Expandable Foam from Polystyrene & Polypropylene

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EPS & XPS
Global Consumption & Capacities

Worldwide consumption

2001 3.251 MMT

2011 5.833 MMT

80% increase.

Asian Growth has increased by 110%

Worldwide Capacities

Global EPS Capacities- 9.676 MMT (Asia – 6.694)

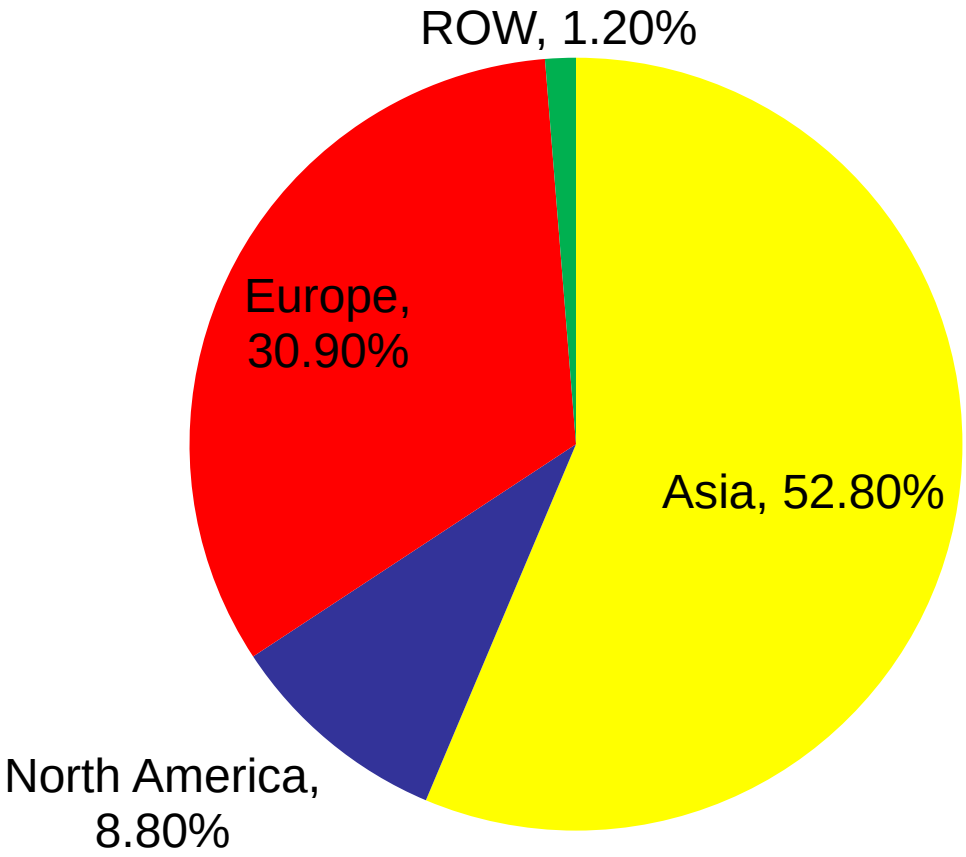
Global XPS Capacity - 0.9 MMT(Major Market- Europe)

