



# DERIVATIVES OF STYRENE

PS, EPS AND OTHERS



1

# GLOBAL STYRENICS

Styrene Monomer

2



## HISTORY OF STYRENE

- LAB SCALE STYRENE WAS FIRST PRODUCED IN 1839 IN GERMANY FROM AMERICAN SWEET GUM TREE AND WAS CALLED “STYROL”
- INDUSTRIAL SYNTHESIS OF STYRENE BY DEHYDROGENATION OF ETHYL BENZENE FIRST OCCURRED IN 1930s
- PRODUCTION OF STYRENE INCREASED DRAMATICALLY DURING THE 1940s WHEN IT BECAME A FEEDSTOCK FOR SYNTHETIC RUBBER REPLACING THE SCARCE NATURAL RUBBER FOR TYRES IN WAR EFFORT



## STYRENE TECHNOLOGIES

- GLOBAL STYRENE CAPACITY – 35 MILLION TONS
- BADGER / EXXON MOBIL TECHNOLOGY – DEHYDROGENATION OF EB (90%)
- LYONDELL / SHELL TECHNOLOGIES – STYRENE / PROPYLENE OXIDE (10%)
- EXELUS INC TECHNOLOGY – FROM TOLUENE AND METHANOL , YET TO BE COMMERCIALIZED

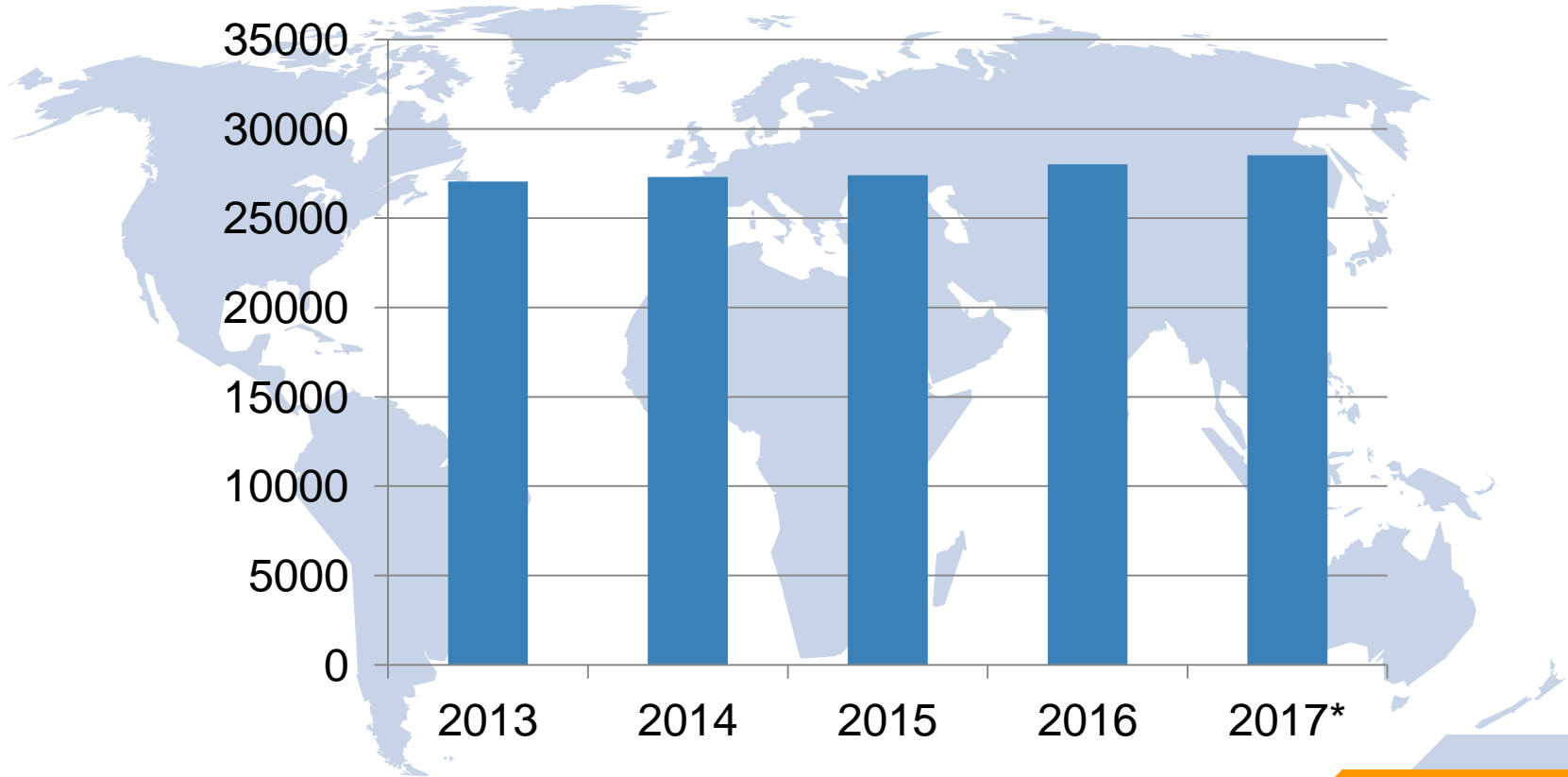


## STYRENE TECHNOLOGIES

- MINIMUM ECONOMIC SIZE FOR STYRENE PLANT – 700 KTA
- ESTIMATED ISBL CAPITAL INVESTMENT – USD 250 - 300 million
- TOTAL COST OF PRODUCTION = 8PARTS BENZENE + 3PARTS ETHYLENE + USD 200 ~ USD 250 CONVERSION
- SUPREME PETROCHEM HAS A LICENSED TECHNOLOGY BUT HAVE DECIDED NOT TO PUT STYRENE PLANT



