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REFRIGERATION AND AIR CONDITIONING ENGINEERS

REPORT ON THE INSULATION VALUE OF

INSULTEC

FOR AGGREGATED APPLICATORS OF AUSTRALIA P/L.

TEST REPORT COMPILED ON THE 30 MARCH 1990

1.0 INTRODUCTION

This technical appraisal has been prepared at the request of Mervin O'Keefe, for Aggregate Applicators of Australia Pty Ltd., to determine the reduction in temperature across a roof, gained by the application of Insultec to the exposed surface of the roof.

2.0 CASE STUDIES

We have taken the following case studies as examples of typical situations where Insultec may be applied. It has been assumed that the electricity used is charged at the Tariff 41 rate and that the reflectance of Insultec, remains constant over the period of the ten years

2.1 New Uninsulated Roof

For a new uninsulated metal deck roof the application of Insultec would give a reduction in air conditioning operating costs, of approximately \$3.38 per square metre per year. At an application rate of \$8.50 per square metre for a new roof, this would give a payback period in the order of 2.5 years.

2.2 Existing Uninsulated Roof

The savings gained in the air conditioning operating costs by the application of Insultec to this type of roof, would be the same as for new uninsulated roof \$3.38 per square metre, per year. Assuming the cost of cleaning the roof was a \$1.00 per square, the pay back period would be in the order of 2.8 years.

2.3 New Insulated Roof

For a new building with an insulated (fibre-glass or similar insulation) metal deck roof, the application of Insultec would give a reduction in air conditioning costs of approx. 0.85cents per sq metre per year. At an application cost of \$8.50 per sq metre for a new roof, this would give a payback period in the order of 8 years. However the additional protection to the metal, with Insultec against corrosion, pollution, contraction and expansion etc., would enhance the life of the roof and reduce the payback period by several years, although how this would be saved, would depend on several factors such as location, maintenance etc.

2.4 Existing Insulated Roof

The savings in air conditioning operating costs gained by the application of Insultec to this type of roof would be the same as for a new insulated roof (see 2.3 above).

2.5 Insultec V Other Insulation

Substantial field tests have been carried out by various experts in the field of Thermal Insulation, one such report showed that Insultec had a maximum daily temperature of 4C lower than fiberglass batts rated R2.5. the same report stated "It is concluded that a coating of Insultec on the roof of a building confers considerable benefit in maintaining the interior at a relatively low temperature.....Although the use of fiberglass enables the temperature to be kept more nearly constant between day and night it does not seem to be effective in keeping the maximum daytime temperature at a low value.

The experimental findings of the report indicate substantial benefits of the temperature trials by the use of Insultec against fiberglass batts rated R2.5. We are unable to confirm the results of this report as certain factors have not been adequately explained to us. We therefore believe the figures produced in our technical appraisal are conservative.

3.0 EXPERIMENTAL DATA

Dr. Julien Goldsmid has conducted experiments on Insultec to determine the imperial values of absorptance and reflectance of Insultec. Dr. Goldsmid found in his experiments that Insultec had an emissivity of 95% at Infra-Red wavelengths. Dr. Goldsmid considers that this high emissivity at infra red wavelengths was part of the reason for the better than expected performance of Insultec.

4.0 CALCULATIONS

4.1 General

Heat flow through a roof can be found by using well established heat transfer formulae.

4.2 Transmission Co-efficient

We will assume that the roof is constructed of corrugated metal, 50mm fiberglass insulation, an air gap and plasterboard false ceiling for the following calculations:

Air film	0.044
Insultec	0.000
Corrugated Iron	0.000
Fibreglass Insulation	1.576
Air Gap	0.217
Plasterboard	0.071
Air Film	0.162
TOTAL	2.07

$$U = R = 2.07 = 0.483$$

But we will use $U = 0.5 \text{ W/m}^2 \text{ }^{\circ}\text{C}$

Dr. Goldsmid states in his report that: " the temperature inside a closed building is determined by the properties of it's cladding. One such property is the thermal resistance per unit area, which is proportional to the thickness of the cladding material and inversely proportional to its thermal conductivity.

It can therefore be assumed that corrugated iron and the Insultec membrane (when applied) have no thermal resistance to the heat flow since they are both very thin. However, the lack of thermal resistance of Insultec is counted by the high degree of reflection.

We again refer to Dr. Goldsmid, wherein his practical experiments indicate a lower internal temperature for Insultec compared with fiberglass batts.

Carrier Method for Heat Load Estimating.

The Carrier Design manual provides a table of equivalent temperature differences for a roof with an absorptance of 0.9 and based on 35°C Dry Bulb outdoor design temperature. 25°C DB room temperature, 10°C daily range, January and 40° South latitude.0C

Brisbane is located on 27.5° South latitude and we are interested in the year long data so therefore corrected the information provided by Carrier.

4.3.1 Adjusted Equivalent Temperature Differences

The following table of figures is the corrected year long data for Brisbane area.

TABLE OF EQUIVALENT TEMPERATURE DIFFERENCES

<u>TIME</u>	<u>JAN</u>	<u>FEB</u>	<u>MAR</u>	<u>APR</u>	<u>MAY</u>	<u>JUN</u>	<u>DEC</u>
6 am	-0.51	-0.57	-0.80	-0.80	-0.60	-0.60	-0.53
7 am	-0.71	-0.67	-0.68	-0.83	-0.61	-0.61	-0.70
8 am	-0.41	-0.33	-0.28	-0.20	-0.16	-0.11	-0.40
9 am	-0.88	-0.72	-0.76	-0.81	-0.87	-0.89	-0.68
10 am	2.1	2.1	2.1	2.1	2.1	2.1	2.1
11 am	4.0	4.0	3.9	3.9	3.8	3.8	4.0
12 noon	6.9	6.8	6.7	6.6	6.5	6.4	6.9
1 pm	9.4	9.2	9.1	8.9	8.7	8.6	9.3
2 pm	11.7	11.5	11.3	11.0	10.7	10.5	11.8
3 pm	12.9	12.5	12.2	11.7	11.3	11.1	12.9
4 pm	13.8	13.1	12.7	11.9	11.4	11.1	13.8
5 pm	13.4	12.1	11.1	10.4	9.7	9.6	13.0
6 pm	11.7	9.8	8.9	8.9	8.9	8.9	11.0

5.0 COMPARISONS

For the purposes of comparing different room treatments, we will consider 1sq metre of roof.

<u>TREATMENT</u>	<u>Q (W/ =2)</u>	<u>% REDUCTION</u>
Bare roof	12.8	0
White roof	9.2	28.1
Insultec	6.9	46.1

It can be seen therefore, that a white paint treatment, is 33% less effective than Insultec.

In the comparison between Insultec and fiberglass insulation, the two products operate on separate principles, reflection is the major character of Insultec, thereby preventing heat from traveling through a metal roof into the relative area. Fiberglass insulation allows heat to penetrate through the metal roof but absorbs the heat before passing into the protected area. Again we report we have been unable to theoretically prove the better efficiency of Insultec, but the field tests that have been carried out by Dr. Goldsmid indicate up to 6°C lower temperatures inside a metal shed than a protection of fiberglass batts.