EPS Material Manufacturers

Worldwide following are the major manufacturers

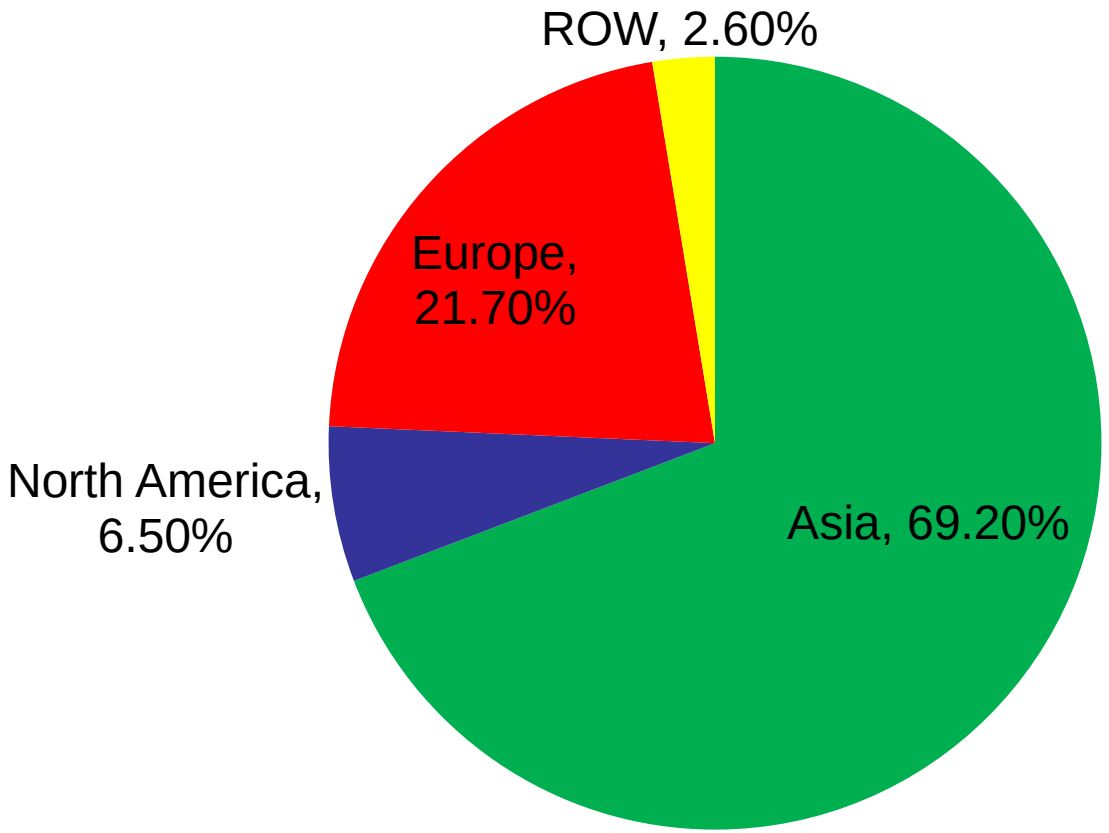
- Loyal Group, Taiwan 1.26 MMT
- Wuxi Xingda, China 0.9 MMT
- BASF, worldwide 1.0 MMT
- Ineos Styrenics,USA 0.4

Scenario 2011 Consumption



5.833 MMT

Scenario 2011 Capacity



9.676 MMT

Applications of EPS

Main applications of EPS

- Construction
- Packaging

However, there are large regional differences

Application of EPS

Region	Construction	Packaging
Europe	80%	20%
North America	41%	59%
Asia	20%	80%
Rest of World	50%	50%

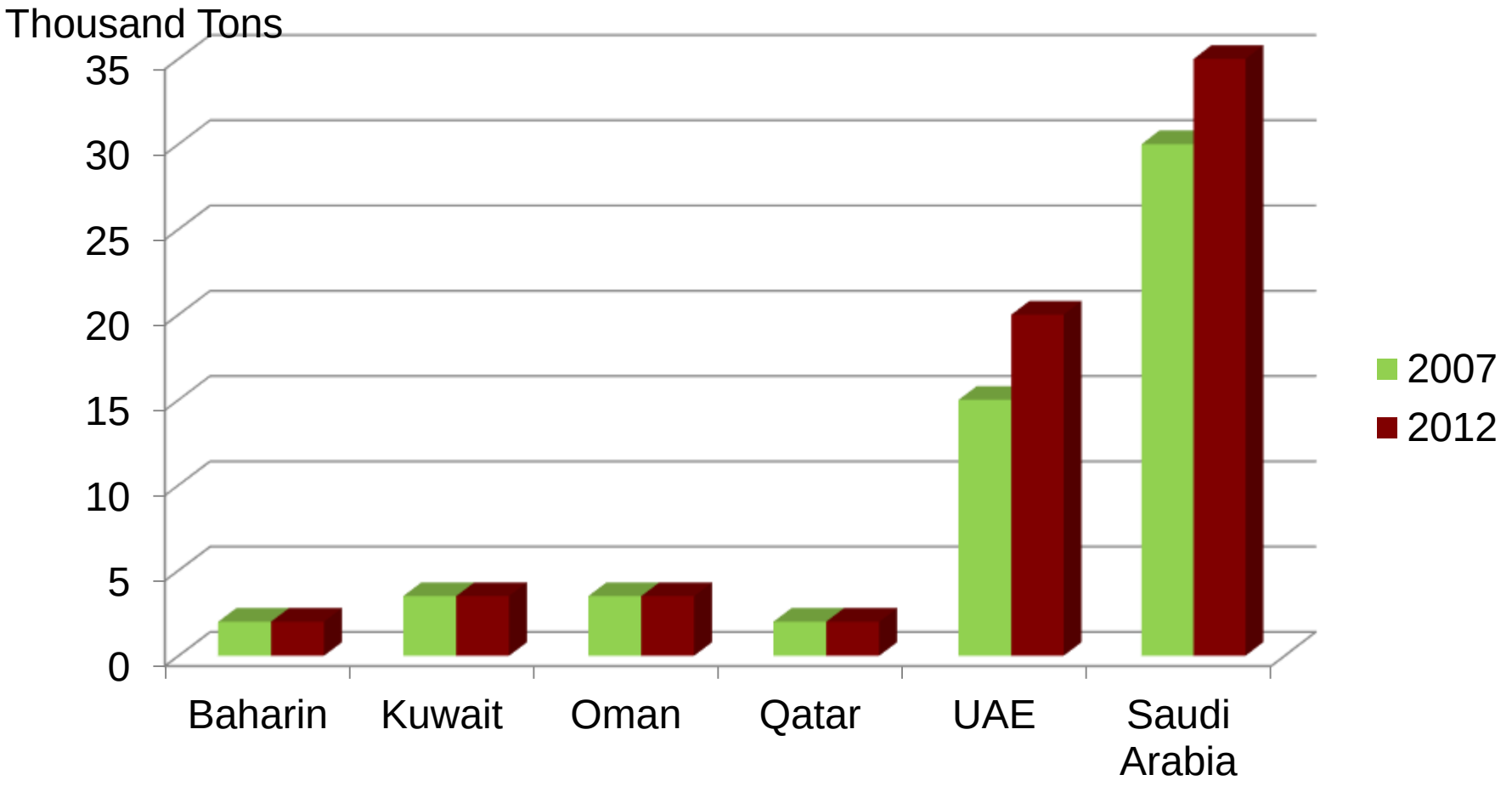
In Asia large quantities of EPS goes into protecting the white goods. In North America EPS cups are used for hot beverages.