# STYRENE CAPACITY AND OPERATING RATES, KTA





# STYRENE DERIVATIVES

## MAJOR POLYMERS

POLYSTYRENE (PS), EXPANDABLE POLYSTYRENE (EPS)

ACRYLONITRILE BUTADIENE STYRENE (ABS), STYRENE ACRYLONITRILE (SAN)

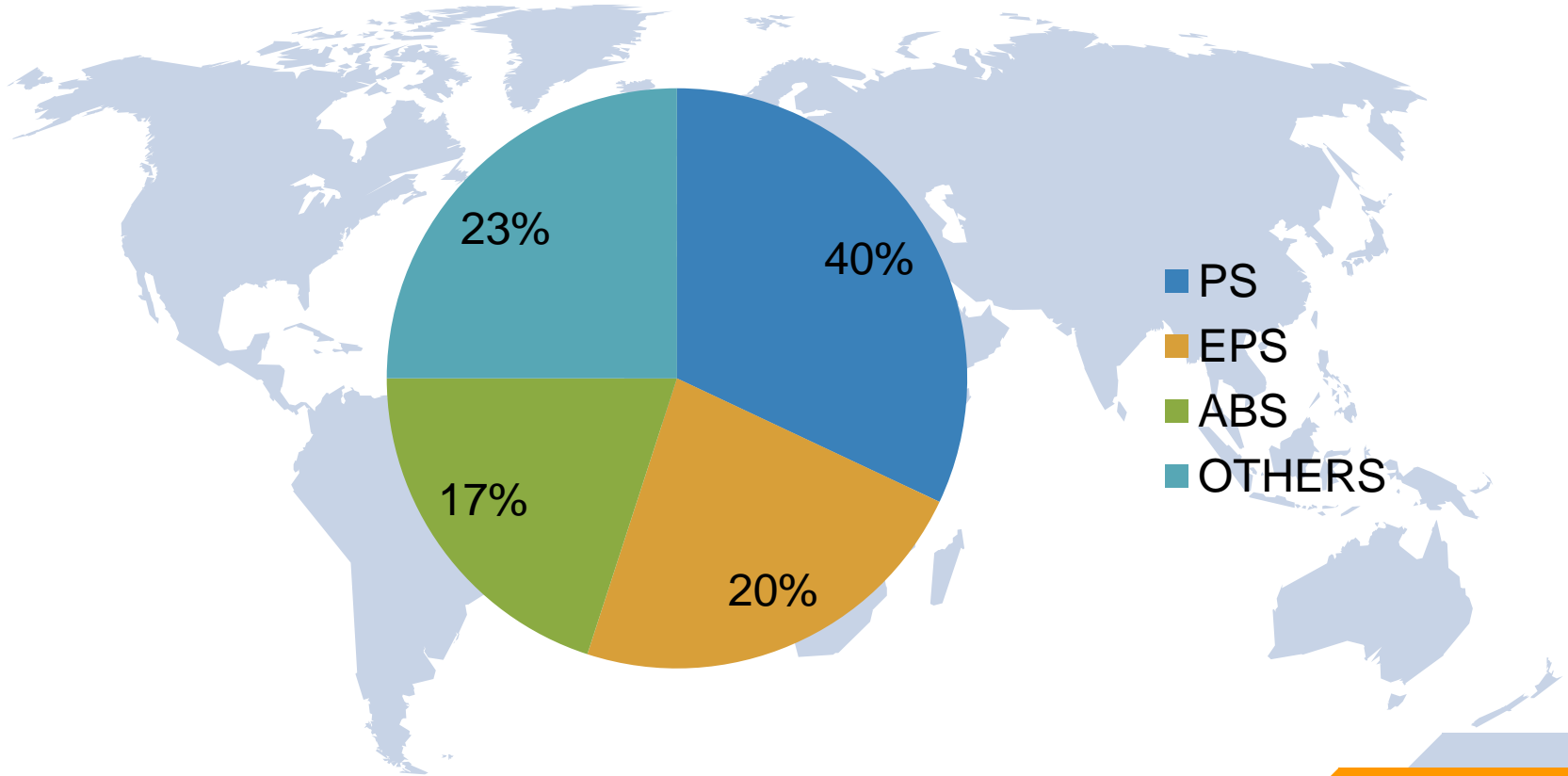
STYRENE BUTADIENE RUBBER (SBR), STYRENE BUTADIENE STYRENE (SBS)

STYRENE METHYL METHACRYLATE (SMMA)

