BUILDING DIGEST

CENTRAL BUILDING RESEARCH INSTITUTE, INDIA

SUITABILITY OF RICE-HUSK AND SAW-DUST AS A COLD STORAGE INSULATION

Introduction

Correct design of the thermal insulation system contributes to the efficient and economic operation of the cold storage space. A survey of some of the existing potato cold storages in Northern India was conducted by the Central Building Research Institute, Roorkee, to collect information on their structural and insulation practices with a view to evolve efficient and economical thermal designs. The survey indicates that commonly used insulating materials are saw-dust, rice-husk, expanded polystyrene and fibre glass. Since the material costs of saw-dust and rice-husk are much lower, most of the cold storage owners prefer to use these materials inspite of some inherent draw backs.

This disgest aims to provide the necessary background information on these cheaper types of insulation, vapour barrier design and correct method of application.

Types of Insulation

The requirement for thermal insulation in cold storage construction is to minimise initial cost of refrigeration plant and running expenses. The types of insulation used may broadly be classified as (a) fibrous materials such as glass wool, rock wool and fibre glass, (b) loose fill insulations like rice husk, saw dust and (c) cellular organic materials like polyurethene, expanded polystyrene and cork. The most important properties which a cold storage insulation should satisfy are, insulating efficiency, resistance to water vapour migration and durability at low temperatures. Although the intial cost of the insulating material is an important factor, due consideration should be given to various requirements such as safety, fire hazard.

Saw-Dust and Rice-Husk

Saw-dust and rice-husk are permeable hygroscopic class of insulations. They absorb moisture which migrates due to vapour pressure differential and condenses where the vapour pressure is greater than the saturation vapour pressure. Their thermal conductivity depends upon density, moisture content, mean temperature and direction of heat flow. There is an optimum density at which thermal conductivity is minimum. For saw-dust it lies in the range of 150 to 180 Kg/m^3 where as for rice husk it lies in the range of 140 to 170 Kg/m^3 (Table 1). Normal moisture content for air dry rice-husk and saw-dust at these densities varies form 3.5 to 6 per cent by weight. Once the moisture contents are known the correction factor, can be applied to the oven-dry thermal conductivity values (Table 2).

Table 1

Thermal conductivity values of Rice husk and saw dust insulation under oven dry condition

S. No.	Density Kg/m^3	Thermal Conductivity in Kcl/hr°C Saw Dust	Rice husk
1.	120	0.061	0.055
2.	140	0.054	0.051
3.	160	0.051	0.050
4.	180	0.052	0.054
5.	200	0.057	0.061

Table 2

Correction factor for moisture on thermal conductivity as given in table I

% Moisture contents by weight	Correction Factor Saw Dust	Rice Husk
1.0	1.06	1.05
2.5	1.15	1.12
5.0	1.30	1.25
10.0	1.50	1.41
15.0	1.65	1.62
20.0	1.71	1.70

There are considerable variations in thickness of insulation for wall, roof and floor sections employed in practice. Economical thickness of insulation to satisfy the requirement of the I. S. Code of Practice (I.S.661-1964) have been worked out. (Table 3).

Vapour Barrier

Vapour barrier has been defined as any material which has a water vapour transmission rate of less than 1 perm. It should always be applied on the hot side in sufficient thickness and with care.

Table 3

Variation in thickness of Insulation for potato Cold Stores

Thickness in Centimeter

Material	Walls	Roof	Floor
1. Saw dust and Rice husk	30 to 45 (25)	45 to 75 (30)	30 to 45 (20)
2. Cork	10 to 15	10 to 15	7.5 to 10
3. Expanded Polystyrene.	8 to 10	8 to 10	5 to 7
4. Fibre Glass	8 to 10	8 to 10	5 to 7

