

## COMPARITIVE BETWEEN VARIOUS INSULATION SOLUTIONS

PARAMETERS	EPS / XPS	PUF	NBR WITH PVC	EPDM	FIBREGLASS	PE / XLPE
<b>Chemical Structure</b>	It is produced by molding sprayed styrene resin polymerization under pressure ( <b>Extruded Polystyrene – XPS</b> ) or <b>by pressing polystyrene grains into molds</b> expanded under steam or in hot water with the help of steam again ( <b>Expanded Polystyrene – XPS</b> )	A two-component mixture <b>composed of isocyanate and polyol resin comes together</b> at the tip of a gun, and forms an expanding foam that is sprayed into cavities, or through holes drilled in into a cavity of a finished wall.	<b>Nitrile butadiene rubber (NBR)</b> is a NBR is actually a complex family of unsaturated copolymers of acrylonitrile, butadiene and Poly vinyl chloride (PVC). NBR is popular in a wide variety of application areas requiring oil, fuel, and chemical resistance. However, <b>the material is Polar - Reacts with water has polar reacts with polar</b>	EPDM rubber (ethylene propylene diene mono mer rubber), a type of synthetic rubber, is an elastomer characterized by a wide range of applications. The material is <b>Non Polar - Does not react with water</b>	Fiberglass is a strong lightweight material and is used for many products. Although it is not as strong and stiff as composites <b>based on carbon fiber, it is less brittle, and its raw materials are much cheaper.</b>	Polyethylene is the most Common plastic. Many kinds of <b>polyethylene are known, with most having the chemical formula (C<sub>2</sub>H<sub>4</sub>)<sub>n</sub>H<sub>2</sub>.</b>
<b>Cellular Structure</b>	Semi closed cell. Moisture can penetrate. <b>Needs Vapour barrier.</b>	Semi closed cell. Moisture can penetrate. <b>Needs Vapour barrier.</b>	Closed cell. Moisture cannot penetrate. <b>Needs no Vapour barrier.</b>	Closed cell. Moisture cannot penetrate. <b>Needs no Vapour barrier.</b>	Open cell. Moisture can migrate freely. <b>Needs high quality Vapour barrier.</b>	Closed cell. Moisture cannot penetrate. <b>Needs no Vapour barrier.</b>
<b>Water Vapour Transmission</b>	<b>Low ‘μ’ Value (34-100).</b> Very poor resistance to water vapour ingress. Needs external vapour barrier (difficult & takes longer time for installation Increase in Thermal Conductivity ‘λ’ over a period of time is very high	<b>Low ‘μ’ Value (200).</b> Very poor resistance to water vapour ingress. Needs external vapour barrier (difficult & takes longer time for installation Increase in Thermal Conductivity ‘λ’ over a period of time is very high	<b>Nitrile Rubber has a homogenous Vapour Barrier on account of its completely closed cell structure.</b> The Water Vapour Permeability of NBR is 0.3 Perm.Inch .	EPDM has a homogenous Vapour Barrier on account of its completely closed cell structure. The Water Vapour Permeability of NBR is 0.1 Perm.Inch regardless of the site condition. <b>This means excellent Long Term efficiency and performance.</b>	<b>Worst ‘μ’ Value (1).</b> Extremely poor resistance to water vapour ingress. Needs external vapour barrier (difficult & takes longer time for installation Increase in Thermal Conductivity ‘λ’ over a period of time is very high	<b>PE has a homogenous Vapour Barrier on account of its closed cell structure.</b>
<b>Water Absorption</b>	<b>Extremely high.</b> One needs to just immerse EPS in water to see the effect.	<b>Extremely high.</b> One needs to just immerse PUF in water to see the effect.	<b>Less than 10% even after 28days immersion in water.</b>	<b>Less than 3% even after 28days immersion in water.</b>	<b>Extremely high.</b> One needs to just immerse FG in water to see the effect.	<b>Less than 10% even after 28days immersion in water.</b>
<b>Fire Resistance</b>	<b>Poor fire resistance</b>	<b>Poor fire resistance. Releases toxic gases on burning.</b>	<b>Meets CLASS “0”</b> as per BS-476 Part 6 & CLASS “1” as per BS-476 Part 7. The Class 1 rating indicates a “Nil” surface spread of flame.	<b>Meets CLASS “0”</b> as per BS-476 Part 6 & CLASS “1” as per BS-476 Part 7. The Class 1 rating indicates a “Nil” surface spread of flame.	<b>Meets CLASS “0”</b> as per BS-476 Part 6 & CLASS “1” as per BS-476 Part 7.	<b>Very Poor fire resistance.</b> Not only the basic material does not meet the Class O standard (w/o foil) but also aids in flame spread.
<b>Density</b>	<b>24 Kg/cum</b>	<b>24 to 32 Kg/cum</b>	<b>40 to 60 Kg /cum</b>	<b>40 to 60 Kg /cum</b>	<b>24 to 32 Kg /cum</b>	<b>24 Kg /cum</b>
<b>Weather Resistant</b>	<b>Not weather resistant.</b> Cracks occur due to prolonged exposure to Sun and rain.	<b>Not weather resistant.</b> Cracks occur due to prolonged exposure to Sun and rain.	<b>Not weather resistant.</b> Cracks occur due to prolonged exposure to Sun and rain.	<b>Only weather resistant material.</b>	<b>Not weather resistant.</b> Disintegrates with exposure to environment.	<b>Not weather resistant.</b> Cracks occur due to prolonged exposure to Sun and rain.