## OTHERS

UNSATURATED POLYESTER RESIN (UPR), PAINTS

## SHARE OF DOWNSTREAM IN STYRENE DEMAND







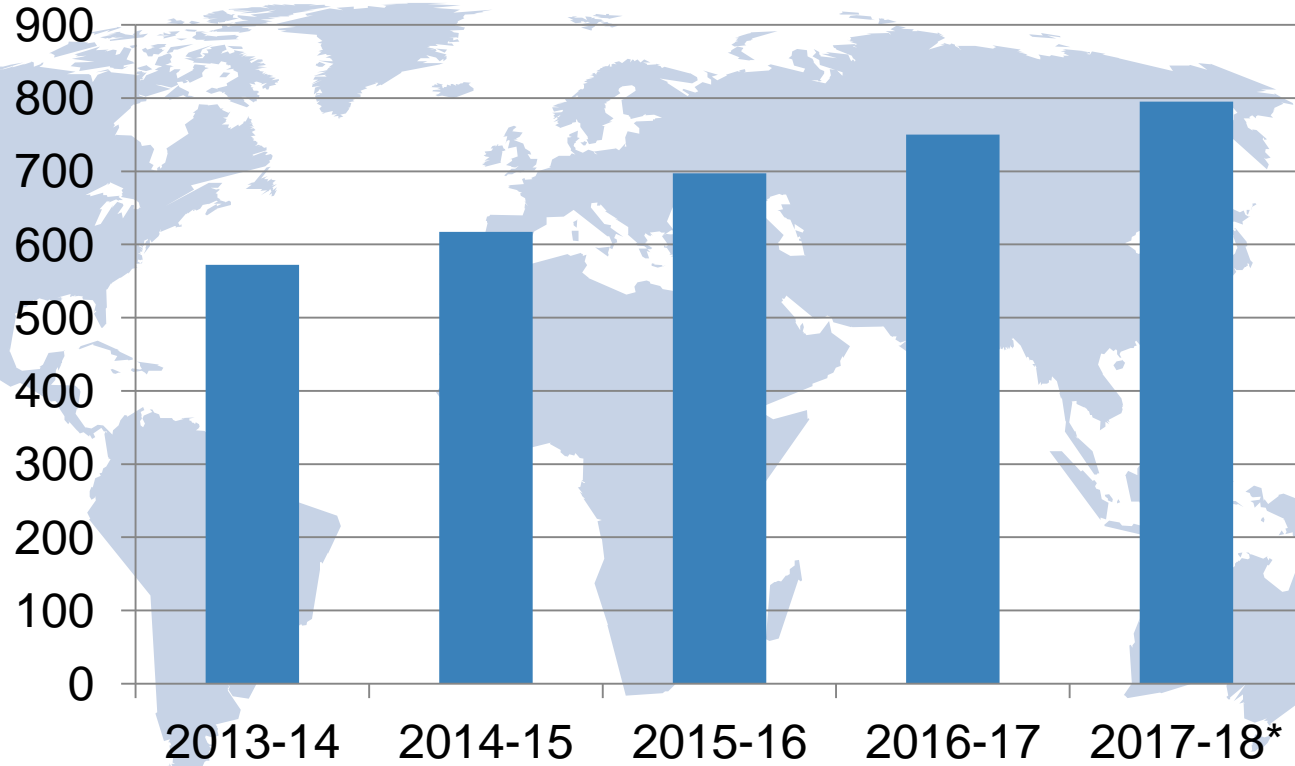
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## INDIA STYRENICS

