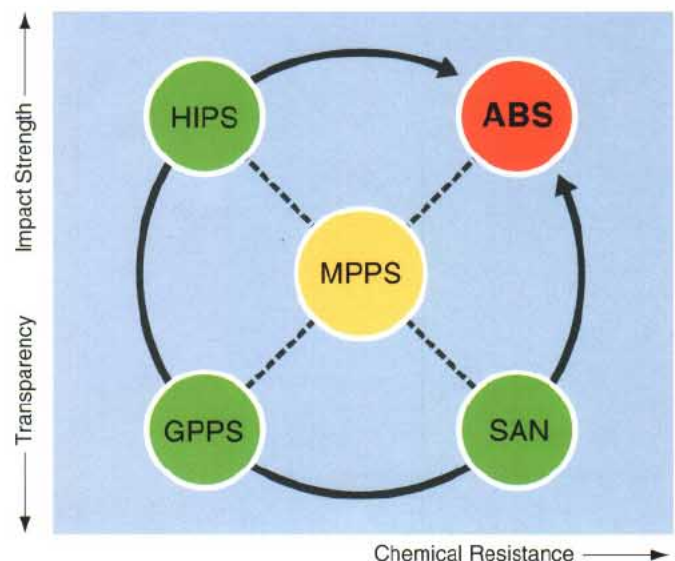
### ● Typical Properties of Mitsui Bulk ABS Polymer

Properties	Method	Unit	Types		
			High Stiffness	Good Flow	Medium Impact
Tensile Strength (at Yield)	ASTM D-638	Kg/cm <sup>2</sup>	600	530	500
Flexural Strength	ASTM D-790	Kg/cm <sup>2</sup>	900	760	740
Flexural Modulus	ASTM D-790	Kg/cm <sup>2</sup>	25000	24000	23000
Izod Impact Strength (Notched, 6.4 mmT)	ASTM D-256	Kg·cm/cm <sup>2</sup>	8	14	19
Vicat Softening Point (1 kgf)	ASTM D-1525	°C	110	106	104
Rockwell Hardness(R-scale)	ASTM D-785	—	119	118	113
Melt Flow Index (200°C, 5kg)	ASTM D-1238	g/10min.	1.8	3.0	2.0
Gloss	JISK-7105	%	90	95	93

Note: 1Kg/cm<sup>2</sup> = 9.807 × 10<sup>4</sup> N/m<sup>2</sup>, 1Kg·cm/cm<sup>2</sup> = 0.9807 KJ/m<sup>2</sup>

## Coverage of Styrenics Production by Mitsui Bulk Continuous Processes

GPPS : General Purpose Polystyrene  
 HIPS : High Impact Polystyrene  
 SAN : Styrene Acrylonitrile Copolymer  
 ABS : Acrylonitrile Butadiene Styrene Polymer  
 MPPS : Multi Purpose Polystyrene Process





## Reference

Mitsui and TEC have already contracted over 44 styrenic polymer plants (GPPS, HIPS, SAN and ABS plants) all over the world. The total sum of the total production capacity exceeds one million tons per year.



ABS Plant

(As of March 1998)

Client	Location	Plant	Capacity (T/Y)	Services
Mitsui Toatsu Chemicals, Inc. (Mitsui Chemicals, Inc.)	Osaka (Japan)	GPPS	50,000	
		HIPS	35,000	
		SAN	20,000	
		ABS	30,000	
Sun Styrene Co., Ltd.	Chiba (Japan)	HIPS	30,000	E.P.C.
Dainippon Ink & Chemicals Inc.	Yokkaichi (Japan)	GPPS	32,000	L.E.P.C.
Lucky, Ltd.(LM Chem.)	Yoe-su (Korea)	HIPS	75,000	L.E.
		GPPS	35,000	L.E.
		SAN	10,000	L.E.
Grand Pacific Petrochemical Corp.	Kaohsiung (Taiwan)	SAN	50,000	L.E.
Formosa Chemicals & Fibre Corp.	Chaiyi (Taiwan)	SAN	120,000	L.E.
Gaoqiao Petrochemical Corp.	Shanghai (China)	SAN	5,000	L.E.P.
Jilin Chemical Ind. Corp.	Jilin (China)	HIPS	5,000	L.E.P.
		ABS	10,000	L.E.P.
Lanzhou Chemical Ind. Corp.	Lanzhou (China)	HIPS	5,000	L.E.P.
		SAN	15,000	L.E.P.
Technical Corps for Special Projects	Iraq	SAN	5,000	L.E.
Confidential	Japan	SAN	20,000	L.E.P.C.
P.T Graha Swakarsa Prima	Indonesia	HIPS	13,000	L.E.
		SAN	10,000	L.E.
China Petrochemical International Co.	China	HIPS/ GPPS	36,000	L.E.P.
Confidential	Thailand	SAN	53,000	L.E.
Pushpa Polymers Pvt., Ltd.	India	HIPS	30,000	L.E.
		GPPS	30,000	L.E.
Eternal Plastics Co.	Thailand	GPPS	30,000	L.E.
Hyundai Industrial Development & Construction Co., Ltd	Korea	SAN	66,000	L.E.
		ABS	30,000	L.E.
Taita Chemical Co.	Kaohsiung (Taiwan)	SAN	30,000	L.E.

Note: L: License; E: Engineering; P: Procurement; C: Construction

(Typical)

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