Thermal Insulation

Any material that retards or offers resistance to the flow of heat through it is known as a 'Thermal Insulator'. Thermal insulation however cannot stop the heat flow completely, but it can only retard or reduce the rate of heat flow through it. By insulating the walls, ceiling and floor of a refrigerated space with thermal insulation, the heat flow from the surroundings can be retarded, i.e. the heat gain is reduced. This reduces the load on the refrigeration plant to that extent; or in the case of heating, the heat loss can be reduced, thereby limiting the load on the heating equipment. Thus insulation conserves energy by reducing the heat gain/loss. It also reduces the size of the plant/ equipment where such heat gain/loss is substantial. In case the temperature difference between the surroundings and the refrigerated space is large, such as in cold storage and low-temperature applications, insulation becomes absolutely essential to achieve and maintain the desired temperature. This is also true in applications where low relative humidity has to be maintained.

Heat flows from a higher temperature region to one at a lower level of temperature. Hence there is a continuous flow of heat:

i) From the surroundings to the refrigerated/air conditioned space, thereby increasing the space temperature (i.e. there is a heat gain by the space)

ii) From the heated space to the outside, thereby lowering the inside temperature (i.e. the space suffers a heat loss).

Heat-transfer, as we have seen occurs due to conduction, convections and radiation. For reducing the heat flow through the walls and roof of cold storages, the heat flow due to conduction and convection has to be reduced. The heat flow due to conduction can be reduced by the use of materials having a low heat conductivity. The heat-transfer through convection can be reduced by having very small closed air cells in the insulation material. Thus an insulating material should have a low heat conductivity and a number of small closed air cells for good insulation.

Selection of Insulating Material

The following factors are of prime importance in the selection of a proper insulating material:

Low thermal conductivity: Thermal conductance value of a material is a measure of its effectiveness to allow the flow of heat through it by conduction. Obviously an insulating material should have a very low thermal conductivity (in other words high thermal resistance or ability to retard the flow of heat). Thermal conductivity is expressed in heat units per hour per unit area per degree of temperature difference per unit thickness of the material such as kcal/h/m^2/°C/cm; (BTU/h/ft^2/°F/in). The thermal resistance or insulating value is the reciprocal of conductivity.

Impervious to water vapour: Presence of water (or ice) will decrease the insulation value of the insulating material and in due course results in its deterioration. Materials having closed cell structure (expanded polystyrene) are relatively impervious to moisture, while fibrous and granular materials permit transmission of water vapour to the colder side.

Resistance to fire: The insulating material selected should not support and spread fire.

Mechanical strength and rigidity of the material: Some insulation materials (expanded polystyrene, cork) have sufficient structural strength and do not need any support and are able to bear the load on the floor. Others, such as fibrous materials (fibre glass, slag wool, wooden shavings etc.) do not have mechanical strength and would need supports.

Low moisture absorption capacity: The materials are compared with the extent they are polar or non polar.

Resistance to fungus and vermin : Extremely important as IAQ is one of the most important parameters

Easiness of laying : Ease of installation determines the final performance f the system.

Cost ; Obviously, it has be economically viable.

ADVANTAGES OF EPDM INSULATION ON HOT & COLD PIPES

PUF

ADVANTAGE

1. EPDM is a non polar material and it's closed cell insulation structure acts as an excellent vapour b a r r i e r . Being non polar EPDM does not react with water.
2. EPDM insulation does not release toxic fumes when burnt. It is free from HCFC gas and is environment friendly.
3. EPDM insulation maintains the stable R value and does not age over a period of time.
4. EPDM insulation is plyable and easy to apply on curved surface. It does not crack when subjected to stress.

Disadvantages

1. PUF insulation absorbs moisture under vapour pressure. This progressively damages the PUF insulation material cell structure and the insulation efficiency of the system reduces. The ice formation in PUF insulation in cold applications and corrosion of pipelines are visible examples of this aspect.
2. PUF insulation emits dense fumes and toxic gases when burnt. It may have HCFC gases.
3. The R value (resistivity) of PUF reduces over a period of time. This is due to ageing effect
4. Rigid PUF have a risk of stress fracture. Cracks and gaps are difficult to insulate effectively. Cracks in insulation panels which occur due to stress or during handling will result in thermal leakages.