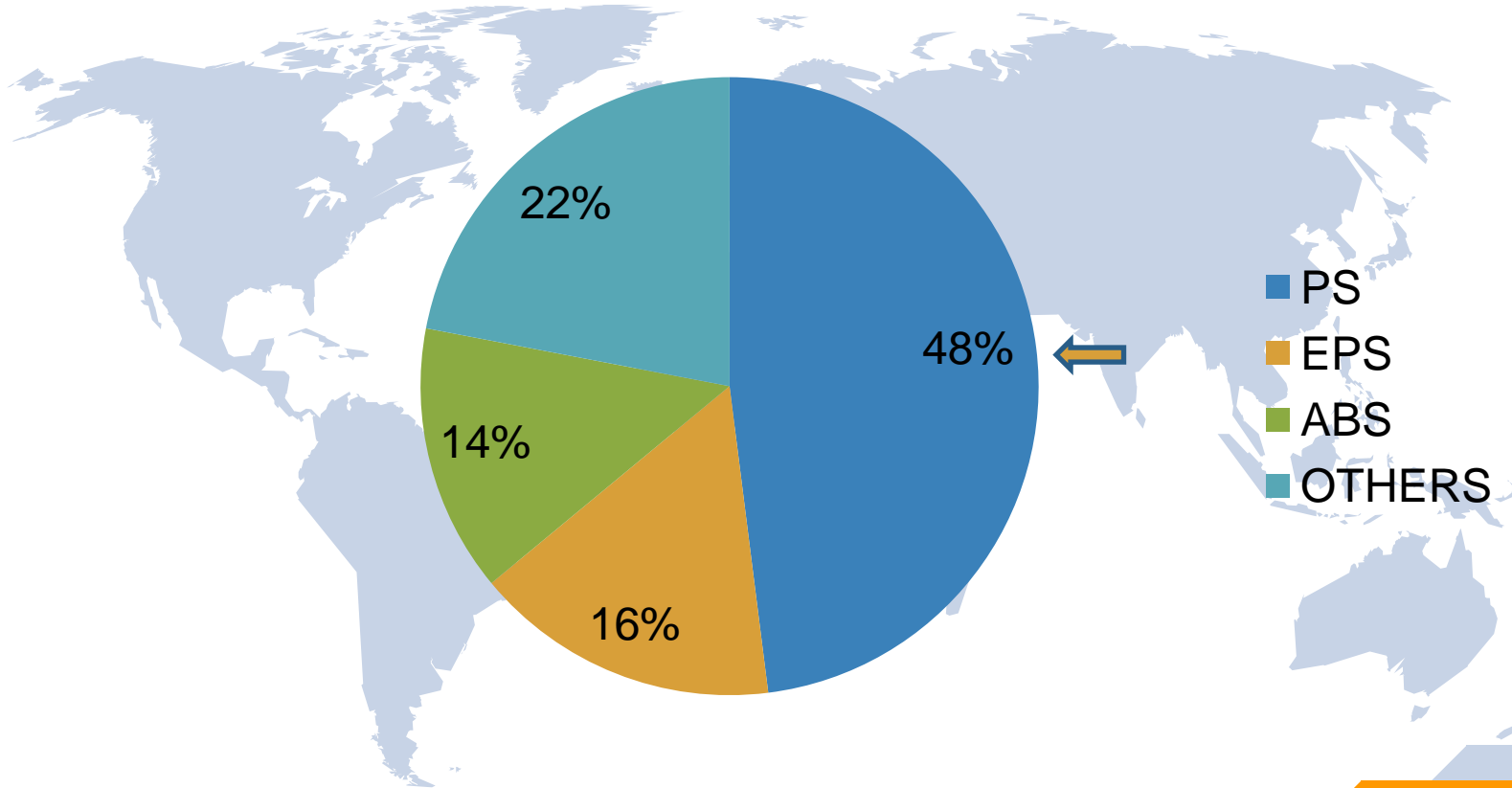
Current Scenario



## STYRENE IMPORTS IN INDIA, KTA



## SHARE OF DOWNSTREAM IN STYRENE DEMAND





## DERIVATIVES DEMAND IN INDIA

(KTA)	2013-14	2014-15	2015-16	2016-17	2017-18*	CAPACITY
PS	<b>217</b>	<b>238</b>	<b>261</b>	<b>275</b>	<b>290</b>	<b>490</b>
EPS	<b>80</b>	<b>82</b>	<b>91</b>	<b>102</b>	<b>112</b>	<b>150</b>
ABS	<b>151</b>	<b>166</b>	<b>183</b>	<b>200</b>	<b>220</b>	<b>190</b>



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**SUPREME PETROCHEM LTD**

LEADERS IN STYRENICS

**SUPREME PETROCHEM LIMITED**

The image shows the entrance to the Supreme Petrochem Limited facility. A large, white, curved concrete archway spans the road, with the company name 'SUPREME PETROCHEM LIMITED' written in bold, black, sans-serif capital letters across its top. Below the archway, a multi-story brick building with several windows is visible. The entrance is flanked by green trees and shrubs. A yellow metal gate is partially open on the right side. The sky is clear and blue.





## COMPANY PROFILE

- SALES TO OVER 100 COUNTRIES GLOBALLY
- LARGEST MANUFACTURER OF POLYSTYRENE IN INDIA – 272 KTA
- LARGEST MANUFACTURER OF EPS IN INDIA – 50 KTA
- FIRST AND ONLY FOOD GRADE EPS MANUFACTURER IN INDIA – 24 KTA
- FIRST PRODUCER OF XPS THERMAL INSULATION BOARDS – 150,000 CUM
- FIRST PRODUCER OF SMMA COPOLYMER – 42 KTA
- SPECIALITY COMPOUNDS PRODUCER – 33 KTA





## COMPANY PROFILE

- TWO MANUFACTURING LOCATIONS – NAGOTHANE, IN MAHARASHTRA AND MANALI, IN TAMILNADU
- STATE OF THE ART MANUFACTURING SITES
- VARIOUS RECOGNITIONS AND AWARDS IN THE FIELD OF ENERGY CONSERVATION, ENVIRONMENT PROTECTION AND SAFETY
- SIGNATORY TO RESPONSIBLE CARE INITIATIVE





# 4

## POLYSTYRENE

A Versatile Polymer



## POLYSTYRENE TECHNOLOGIES

- POLYSTYRENE IS A SYNTHETIC AROMATIC POLYMER MADE FROM STYRENE MONOMER
- CAN BE PRODUCED BY CONTINUOUS MASS POLYMERIZATION OR SUSPENSION PROCESS - WHICH IS ALMOST OBSOLETE
- CONTINUOUS MASS IS A CLEAN, ENERGY EFFICIENT AND FLEXIBLE PROCESS WHICH CAN ALTER POLYMER PROPERTIES ACCORDING TO APPLICATION REQUIREMENTS



## POLYSTYRENE TECHNOLOGIES

- INDIA POLYSTYRENE CAPACITY – 490 KTA
- INDIA POLYSTYRENE PRODUCTION – 325 KTA
- SUPREME PETROCHEM HAS HUNTSMAN TECHNOLOGY WITH INSTALLED CAPACITY OF 272 KTA



# POLYSTYRENE APPLICATIONS

## CRYSTAL

### CLEAR POLYSTYRENE FOR

1. REFRIGERATOR PARTS
2. SHEETS
3. INSULATION - XPS
4. FOOD TRAYS
5. MEDICAL DISPOSABLES
6. PACKAGING

## HIGH IMPACT

### IMPACT RESISTANCE FOR

1. REFRIGERATOR COMPONENTS
2. THERMOFORMED FOOD AND NON FOOD PACKAGING
3. MOLDED PARTS OF AC
4. COMPUTER HOUSINGS
5. COMPOUNDS FOR ELECTRICALS

# APPLICATIONS OF PS



# APPLICATIONS OF PS

PS Sheets  
Transparent / Coloured



Stretch Blow  
Molded Bottles







# 5

## XPS INSULATION BOARDS

High Performance Insulation



## XPS INSULATION BOARDS

LEED (LEADERSHIP IN ENERGY AND ENVIRONMENTAL DESIGN) CERTIFIED BUILDINGS ARE RATED BASED ON FIVE FOCUS AREAS:

- 1. SUSTAINABLE SITES
- 2. WATER EFFICIENCY
- 3. ENERGY AND ATMOSPHERE
- 4. INDOOR ENVIRONMENTAL QUALITY
- 5. INNOVATION AND DESIGN PROCESS

