TRADE OF

Industrial Insulation

PHASE 2

Module 4

Insulation – Materials, Science and Application

UNIT: 15

Finishing Materials & Cladding

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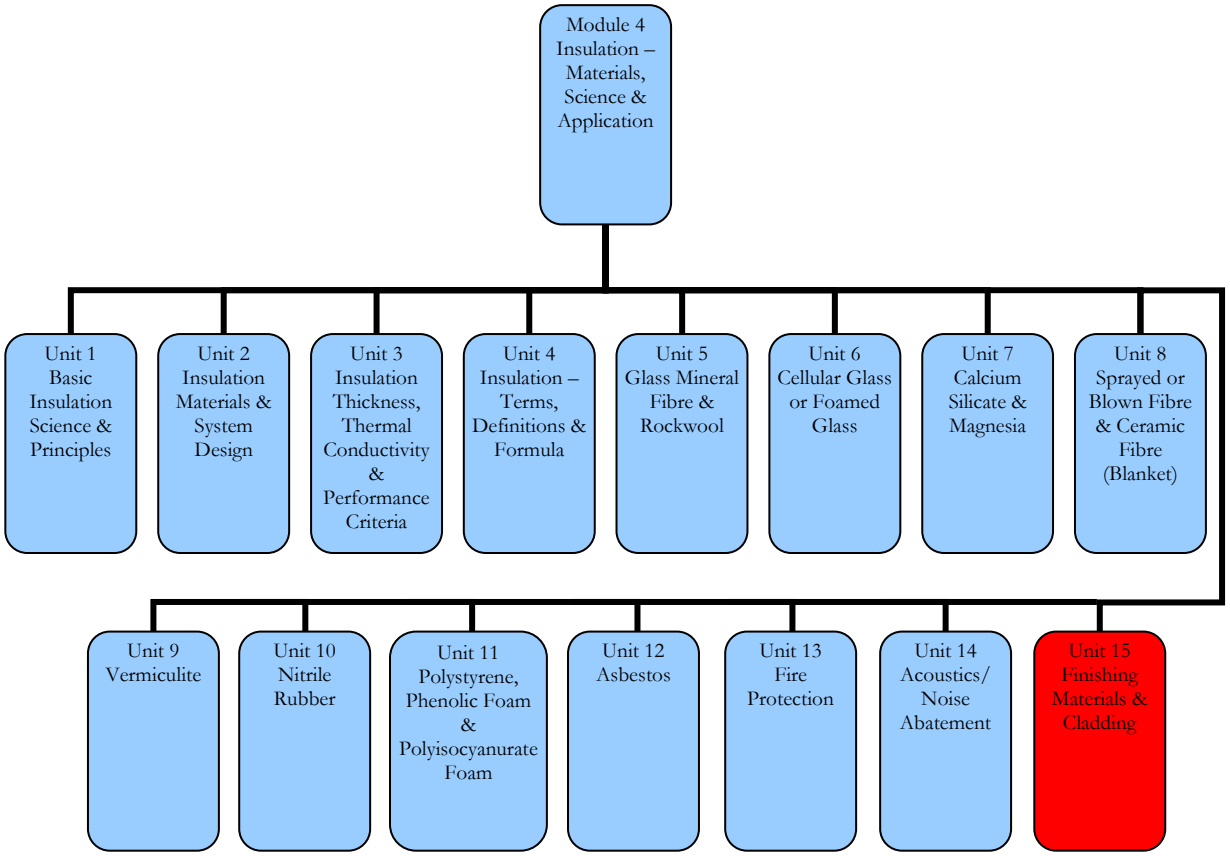
Introduction

Finishing materials including metal cladding are designed to enhance and protect the integrity of the insulating material they are covering. There are many finishing materials on the market which cover every possible system design and specification. In this unit we will look at the materials available , their applications and installation guidelines to ensure that the materials are applied and installed according to the job specification.



Unit Objective

By the end of this unit ***each apprentice*** will be able to:

- Recognise and state the uses of materials and cladding.
- Select suitable finishing materials for a range of applications.

1.0 Finishing Materials and Cladding

Key Learning Points

- Identification of cladding and finishing materials.
- Reinforced aluminium foil. Mastic and coating finishes.
- PVC sheet.
- Sheet metal cladding.
- Polyisobutylene sheet.
- Roofing felt.
- Hard setting cements and compounds.