In all regions it is expected that applications of EPS in building construction will increase faster than in packaging sector.

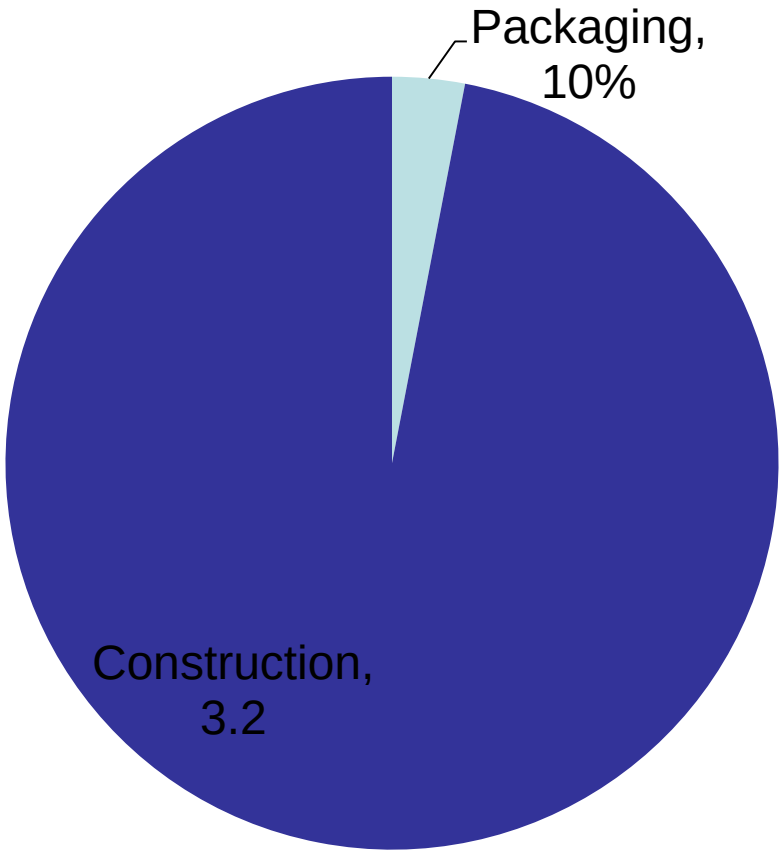
GCC Markets

The EPS market in the Middle East is fairly small due to limited use of building insulation and the small-scale packaging industry. The construction boom in the United Arab Emirates has also provided sufficient demand for some converters to become established. Future demand growth is expected to stay above GDP growth rates supported by both the packaging and construction sectors