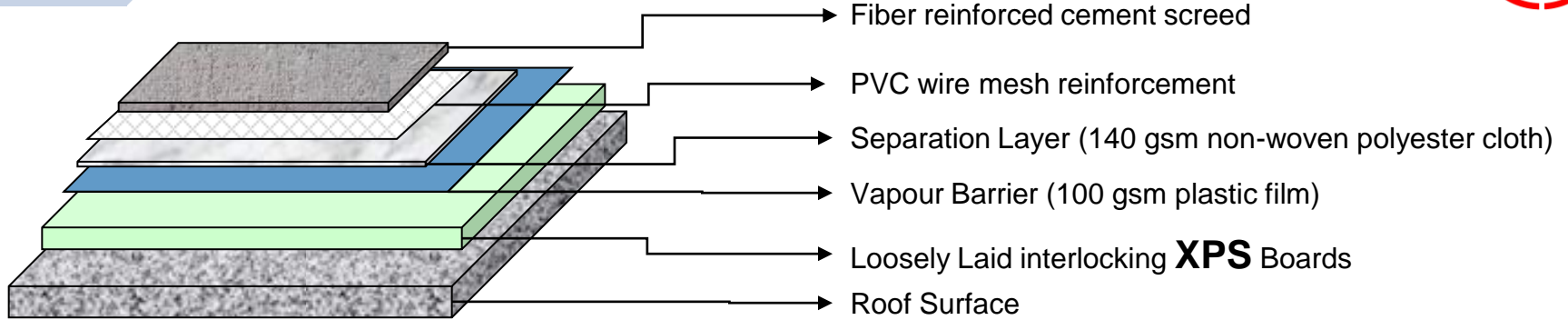
EXTRUDED POLYSTYRENE RIGID FOAM (XPS) PLAYS AN IMPORTANT ROLE TO ACHIEVE 'GREEN' OR 'SUSTAINABLE' GOALS



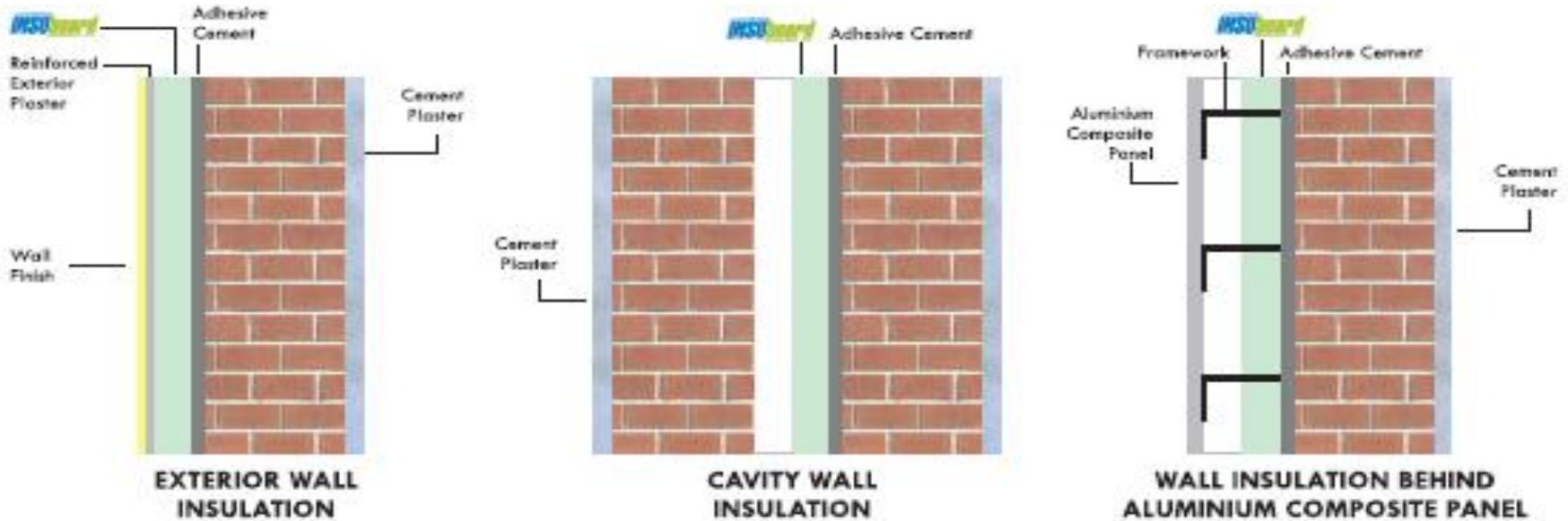
## XPS INSULATION BOARDS

- XPS IS AN EXCELLENT ENVIRONMENTALLY – RESPONSIBLE ALTERNATIVE TO OTHER TYPE OF BUILDING INSULATIONS
- XPS RANKS WELL IN MOST OF THE KEY ATTRIBUTES OF A ‘GREEN BUILDING MATERIAL’ INCLUDING CHARACTERISTICS LIKE ENERGY EFFICIENCY, REUSABILITY / RECYCLABILITY, AIR QUALITY, DURABILITY
- XPS INSULATION ADDRESSES ENERGY EFFICIENCY AND MOISTURE MANAGEMENT WITH A SINGLE PRODUCT REDUCING THERMAL BRIDGING AND MOISTURE ABSORPTION, MAINTAINING R-VALUE OF INSULATION

## A ROOF INSULATED WITH XPS



# VARIOUS APPLICATION OF XPS





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## EXPANDABLE POLYSTYRENE

Lightweight Foam Resin



## EXPANDABLE POLYSTYRENE TECHNOLOGIES

- EPS CAN BE PRODUCED BY SUSPENSION PROCESS – STARTING FROM STYRENE OR BY EXTRUSION PROCESS – STARTING FROM GPPS
- PENTANE IS USED AS BLOWING AGENT WHICH IS IMPREGNATED INSIDE THE POLYSTYRENE BEADS
- SUSPENSION PROCESS IS ENERGY EFFICIENT AND FLEXIBLE IN TERMS OF QUALITY REQUIREMENTS OF VARIOUS APPLICATIONS
- SUPREME PETROCHEM HAS SHIN-A CHEMICALS TECHNOLOGY FOR STANDARD EPS AND NOVA TECHNOLOGY FOR FOOD GRADE EPS WITH COMBINED INSTALLED CAPACITY OF 74 KTA