1.1 Materials

- Reinforced aluminium foil.
- Mastic and coating finishes.
- PVC Sheet.
- Sheet metal cladding.
- Polyisobutylene Sheet (PIB).
- Roofing felt.
- Self-setting cement.

1.2 Reinforced Aluminium Foil

Plain aluminium foil or reinforced aluminium foil laminates can be pre-applied to insulation material by the insulation supplier or manufacturer. These facings should not normally require further finishing and are used as dust and/or vapour barriers in areas where there is little risk of mechanical damage, e.g. on pipe-work at high level or in service ducts. Where the use of aluminium foil is essential to the proper functioning of the system, the foil should be protected from mechanical damage.

Longitudinal overlaps on pipe sections and all joints between abutting slabs and mats should be sealed with matching self adhesive tape. Care should be taken on chilled or cold-water services to ensure the integrity of the vapour barrier.

1.3 Mastic and Coating Finishes

The technique of application, e.g. by brush, hand or spray, depends on size, location, risk of overspray and any possible need to permit evaporation of a solvent. The contractor should consult the manufacturer of the material on the details of the procedure be followed, on any special equipment required and safety precautions to be taken.

Mastic and coating finishes based on ingredients such as bitumen's, resins of polymers can be of three types: water based (emulsions), solvent based or solvent free. Selection of the type should depend on whether it can be applied

direct to the insulant, or whether it has to be used in conjunction with open-weave glass cloth, cotton scrim or canvas and the degree of protection required.

Water based materials should be protected from frost during storage and it is essential that they should not be applied when the ambient or surface temperature is below 5ºC, or when freezing conditions are expected within 24 hours of application. These materials are non-flammable during application. However, some water based mastics are available with special antifreeze ingredients, allowing application in freezing conditions.

Solvent-based mastics and coatings can withstand freezing, but for best results they should not be applied at temperatures below 5ºC. Most of them thicken considerably at low temperatures, rendering application by spraying particularly difficult; for winter use, enclosed storage at a minimum of 10ºC should facilitate easy application. Many contain highly flammable solvents and precautions should be taken. Solvent vapours in fairly low concentrations can cause narcosis, therefore adequate ventilation should be ensured whenever solvent based materials are applied.

Solvent-free materials, such as epoxies or urethanes, are recommended where, for example, particular chemical resistance is necessary.

1.4 PVC Sheet

Where rigid plastics (PVC) sheeting is used, it is usually pre-curled to facilitate fitting over pipe sections and should not be less than 0.35mm thick.

Longitudinal and circumferential joints should be overlapped by 50mm and longitudinal overlaps should be neatly secured every 150mm centre's with plastic rivets.

Alternatively, for cold work, or where a hygienic finish is required, the joints can be continuously bonded with special formulated solvent. They can be finished with matching PVC tape, if desired.

Where hot work is involved, care should be taken to see that the plastics sheets are not subjected to excessive temperatures where the equipment is in use.

Bends and tees can be finished with purpose made fittings, which are usually an integral part of the finishing system.

1.5 Sheet Metal Cladding

Sheet Metal is very widely used over both pre-formed and flexible insulating materials for its resistance to mechanical damage and for its attractive appearance when correctly applied. Corrosion is often a problem and for this reason aluminium can be preferred for some applications. It is essential that the aluminium should be isolated from dissimilar metals.

N.P. Aluminium (plain and stucco), Galvanized mild steel, Aluminium-Zinc coated steel sheet (Aluzinc) and Stainless Steel are the standard sheet metals used for cladding.

Aluminium

Aluminium being relatively soft, should not be used for protection in areas where it is likely to be exposed to substantial mechanical damage, particularly, when it is applied over flexible insulating material.

As flat sheets of polished aluminium, through reflection of light, tend to emphasise areas of minor damage, the reflecting surface, particularly with large flat areas should preferably be broken up by the use of ribbed sheet or material with an embossed "stucco" finish. Sheets with box or ribbed profile have greater intrinsic resistance to deformation than flat sheet.

Profiled aluminium sheet has the advantage of scatter of reflective light as well as increased resistance to deformation in the direction of the corrugations while, in the direction across the corrugations, the sheet confirms easily round uniform curved surfaces.