GCC Consumption



GCC Consumption



XPS

Compared to EPS board XPS board provides

- Greater compressive strength perpendicular to the board plane with no loss of elasticity.
- It’s closed cell structural gives water repellent surface texture. Hence preferred for insulating flat roof ,facades and load bearing insulation material in civil engineering.
- Due to low weight is used as substrate in composite components

XPS Manufacturers

Major manufacturers are

- DOW, USA
- Owens Corning, USA
- BASF, Germany
- Ursa, Germany

Europe has 50% of the world capacity

Properties of EPS & XPS

Property	Units	EPS	XPS
Thermal Conductivity	W/m k	0.03-0.045 **With graphite**	0.035-0.045
Density	Kg/m3	10-35	25-45
Compressive strength at 10% deformation	MPa	0.07-0.26	0.15-0.70
Allowable compressive stress at pressure load (50 years ,2% deformation)	MPa	0.012-0.11	0.06-0.25
Heat Capacity	J/Kg K	1,500	1,500
Water vapor diffusion resistance	-	20-100	80-200
Building Material Class	-	B1 Flame retardant(D) E European Classification	

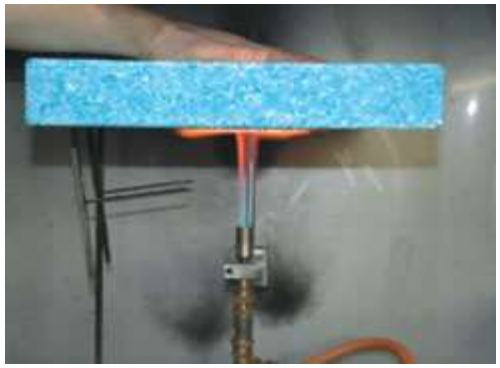
Innovations in EPS by Material Manufactuers

Construction – Trend is to provide materials with better insulating strengths.

- BASF introduced Neopor with finely distributed graphite particles that reflect radiant heat like tiny mirrors. It provides 20% better insulating performance than conventional EPS.
- It costs lower heating costs in colder climate and lower energy costs of air conditioning in hot climate zones.
- Lamda Vento-patented back ventilated .façade system by Swisspor

Innovations by Synbra - **Xire**

Xire® is an innovative insulation material that is developed in-house and is protected by several patents.



Xire consists of expanded glass pearls, which are non-cumbustible and offer excellent thermal insulation properties. These glass pearls are exposed to steam before being compressed to form easily handled sheets or 3-dimensional pre-formed products.
The material is highly resitant to compression, maintains its shape well, is moisture resistant and offers stable insulation performance.

Innovations by Synbra - BioFoam®

The first plant to use a new polymerisation technology for PLA that recently was developed by Sulzer Chemtech and Purac Biochem will be built by Synbra Technology in the Netherlands for the production of BioFoam®; a foamed product made from this PLA. BioFoam® will be positioned complementary to the wide range of polystyrene foam products offered today.

Physical and Thermal Properties of BioFoam® compared to EPS

		BioFoam		EPS	
property	unit	density	value	density	
thermal conductivity	Mw/Mk	35	34	30	33
compressive strength	kPa	40	200	30	200
C value (drop testing)			2,5		2,4
bending strength	kPa	36	300	30	300
Youngs modulus	Mpa	25	3,2	35	3,2

Backward Integration

Sulzer Process

Expandable Polystyrene (EPS) consists of polystyrene micro-pellets or beads containing a blowing agent and other additives for foaming. We have developed a continuous production process in which the blowing agent is directly injected into the melt, combined with subsequent underwater pelletization.

EPS production : 400Kgs/hr

Sulzer has pilot plant for demonstration.

STYRO – Competition from UAE

- STYRO Products
- Core Insulation for EIFS “STYRO” Neopor for EIFS
- Pipe Insulation
- ECO FRIENDLY
- Void Formers
- Piling and Guide Wall “STYRO” Parapet Moulds
- Geo foam
- Super Stick Glue (SSS Glue)
- Sheets
- Boards (Injected Panels)
  EPS for Pontoon and Buoy

- Blocks
- Beads
- Recycled Beads
- Chips
- Boxes
- Customized Packaging

EPS and fire

When EPS is heated it softens and at about 150ºC it begins to shrink. This continues until it is reduced to its original density prior to expansion. Continued heating will melt it to liquid and then a combustible gas will form above 200ºC. This gas can be ignited at temperatures between 360ºC and 380ºC, and will self ignite around 500ºC.

When burning, it produces 40 - 45 MW/Kg of heat.

Temperatures of this magnitude usually occur only in well developed fires.