Mineral wool

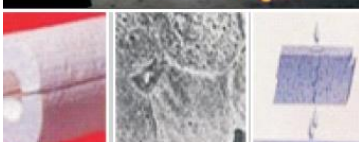
ADVANTAGE

1) EPDM insulation is non-polar. It does react with water.
2) EPDM insulation has antibacterial & antifungal properties.
3) EPDM insulation is fire safe as per UL 94-VO.
4) EPDM insulation does not sag, settle in vertical application.
5) It is flexible & easy to apply
6) It does not corrode the metal pipe & tube surface on which it is applied.

Disadvantages

1) Mineral wool and Glass wool are open cell fiberous material . Due to gaps in vapour barrier, water enters the insulation and reduces insulation property.
2) Fiberous glass wool and mineral wool material is a health hazard.
3) The binder used in glasswool and mineral wool is not fire safe.
4) Fiberous material sags during installation, leaving gaps resulting in thermal leakages.
5) Glass wool and mineral wool insulation are difficult to apply.
6) The shot content and impurities in mineral wool corrodes the metal pipe and tank surface on which it is applied.

EPS



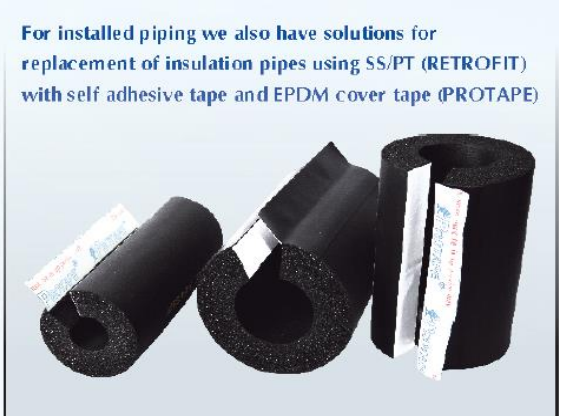
ADVANTAGE

1.EPDM insulation is fire safe and meets the smoke and toxicity stringent requirements.
2.EPDM's closed cell structure is a vapour barrier. It neither reacts nor absorbs moisure.
3.Being flexible and elastomeric, it is easy to apply to both curved adn flat surfaces. Joints can be easily scaled.
4.It has a wide temperature range
00-200 C to 150 C.
5.It is UV stable. It is RoHS complaint and is nitrosamine free as per USFDA norms.

