THERMAL INSULATION MANUFACTURERS & SUPPLIERS ASSOCIATION

THERMAL INSULATION OF INDUSTRIAL PROCESS PLANT, PIPING AND EQUIPMENT

Elements of design for consideration

TGN 2

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1. INTRODUCTION

Many industrial facilities involve the transportation, storage or handling of fluids and other materials at demanding temperatures (high or low) - e.g. furnaces, boilers, refrigeration plant. The correct application of thermal insulation can significantly reduce operating costs and may even prevent plant breakdown.

Of course the importance of energy efficiency has now gone beyond the requirements of cost saving and plant/personnel protection. With the adoption of the Kyoto Protocol in December 1997, the issue of minimising carbon dioxide emissions has become a key factor. Whilst carbon dioxide savings will depend on the source of primary energy as well as the amount of energy used, it is vital that every effort is made to save energy use in the industry sector. According to EU figures, industry accounted for nearly 20% of all emissions in 1990 (640 million tonnes). More appropriate insulation of high and low temperature installations can be a key contributor to the success of the Protocol and the welfare of our future environment.

Why Insulate?

Reasons for the use of insulation generally fall into one of the following categories:

- To save Energy - **Good Insulation Saves Money and CO_2 Emissions!**
- To help maintain process temperatures
- To protect site personnel against burns
- To prevent condensation forming
- To protect against frost
- To protect equipment from corrosion
- To provide fire protection
- To provide acoustic insulation

This article deals principally with the first six of the above, involving energy conservation.

2. WATER - THE COMMON ENEMY

Most commercially available thermal insulation materials work on the common principal of trapped air (or other gases) in much the same way as the clothes we wear or an animal's fur/feathers.

If this 'air' is replaced by water, then the ability of the material to insulate will be reduced. Furthermore, the risk of plant corrosion is dramatically increased.

If the plant is operating at temperatures below 0°C, then water vapour may pass through the insulation and quickly condense into water droplets and freeze. This may cause mechanical breakage of the insulation, corrosion of the plant and total breakdown of the insulation system or the equipment itself.

The common enemy of a good insulation system is water. A well thought out design will reduce the possibility of water penetration into the insulation system and make provision for any entrapped water to escape.

3. REGULATIONS

All thermal insulation materials, finishes, emulsions, adhesives, etc. should conform to the requirements of:

- National Buildings Regulations
- Local Authority
- Local Fire Brigade, Fire prevention department, etc.

4. INSTALLATION – GENERAL GUIDANCE

Good insulation practice starts with good housekeeping on site.

Operatives should ensure that insulation is stored in clean, dry conditions and, if applied outdoors, is protected from the elements until fully weatherproofed. Wet insulation should never be used.

Where insulation is applied in two or more layers, all joints, both longitudinal and circumferential, should be staggered. It is generally recommended insulation thicknesses greater than 75mm are applied in multi-layers.

The design of the insulation system should reflect future possible maintenance requirements.

Most insulation materials are easily damaged and consideration should be given to local site conditions, e.g. extreme climates, foot traffic, operational vehicular movements, etc.

Metal cladding used outdoors should have joints overlapped to form a watershed and be sealed with a suitable 'mastic'. If securing screws penetrate the metal finish, these should be sealed.

Where insulation is fixed by means of stick pins (insulation hangers), manufacturers' recommendations should be observed. Care should be taken to minimise the risk of injury to installers and plant operators.

5. VAPOUR BARRIERS

A vapour barrier should be applied to the outside (warm side) of all insulation applied to plant, equipment or structures operating at temperatures below that of the surrounding ambient air. The vapour barrier should take the form of an adequately sealed coating or sheet material that is resistant to the passage of water vapour. The vapour barrier should be applied at the same time as, or immediately after, fitting the insulation and before the plant is cooled.

The vapour barrier should comply with BS 5422 (table 1) and BS 5970 (table 7) and, within buildings, Building Regulations Class 0 definition.

The vapour barrier should not reduce the fire performance of the complete assembly of insulating and finishing materials from the limits specified.

Where insulation having a Class 0, aluminium foil facing vapour barrier is used, butt joints should be securely taped with 75mm wide (minimum) Class 0 aluminium foil tape. Particular attention should be paid to ensure integrity and continuity of the vapour barrier. Care should be taken at termination points, where any exposed insulation edges should be taped and returned to the equipment surface. Where insulation abuts supports, the vapour barrier should be taped to all inserts. Any stick pins protruding through the foil facing, should be securely taped with 100mm wide (minimum), Class 0 aluminium foil tape.

Where a liquid-applied ('mastic') vapour barrier is used (e.g. on cryogenic processes) joints should be filled with a suitable sealant to effectively isolate each section and hence localise water (and water vapour) ingress should any mechanical damage occur. Where insulation is stopped (i.e. at pipe support shoes, expansion joints, flanges, instrument penetrations, etc.) each end stop should be flashed continuously from the outer vapour barrier to the cold face with a suitable sealant.

It should be noted that liquid-applied finishes are divided into water vapour barriers for cold applications and vapour breathers for hot service. Each type may or may not be self weather proofing.

Metal cladding applied over insulation in hot service should have drain holes located at the lowest point to allow any entrapped water to escape.

Care should be taken to avoid puncturing the vapour barrier with screws or other fixings (e.g. those used to secure additional cladding). Banding and/or self-sealing pop rivets may be used for this purpose.

6. REMOVABLE ASSEMBLIES

For removable assemblies (e.g. valve boxes, manhole inspection covers, etc.) the insulation system and weatherproof finish (and vapour barrier if required) should be continuous and complete for each assembly. The system design should allow for removal of securing bolts without damage to the main insulation and its finish. The parts should be assembled using a non-setting sealing compound.

The insulation lining should be of same type and thickness as the adjoining plant.

Insulated, removable, stucco embossed aluminium boxes are commonly used for valves, strainers, flanges, unions, pump casings, etc. All metal edges should be works folded wherever practicable. Site-cut edges to be provided with continuous grommet surrounds. The boxes to be secured with quick release toggle fasteners to facilitate easy removal without disturbing the adjacent insulation.

The above notes are not intended to be exhaustive, but with consideration to these and similar aspects at design stage, it is possible to plan a cost effective and efficient system with a maximum life expectancy.

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