Aluminium sheet can develop irregular white areas of oxide film after a period of exposure to outdoor weather conditions, but this can be avoided by the use of material that has received a chemical treatment or an electrolytic, e.g. anodized surface treatment. Aluminium should be isolated adequately from direct contact with dissimilar metals to avoid galvanic corrosion.

Under certain conditions, aluminium cladding can constitute a hazard in the event of fire in large process plants or the immediate vicinity, when it is possible for the aluminium to melt and ignite adjacent materials. In a major fire, hot molten aluminium can be scattered over a wide area of a plant leading to many fires.

The thickness of flat aluminium used for cladding is usually between 0.7mm and 1.6mm. The 1.6mm metal would be used for large flat areas over flexible insulation for extra strength and support. The thickness of profiled aluminium used is usually 0.9mm.

Galvanised Mild Steel

Galvanised Mild Steel is used in cladding for its appearance, good mechanical strength and fire resistance. It is relatively cheap compared to stainless steel and should be used in preference to aluminium where there is a risk of development of fires due to the low melting point of aluminium.

The thickness of flat galvanised sheets used is usually between 0.6mm and 1.2mm.

For all materials, precautions should be taken against electrolytic corrosion, particularly for plant within 10km of the sea. Where necessary precautions should be taken to avoid direct contact between dissimilar metals.

Stainless Steel

Stainless steel (various grades) is used for cladding because of its excellent appearance, excellent mechanical strength, corrosion resistance, mildew and bacteria resistance, as well as excellent resistance to fire. These qualities make it an ideal material to use in pharmaceutical, brewing and chemical, food processing plants etc, where a high class finish is required coupled with high levels of hygiene and resistance to fire.

The cost of stainless steel is high compared to aluminium and galvanised mild steel, however, in applications where galvanised may last only a number of years, stainless steel will last indefinitely. Because of its almost complete resistance to corrosion, the high cost of stainless does not necessarily mean it is the most expensive metal to use, since its long life often makes it the cheapest material to use in the long run. The thickness of flat stainless steel used is usually between 0.5mm and 1.0mm.

Aluminium – Zinc Coated Steel Sheet (Alu-zinc)

Alu-zinc is used in cladding work for its excellent corrosion resistance, very attractive appearance and excellent thermal and light reflectivity. With this material you have the combination of three metals – the strength of steel, the protection of zinc and the stability of aluminium.

Aluzinc has an ability to repair itself which makes the material resistant to corrosion caused by scratches. The aluminium-zinc coating provides the steel sheet with a double protection against corrosion. The first protection factor is the coating on the steel sheet that forms a passivating barrier against general corrosion. The other protection factor involves the formation of a galvanic element when the sheet is exposed to moisture (electrolyte), resulting in zinc ions flowing over the protecting the exposed steel against corrosion in scratches or trimmed edges.

Aluzinc can be used in considerably more corrosive environments that for instance hot dip galvanised sheets.

1.6 Polyisobutylene Sheet (PIB)

When insulated pipe work or ductwork is installed outdoors it can be finished with Polyisobutylene (PIB) sheeting to protect it against the weather. Minimum thickness is usually 0.8mm.

When fitting PIB over pipe work insulation for example it is important to ensure that all joints are well butted together.

Longitudinal overlaps should be securely bonded by welding together with white spirit or other suitable solvent. Circumferential joints should be overlapped by typically 50-70 mm and securely bonded in the same way as the longitudinal seams.

All overlaps must be arranged to shed water and special care taken when sealing joints in order to prevent the ingress of moisture.

1.7 Roofing Felt

Applied directly to the external surface of the insulation, with all joints lapped "weather-wise", secured and sealed by suitable adhesive. All longitudinal and circumferential overlaps should be a minimum of 50mm. Finish with two coats of black bituminous paint. All such jointing, sealing materials and methods of application should follow the recommendations of the sheet material manufacturer. Secure in position with galvanised wire netting of 25mm mesh. The netting joints should be secured with a lacing of 1mm galvanised wire.

1.8 Self Setting Cement

Normally these finishing materials are based on Portland cement, but can be gypsum plaster as a base. Supplied in loose, dry form, they are mixed on site with water and trowelled as an armouring to the insulating sub-coat. They will dry in-situ without the application of heat and give a much harder finish than the hard setting compositions.

2.0 Materials and Their Applications

Key Learning Points

- Effect of environmental conditions on finishing and cladding materials.
- Factors governing the application of different finishes.