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# EPS APPLICATIONS

## STANDARD

1. APPLIANCE PACKAGING
2. AUTOMOTIVE PACKAGING
3. INSULATION
4. FISH BOXES
5. DECORATIVE SHAPE MOULDINGS

## FLAME RETARDANT

1. 3D PANEL
2. INSULATED CONCRETE FORM
3. GEOFOAM
4. BUILDING INSULATION
5. LIGHT WEIGHT CONCRETE

## FOOD GRADE

1. FOOD SERVICEWARE
2. COFFEE CUPS
3. FOOD TRAYS
4. THIN WALL MOULDINGS
5. MEDICAL DISPOSABLE PACKAGING

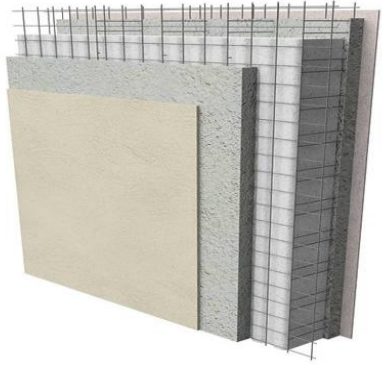




## EPS IN CONSTRUCTION

- 4% POLYMER AND REST AIR
- LIGHT WEIGHT – EASY TO HANDLE
- GOOD COMBINATION OF INSULATION PROPERTIES AND MOULDABILITY
- TECHNOLOGIES – 3D PANELS, ICF, SIP
- GEO-FOAM TECHNOLOGY FOR FASTER ROAD CONSTRUCTION
- LIGHT WEIGHT CEMENT / CONCRETE MIXES
- BRICKS/BLOCKS – FIX SIZE, BUILT IN INSULATION, LIGHT WEIGHT, WATER RESISTANCE

# EPS- 3D PANELS



PRE-REINFORCED SANDWICH PANEL WITH GALVANIZED STEEL CAGE  
POLYSTYRENE SLAB FOR THERMAL INSULATION  
3,5 CM SHOTCRETE ON EACH SIDE FOR STRUCTURAL RESISTANCE  
MONOLITHIC BUILDING SHELL  
SUPPORTS ANY SURFACE FINISHING



Single



Double

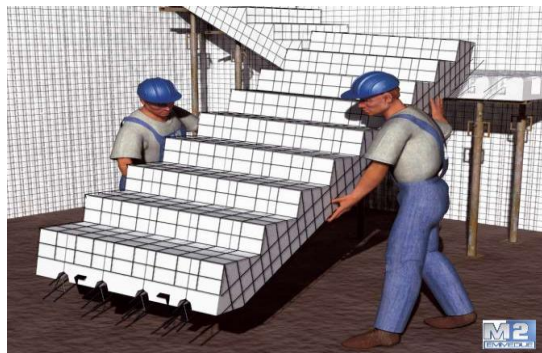
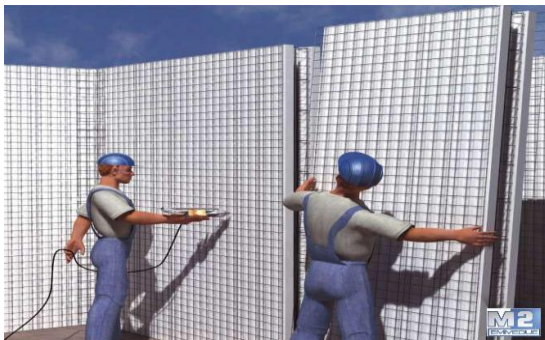


Roof/Slab



Stairs

# CONSTRUCTION USING 3D PANELS



# CONSTRUCTION USING 3D PANELS



## EPS- INSULATED CONCRETE FORM

ICF'S ARE HOLLOW EPS FORMS THAT ARE ERECTED AT THE SITE AS LEGO BLOCKS, AND THEN FILLED WITH FIVE OR SIX INCHES OF REINFORCED CONCRETE



# ICF CONSTRUCTION

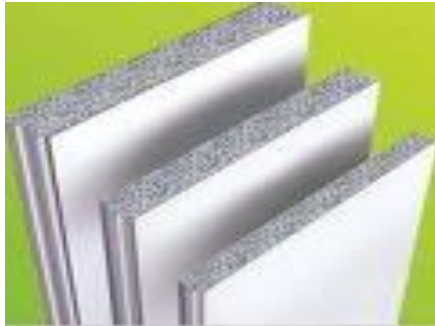


# STRUCTURAL INSULATED PANELS

SANDWICH STRUCTURE IS MADE UP OF TWO MAJOR ELEMENTS, THE SKIN AND THE CORE  
SKIN-THE OUTER LAYERS-CAN BE GALVANIZED STEEL, PVC, ALUMINUM, ETC.