N. B. : **Values given in brackets are the recommended values.**

Film vapour barriers are best suited for most of the systems. Joints in the film should be properly sealed and their number should be kept minimum. Polyethylene in 600 to 800 gauge thickness may be used and is less expensive than aluminium foil laminates. The vapour transmission rate of a few typical vapour barriers are given in (Table 4)

Table 4

Vapour transmission rates of a few Vapour barriers and materials

Material	Permence in perms
1. polyethylene 800 gauge	0.04
2. —do— 600 ,,	0.06
3. —do— 400 ,,	0.10
4. Bitumen coating (2 coats)	0.10
5. Aluminium foil 100 gauge	0.04
6. Tarfelt (2 layers) with bitumen coating.	0.08
7. Asbestos sheet 6 mm	4.80
8. Plywood 6 mm	5.20
9. 1.25 cm. cement sand plaster	10.21
10. 20.0 cm brick work;	0.65

* Those materials with less than O.1 perms may be considered as effective vapour barriers.

Application

Careful application of the insulating material is very important since it will improve efficiency. The technique of application of various elements of the cold storage structure is described below :

(a) Walls

1. Wooden pegs of size 10 x 10 cm (or M. S Angle 4 x 4 cm) should be fixed on walls at a suitable spacing depending upon the size of the asbestos sheet or wooden planks available. Wooden or A.C. sheet framing on long walls to form a cavity for filling the insulation should first be constructed.
2. Clean by brush and dry the surface to be insulated.
3. Apply two coats of hot bitumen.
4. After the second coat has cooled down but is still sticky, fix 600 gauge polyethylene to the surface with 7.5 cm overlap.
5. Fix 3 mm thick A.C. sheet or wooden plank on cold side starting from the bottom.
6. Pour rice-husk or saw-dust in the cavity. Packing density in the range of 30 to 45 Kg/m² (for 25 cm insulation thickness) is preferred. It is not necessary to pack it tightly.
7. Continue the process of fillling and packing the insulating material in the same manner upto the ceiling level.
8. Seal all the joints on the cold side with (1:6) cement plaster.

(b) Floors

1. Clean the surface.
2. Apply hot bitumen on the surface and fix 2 layers of tarfelt with 7.5 cm overlap, sealing all joints with hot bitumen.

3. Fill the insulation perferably at a density ranging from 24 to 36 Kg/m² (20 cm thick insulation).

4. Fix 12.0 mm thick wooden planks or particle boards across the pegs on battens.

5. Apply 5.0 cm thick concrete screed.

(c) **Ceiling**

It is necessary to provide a false ceiling in case of sloping roofs.

1. Clean the surface of the wall below the roof upto a depth of 50 cm.

2. Apply 2 coats of hot bitumen.

3. After the second coat has cooled down but is still sticky fix 600 gauge thick polyethylene to the surface with 7.5 cm overlap and 20.0 cm projecting outwards.

4. Fix wooden planks or particle board or A.C. sheet on wooden battens and pour rice husk or saw dust with a density ranging from 36 to 54 Kg/m² (30 cm thick insulation).

5. Cover the upper surface of the insulation towards hot side with 400 gauge polyethylene sheet with 7.5 cm overlap. Seal all joints with hot bitumen.

6. Seal all joints on the cold side with (1:6) cement sand plaster.

For new cold storages summer months are suitable for applying the insulation. Before application, insulating materials must be dried in open air for at least 15 days to avoid excess moisture contents.

Although use of film vapour barrier involves additional cost, the total cost of the insulation system is comparatively less than the one used in the conventional method. The main saving is in labour and material. It also ensures slightly more storage space. Saw-dust and rice-husk require replacement after three years and proper provision should be made in the design to enable easy replacement.

There is a demand for short notes summarising available information on selected building topics for the use of Engineers and Architects in India. To meet the need, this Institute is bringing out a series of Building Digests from time to time and the present one is the 85th in the series. Readers are requested to send to the Institute their experience of adopting the suggestions given in this Digest.

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Prepared by : *K.N. Agarwal & V.V. Verma*
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