2.1 Applications

Aluminium Foil

Aluminium foil is used in areas where there is little risk of mechanical damage e.g. on pipe work at high level or in service ducts.

Mastic and Coating Finishes

Generally used to provide a more robust vapour barrier or to provide an appropriate surface for decorative surfaces. Water-based materials should not be applied when the ambient or surface temperature is 5ºC or when freezing conditions are expected within 24 hours of application.

PVC Sheet

PVC cladding is usually designed to last a very long time and requires little maintenance. Due to pvc's durability, high thermal insulation, excellent weathering performance and good resistances to UV light and ozone. PVC cladding can remain in place for many years. It is hygienic and can be easily cleaned.

Sheet Metal Cladding

Sheet metal is very widely used for its resistance to mechanical damage and for its attractive appearance when correctly applied. It is readily available and inexpensive and is also available in alloys and with special coatings and finishes that makes it a very versatile material that is used for many applications in the thermal insulation industry.

Polyisobutylene Sheet (PIB)

Polyisobutylene or PIB is a good outdoor weather resistant finish that is used to cover pipe and ductwork insulation. It is easily applied and the manufacturer's instructions/recommendations should be adhered to for proper installation. It is very cost effective compared to metal cladding but would not offer the same protection against mechanical damage or abrasion. To prevent bellying, particularly on large ducts, the PIB covering can be wrapped with galvanised wire netting secured with 1mm galvanised wire.

Roofing Felt

Like PIB, roofing felt is cost effective compared to sheet metal cladding and can be easily applied. For proper installation, manufacturer's recommendations

should be followed. Roofing felt is secured with galvanised wire netting and lacing wire.

Self-Setting Cement

Self-setting cement can be exposed to outdoor weather conditions without further protection, but it is important to note that it is not impervious to water. It is easily mixed with water and applied but it is important that the manufacturer's instructions are adhered to, so as to achieve a satisfactory outcome. Whey dry, self-setting cement can be painted with various finishes.

3.0 Fixings

Key Learning Points

- Identification and use of fixing products.
- Fixing techniques.
- Manufacturer's catalogues or brochures.
- Personnel attitude towards finish.

3.1 Identification and Use of Fixing Products

As most insulations are not structural materials they must be supported, secured, fastened or bonded in place. Fixings or secure-ments must be compatible with insulation and jacketing materials. Some of the possible choices include:

- Self-Tapping Screws and Rivets
- Bands, Wire, Wire Netting
- Mechanical Fasteners
- Aluminium Foil Tape
- Self-Adhering Laps
- Reinforcing Mesh
- Adhesives
- Mastics

3.2 Self-Tapping Screws and Rivets

Both of these types of fixings are used to secure sheet metal cladding in place over insulated pipe work, ductwork or other equipment.

Precautions should be taken to prevent electrolytic corrosion developing between dissimilar metals for example between aluminium 'pop' rivets and galvanised mild steel cladding. Galvanised mild steel should be secured with cadmium-plated or stainless steel fixings and aluminium cladding can be secured with either aluminium or stainless steel fixings

3.3 Bands, Wire and Wire Netting

Unless the insulating material can be secured directly to the surface to be insulated, e.g. by means of adhesives some form of mechanical accessory should, if necessary, be used to secure it to the permanent attachments on the tank or vessel etc. Banking, Tie Wire or Lacing Wire are some of the ways to secure the insulation in place or the insulation can sometimes be covered with wire netting with the edges laced tightly together. Banding is also used to secure the outer cladding in place without the need for fixings such as self-tapping screws or rivets.

Lacing Wire or other securing device that is likely to be in direct metallic contact with a final cladding of aluminium sheet, should be coated with a plastics material in order to avoid bimetallic corrosion in the locations of contact. Alternatively, it can be convenient to use aluminium or stainless steel securing materials.

3.4 Mechanical Fasteners

When slab insulation products are used on square or rectangular ductwork, they can be installed securely with adhesive which may be supplemented by insulation hangers which are stuck to the ductwork with the insulation material secured by a lock washer fixed on the hanger. These fastenings should be spaced at regular intervals as recommended by the insulation suppliers and should finish flush or below the surface of the simulation.

3.5 Aluminium Foil Tape

Plain aluminium foil or reinforced aluminium foil laminated can be pre-applied to insulation material by the insulation supplier/manufacturer.