CORE-EPS SHEET

USED IN PARTITION WALLS, COLD CHAINS, REFRIGERATED CONTAINERS, WAREHOUSES





## EPS AS GEOFOAM

EPS GEO-FOAM HAS BEEN USED FOR OVER 30 YEARS IN APPLICATIONS AS:

- ROAD EMBANKMENTS
- SLOPE STABILIZATION
- EARTH RETAINING STRUCTURES
- COMPRESSIBLE INCLUSIONS
- LANDSCAPE FILL

FOR SPEEDY ROAD CONSTRUCTION

AVOIDS DELAY IN COMPLETION OF INFRASTRUCTURE PROJECTS ESPECIALLY  
BRIDGES

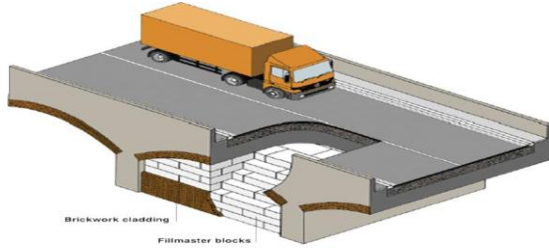


# EPS AS GEOFOAM

SIMPLE BLOCKS – DENSITY DECIDED BY GEO ENGINEER AFTER STUDYING THE SOIL CONDITION AND APPLICATION  
GEO-FOAM IS LIGHT WEIGHT, INERT & MOISTURE RESISTANT



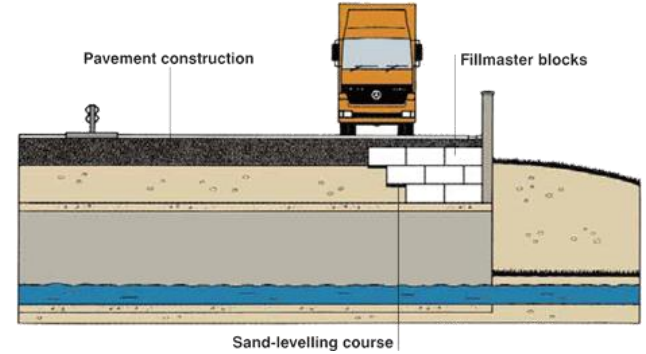
# GEOFOAM APPLICATIONS



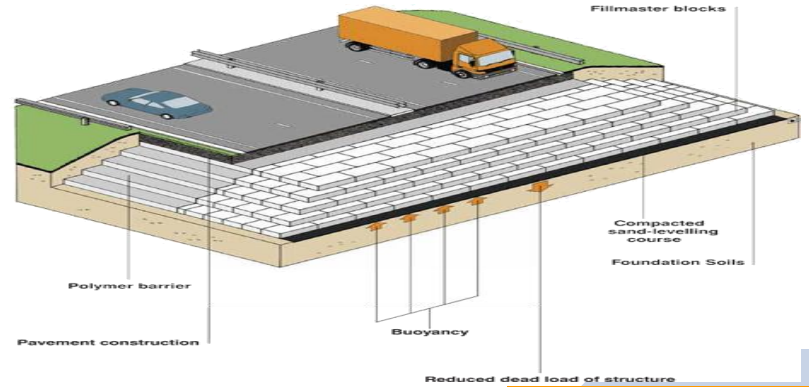
Bridge Underfill



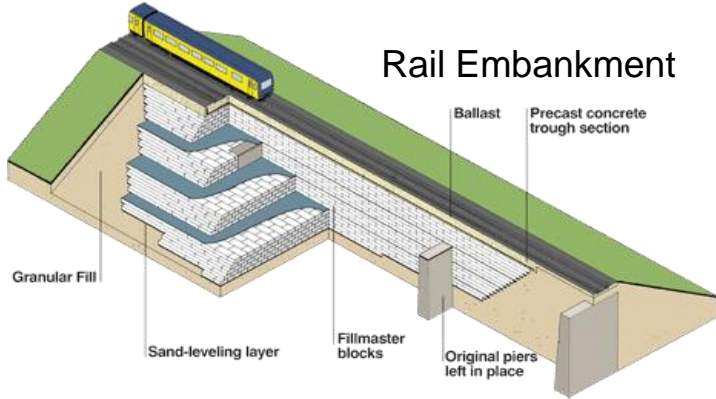
Culvert



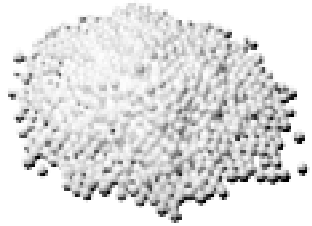
Road



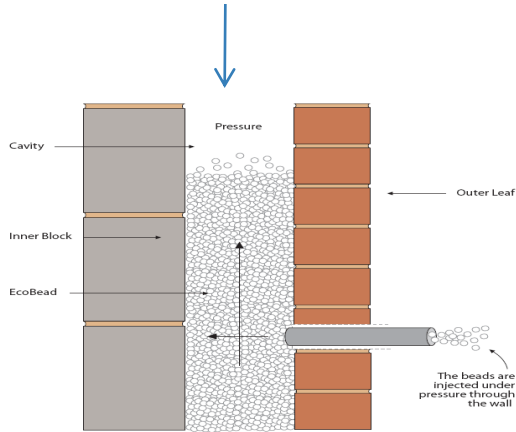
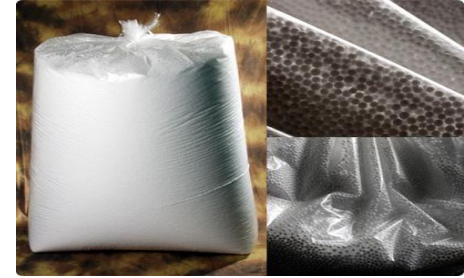
Rail Embankment