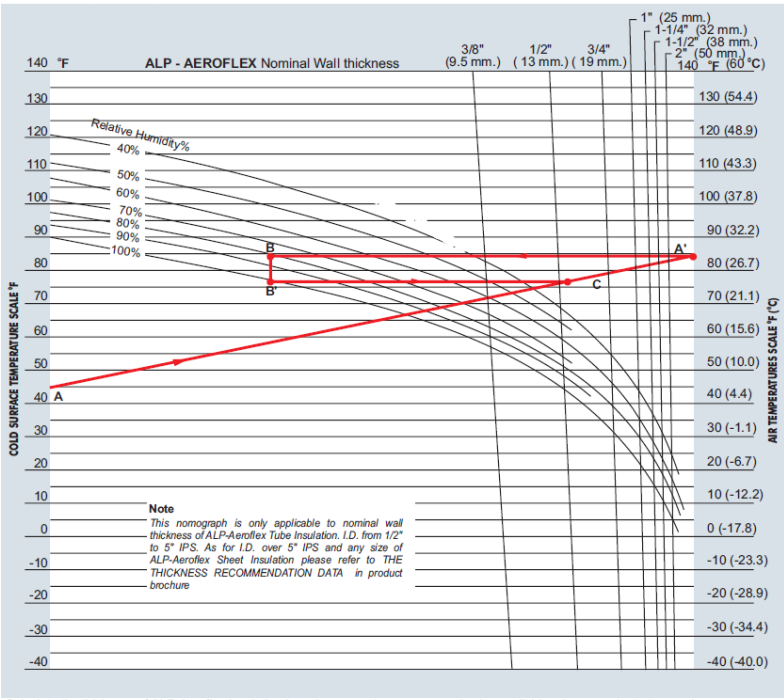
Disadvantages

1.EPS - Thermocol is extremely inflammable. It is a fire hazard. Toxic gases and dense smoke are emitted which can cause loss of human lives.
2.EPS is prone to absorbing moisture and water vapour. This results in corrosion and mold growth.
3.EPS is rigid insulation and application is difficult. The pipe section joints are required to be sealed properly. Cracks are difficult to detect and repair.
4.EPS has a limited temperature range.
5.It is non hygienic. It creates dust during cutting. It turns yellow and degrades when exposed to UV.

EPDM Tube Range



CONDENSATION CONTROL NOMOGRAPH



Calculate the thickness of ALP-Aeroflex insulation by using computer programme is also available, please contact at www.alpoverseas.com

DIRECTION

This nomograph is for your convenience in determining the required thickness of ALPAeroflex Closed Cell Insulation for cold pipes of airconditioning systems, when cold pipe temperature, room temperature, and relative humidity are already known.

How to determine the required thickness of ALP-Aeroflex insulation

EXAMPLE:
Cold Pipe Surface Temp. 45₀F (7.2₀C)
Room Temperature 85₀F (29.4₀C)
Relative Humidity 80%

1. Connect 45₀F (point **A**) on Cold Surface Temperature Scale, and 85₀F (point **A'**) on Air Temperature Scale with a straightedge, forming straight line between **A** and **A'**.
2. From point A' : follow the horizontal line up to the relative humidity 80% curve. From this intersection (point **B**), draw a straight vertical line to the relative humidity 100% curve (point **B'** - saturation curve). Point B' (78.2₀F, 25.7₀C) shows DEW POINT value of the above mentioned atmosphere (air temp. 85₀F, relative humidity 80%).
3. From point B' : draw a backward straight line, until it intersects the line **A-A'** (point **C**). Point C shows the proper thickness of Aflex-Aeroflex Closed Cell Insulation (Vertical lines 3/8", 1/2", 3/4", 1", 1-1/4", 1-1/2" and 2"). To avoid any condensation problem, the 3/4" nominal wall thickness should be used in the situation indicated above.

Pipe Size	Line Temp. 60°F (15.5°C)	Line Temp. 50°F (10°C)	Line Temp. 35°F (1.7°C)	Line Temp. 0°F (-18°C)
	Based on Normal Condition Max. 85°F (29.4°C) 70% RH*			
3/8" ID Thru 3" IPS Over 3" IPS	1/4" Wall 3/8" Sheet	3/8" Wall 1/2" Sheet	1/2" Wall 3/4" Sheet	1" Wall 1-1/4" Sheet
	Based on Mild Condition Max. 80°F (26.6°C) 50% RH**			
3/8" ID Thru 3" IPS Over 3" IPS	1/4" Wall 3/8" Sheet	3/8" Wall 1/2" Sheet	3/8" Wall 3/4" Sheet	3/4" Wall 3/4" Sheet
	Based on Severe Condition Max. 90°F (32.2°C) 80% RH***			
3/8" ID Thru 3" IPS Over 3" IPS Thru 10" IPS Over 10" IPS	1/2" Wall 3/4" Sheet 3/4" Sheet	3/4" Wall 1" Sheet 1" Sheet	1" Wall 1-1/8" Sheet 1-1/8" Sheet	1-1/2" Wall 1-3/4" Sheet 2" Sheet
	Based on Extremely Severe Condition Max. 90°F (32.2°C) 85% RH****			
3/8" ID Thru 3" IPS Over 3" IPS Thru 10" IPS Over 10" IPS	3/4" Wall 1" Sheet 1" Sheet	1" Wall 1-1/4" Sheet 1-1/4" Sheet	1-1/4" Wall 1-1/2" Sheet 1-1/2" Sheet	2" Wall 2-1/2" Sheet 2-1/2" Sheet

ALP-AEROFLEX TECHNICAL SUPPORT -Our computer based design program is available to assist you with the right thickness selection.