These facings should not normally require further finishing and are used as dust and/or vapour barriers in areas where there is little risk of mechanical damage, e.g. on pipe work at high level or in services ducts.

When foil faced pipe sections or slabs are installed they should be tightly butted together and the joints covered with aluminium foil tape (supplied in rolls, width 50mm or 75mm) to seal the joint and maintain the integrity of the vapour barrier.

3.6 Self-Adhering Laps

These are available on the longitudinal seams of foil faced pipe sections and make the installation and sealing of the joints easy and effective.

3.7 Reinforcing Mesh

One of the most commonly used reinforcing material is galvanised wire netting. The main uses for the metallic reinforcement are with spray-applied fibrous insulation, wet-applied finishing compositions and wet-finishing cements.

3.8 Adhesives

Adhesives are used to form a bond between adjacent insulation elements or the insulation and the surface to be bonded. Most adhesives form a bond by evaporation of solvents which can be flammable and toxic; water-based adhesives are slow drying. Adequate "open time" should be allowed for evaporation of the solvent before making a bond between materials of low permeance.

Many adhesives do not continue to operate effectively at very low temperatures. If they are used as an aid to erection, mechanical support should also be provided. The manufactures advice on the effective temperature range of the adhesive should be sought. Wherever possible, additional mechanical support should be used in the form of banding, insulation pins or self-adhesive tapes.

When using adhesives it is very important to consult all available safety information before individual products are used.

3.9 Mastics

Refer to section 1.3 above.

Note: For further information on the above products including fixing techniques, health and safety etc., please refer to the manufacturer's catalogues and brochures.

4.0 Selection of Suitable Finishing Materials for a Range of Applications

Key Learning Points

- Selection of suitable finishing materials for a range of applications.
- Professional attitude towards finish.

Insulation finishes are applied over the insulation itself to provide, depending upon type used, a vapour barrier, weather protection, chemical resistance, protection from mechanical damage or improved aesthetics. The choice of finish may be dependent upon the type of insulation used and the cost implications for both materials and installation. Wet applied finishes will usually require a firmer base than self-supporting metal coverings which can be used with softer insulation materials. It is important that the installation of these materials is carried out according to the manufacturer's instructions and that a professional approach is taken towards the use of such materials.

4.1 Mechanical Abuse Coverings

Rigid Jacketing provides the strongest protection against mechanical abuse from personnel, equipment machinery, etc. The compressive strength of the insulation material should also be considered when designing for mechanical protection.

4.2 Corrosion and Fire Resistant Coverings

Corrosion protection can be applied to the insulation by the use of various jacket materials. The corrosive atmosphere must be determined and a compatible material selected. Mastics may be used in atmospheres that are damaging to jacketing materials.

4.3 Fire Resistance

Fire resistant finishes can be applied to insulation systems by the use of jacketing and/or mastics. Fire resistant materials are determined by flame spread and smoke generated.

4.4 Appearance Coverings and Finishes

Various coatings, finishing cements, fitting covers and jackets are chosen primarily for their appearance value in exposed areas.

4.5 Hygienic Coverings or Finishes

Coatings and jackets must present a smooth surface which resists fungal or bacterial growth in all areas. High temperature steam or high pressure water wash down conditions require jackets with high mechanical strengths and temperature ranges.

4.6 Properties of Protective Coverings or Finishes

The properties of jacketing and mastic materials that must be considered to meet the aforementioned functions are:

1. Chemical Compatibility – must be compatible with the insulation material over which they are applied and to the elements in the environment such as industrial chemicals, salt, air and ultraviolet or infrared light.
2. Resistance to Internal or External Movement – This property is significant if the covering or finish must absorb or compensate for thermal expansion and contraction of the insulation it covers i.e. (shrinkage of high temperature insulation) or if the system vibration must be considered.
3. Temperature range of the finish or covering – The temperature range must be compatible with the surface temperature of the insulation surface.
4. Vapour Permeability – The covering or finish should prevent the passage of moisture vapour into or through the insulation.

Summary

Insulation finishes are applied over the insulation itself to provide, depending upon type used, a vapour barrier, weather protection, chemical resistance, protection from mechanical damage or improved aesthetics. The choice of finish may be dependent upon the type of insulation used and the cost implications for both materials and installation. Fixings, adhesives and mechanical secure-ments are used in conjunction with the insulation finishes and cladding to ensure a secure overall assembly.

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