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Nitrosamine content	No	No	Yes upto 20000 ppb. Carcinogenic	No	No	No
UIC - Under Insulation Corrosion	Due to moisture migration leads to UIC	Due to moisture migration leads to UIC	UIC does not take place	UIC does not take place	Due to moisture migration leads to UIC	Due to moisture migration leads to UIC
Ageing	Heavy deterioration in thermal properties with time on account of humid conditions	Heavy deterioration in thermal properties with time on account of humid conditions	Temperature variations and humidity have no effect on the cellular structure.	Temperature variations and humidity have no effect on the cellular structure.	Heavy deterioration in thermal properties with time on account of humid conditions	Temperature variations and humidity have no effect on the cellular structure.
Health & Safety	Release toxic fumes when burn. Mould and mildew growth prevalent	Release toxic fumes when burn. Mould and mildew growth prevalent	Has PVC which release chloride compounds during fire. Material not anti fungal. Needs additives for those properties.	Totally safe. Does not have any fibers or harmful material. Basic material is antifungal. No toxic fumes released.	Release toxic fumes when burn. Mould and mildew growth prevalent	Release toxic fumes when burn. Mould and mildew growth prevalent
Thickness due to changing thermal Conductivity	Even though the thermal conductivity of EPS is 0.04W/mDegC, the thickness required is higher on account of increasing K value with time.	Even though the thermal conductivity of PUF is 0.027W/mDegC, the thickness required is higher on account of increasing K value with time.	Because of higher Mu value. Hence thickness required is lower as K value stays stable over a period of time. Thermal conductivity is 0.033W/mDegC at 0 deg C	Because of higher Mu value. Hence thickness required is lower as K value stays stable over a period of time. Thermal conductivity is 0.034W/mDegC at 0 Deg C	Even though the thermal conductivity of EPS is 0.03W/mDegC, the thickness required is higher on account of increasing K value with time.	Because of higher Mu value. Hence thickness required is lower as K value stays stable over a period of time. thermal conductivity is 0.038W/mDegC for high density.
Savings	The long run they work out to be costly.	The long run they work out to be costly.	The installed cost of NBR is comparable with PUF / PIR insulation.	The installed cost of EPDM is higher comparable with NBR insulation. In long run it gives huge savings on account energy savings and almost no maintenance cost.	The long run they work out to be costly.	The long run they work out to be costly.
Space	Required Insulation Thickness is more.	Required Insulation Thickness is more.	Required Insulation Thickness is less. Space Saving.	Required Insulation Thickness is less. Space Saving.	Required Insulation Thickness is more.	Required Insulation Thickness is more.
Installation	Needs special tools and use coal tar Being rigid, even with best installation practices the joints are always prone for water vapour ingress.	Needs special tools and use coal tar Being rigid, even with best installation practices the joints are always prone for water vapour ingress.	No special tools & machinery is required	No special tools & machinery is required	It not user friendly as it causes irritation on the skin of the worker. Also, it has to be covered with cloth / foil or perforated Al sheet to prevent movement of fiber in the air	Needs special tools and use coal tar Being rigid, even with best installation practices the joints are always prone for water vapour ingress.
Alterations	Possible	Very difficult	Allows changes in line very easily	Allows changes in line very easily	Possible	Very difficult
Temp range	-40 to 70 Deg C	-80 to 110 Deg C	-40 to 105 Deg C	-200 to 125 Deg C (150 Deg C intermittent)	-18 to 300 Deg C	-68 to 80 Deg C