Flammability

- As with many construction and packaging materials, EPS must be considered combustible. Its fire behaviour depends on the type of material and its application conditions. It is important to distinguish between the two commonly used grades of EPS.
- All EPS used in construction products contains a flame retardant conforming to AS 1366, part 3 - 1992.
- The flame retardant reduces the flammability and spread of flame on the surface of EPS products, to such an extent that it is classified as "flame retardant" according to the European Standard DIN 4102. If ignited with a flame the EPS extinguishes itself as soon as the ignition flame is removed.
- EPS does not catch fire spontaneously, and small sources of ignition will not ignite it.

Smoke and Dangerous Gas Emissions

Type of test piece	Constituents of the fire gases	Fire gas composition in ppm at a test temperature of 300 °C	400 °C	500 °C	600 °C
Standard EPS	Carbon monoxide	50*	200*	400*	1000**
	Styrene monomer	200	300	500	50
	Other aromats	Traces	10	30	10
	Hydrogen bromide	0	0	0	0
Flame Retardant EPS	Carbon monoxide	10*	50*	500*	1000**
	Styrene monomer	50	100	500	50
	Other aromats	Traces	20	20	10
	Hydrogen bromide	10	15	13	11
Pine wood	Carbon monoxide	400*	6000**	12000**	15000**
	Aromats	–	–	–	300
Insulating softboard	Carbon monoxide	14000**	24000**	59000**	69000**
	Aromats	Traces	300	300	1000
Expanded cork	Carbon monoxide	1000*	3000**	15000**	29000**
	Aromats	Traces	200	1000	1000

Note:
Test conditions as specified in DIN 53 436, air supply 100 l/h, test piece size in mm: 300 x 15 x 10

* Smouldering fire
** Flame fire
\- Not measured

Smoke and Dangerous Gas Emissions

The burning of EPS is less harmful than burning timber and many other commonly used building materials. Gases released during combustion are predominantly carbon dioxide and carbon monoxide. Tests carried out in accordance with European Standard DIN 53436 show that the levels of dangerous gases are considerably less than those occurring when burning timber.

Early Fire Hazard Properties

Testing in accordance with AS 1530.3-1982 to determine early fire hazard properties shows that EPS compares favorably with many timbers in most categories.

Comparative Testing of some Materials to AS 1530.3 - 1982 'Test for early fire hazard properties of materials.'

Comparative Testing of some Materials to AS 1530.3 - 1982 'Test for early fire hazard properties of materials.'				
Material	**Ignitability Index (0-20)**	**Spread of Flame Index (0-10)**	**Heat Evolved Index (0-10)**	**Smoke Developed Index (0-10)**
EPS(i)	**12**	**0**	**3**	**5**
Softboard (ii)	**16**	**9**	**7**	**3**
Oregon (ii)	**13**	**6**	**5**	**3**
Bluegum (ii)	**11**	**0**	**3**	**2**
Radiata Pine (iii)	**14**	**8**	**9**	**3**
Hardboard (iii)	**14**	**7**	**9**	**5**

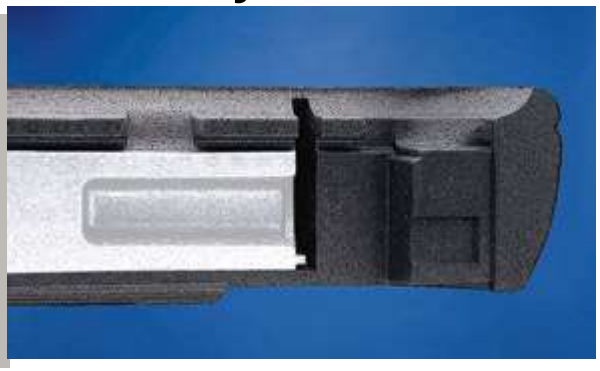
Key Atributes

- **structural strength -** Load bearing structural support from high strength to weight ratio.
- **light weight -** Material mass reduction and minimised component count dramatically decrease weight.
- **recyclable -** 100% recyclable
- **structural strength -** Load bearing structural support from high strength to weight ratio.
- **energy absorption -** closed-cell structure delivers controlled return-to-shape after dynamic stress.
- **thermal insulation -** Outstanding thermal insulation for temperature sensitive applications.
- **acoustical -** Noise reduction levels up to 10 times that of alternative materials.
- **chemically inert -** Unaffected by exposure to oil, grease, petroleum and most chemicals

Expandable Polypropylene Applications

Seating

Safety



Packaging

Insulation

Marine

Acoustical

Thank You