# EPS BASED LIGHT WEIGHT CEMENT



Coated with special chemical

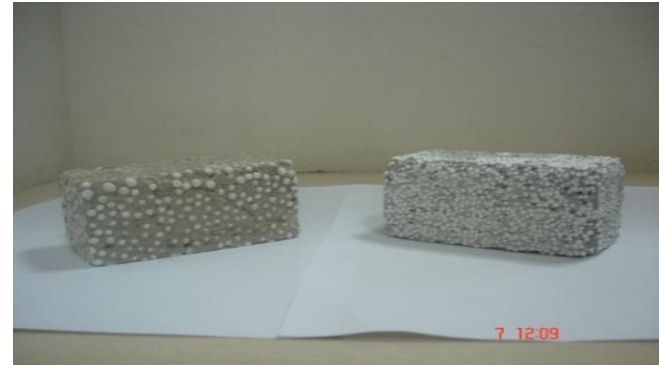


# EPS LIGHT WEIGHT CEMENT PANELS / BRICKS



PANELS MANUFACTURED USING EPS-LWC AND CEMENT FIBER BOARDS

LIGHT WEIGHT BRICKS





## POLYSTYRENE – FOR GREEN & SUSTAINABLE FUTURE

- APPLICATIONS OF POLYSTYRENE (XPS) IN BUILDING INSULATION AND USE OF EPS IN CONSTRUCTION INDUSTRY ( 3 D PANELS, LIGHT WEIGHT CONCRETE ETC ) HAVE VERY GOOD POTENTIAL OF ENERGY CONSERVATION THEREBY HELPING IN ENERGY SECURITY OF THE COUNTRY.
- APART FROM ENERGY CONSERVATION, USE OF 3 D PANELS HAS THE POTENTIAL OF SUBSTANTIAL REDUCTION IN THE TIME TAKEN FOR CONSTRUCTION THEREBY PLAYING A MAJOR ROLE IN MASS HOUSING PROJECTS AND CONTROLLING COST OVER RUNS OF PROJECTS BECAUSE OF DELAYS IN CONVENTIONAL METHODS OF CONSTRUCTION.
- USE OF 3D EPS PANELS HAS BEEN RECOGNISED AS EMERGING TECHNOLOGY BY “BUILDING MATERIAL TECHNOLOGY PROMOTION COUNCIL” OF INDIA
- USE OF XPS AND EPS FOR COLD STORAGES AS WELL AS REFRIGERATED CONTAINERS HAS GREAT POTENTIAL IN ENERGY CONSERVATION AND FOOD SUPPLY CHAIN MANAGEMENT.



# 7

## ACRYLONITRILE BUTADIENE STYRENE (ABS) STYRENE ACRYLONITRILE (SAN)

Engineering Polymer



## ABS AND SAN TECHNOLOGIES

- ABS IS A TRIBLOCK COPOLYMER HAVING BUTADIENE, ACRYLONITRILE AND STYRENE
- CONVENTIONAL ABS PROCESS IS A COMBINATION OF SUSPENSION AND MASS POLYMERIZATION
- BUTADIENE IS POLYMERIZED TO PRODUCE POLYBUTADIENE LATEX WHICH IS THEN POLYMERISED WITH ACRYLONITRILE AND STYRENE TO PRODUCE ABS GRAFT BASE POLYMER
- STYRENE AND ACRYLONITRILE ARE CO POLYMERIZED TO PRODUCE SAN BY CONTINUOUS MASS PROCESS AND FINALLY SAN AND ABS BASE POLYMER ARE COMPOUNDED TO PRODUCE ABS
- CONVENTIONAL ABS A IS CAPITAL INTENSIVE PROCESS WITH VERY HIGH ENERGY CONSUMPTION



## ABS AND SAN TECHNOLOGIES

- ABS CAN ALSO BE PRODUCED BY CONTINUOUS MASS POLYMERIZATION
- POLYBUTADIENE RUBBER IS FIRST DISSOLVED IN STYRENE MONOMER. THE SOLUTION IS THEN FED TO REACTORS WHERE IT IS COPOLYMERIZED WITH ACRYLONITRILE TO PRODUCE ABS PELLETS
- DOW, ENI VERSALIS ARE PIONEERS IN ABS CONTINUOUS MASS PROCESS. ALL NEW ABS PLANTS COMING AROUND THE WORLD ARE WITH CONTINUOUS MASS TECHNOLOGY
- CONTINUOUS MASS PROCESS IS ENERGY EFFICIENT, ENVIRONMENT FRIENDLY AND LESS CAPITAL INTENSIVE PROCESS
- SUPREME PETROCHEM LTD IS IN ADVANCED STAGE OF FEASIBILITY STUDY OF CONTINUOUS MASS ABS PROJECT





## APPLICATIONS

### **ACRYLONITRILE BUTADIENE STYRENE (ABS)**

1. APPLIANCE HOUSING
2. LUGGAGE
3. CAMERA BODIES
4. POWER TOOLS HOUSING
5. BATTERY CASES
6. FURNITURE COMPONENTS
- 7.

### **STYRENE ACRYLONITRILE (SAN)**

1. ELECTRICAL / ELECTRONICS
2. HOUSEHOLD GOODS
3. COSMETIC PACKAGING
4. AUTOMOTIVE PACKAGING
5. KITCHEN WARE



# 8

## OTHER STYRENE DERIVATIVES

Applications



## APPLICATIONS

### **STYRENE BUTADIENE RUBBER (SBR) / STYRENE BUTADIENE STYRENE (SBS)**

1. AUTOMOBILE / TRUCK TYRES
2. SHOE HEELS / SOLES
3. VULCANIZED COMPOUNDS
4. ADHESIVES
5. SEALANTS

### **STYRENE METHYL METHACRYLATE (SMMA)**

1. HOMEWARE / TUMBLERS
2. WATER FILTERS
3. OPTICAL APPLICATIONS
4. POP DISPLAYS
5. CLEAR SHEETS



## RESOURCES

- CPMA Reports
- Published Research Reports
- Data from Our Customers and Suppliers
- Information available in Public Domain



# THANK YOU

**Any questions?**  
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