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Indian Institute of Technology
Powai, Bombay 400 076, India

IIT Bombay

Ref. :

Date :

Dr. J. K. Nayak
Dept. of Mech. Engrg.

December 14, 1995.

To
Mr. K.R. Bhatt
Director, Chitra Insulatec Pvt. Ltd.
"ASHISH" 2nd Floor,
C.G. Road, Swastik 4 Rd. Jn.,
Navrangpura,
Ahmedabad 380 009

Dear Mr. Bhatt,

Please find enclosed herewith our report concerning the consultancy work of insulatec paint. I may mention that the work got unduly delayed because of certain unavoidable reasons; I am extremely sorry for that.

The paint has got reasonably high emissivity and relatively low absorptivity for solar radiation; hence it would be suitable for cooling applications.

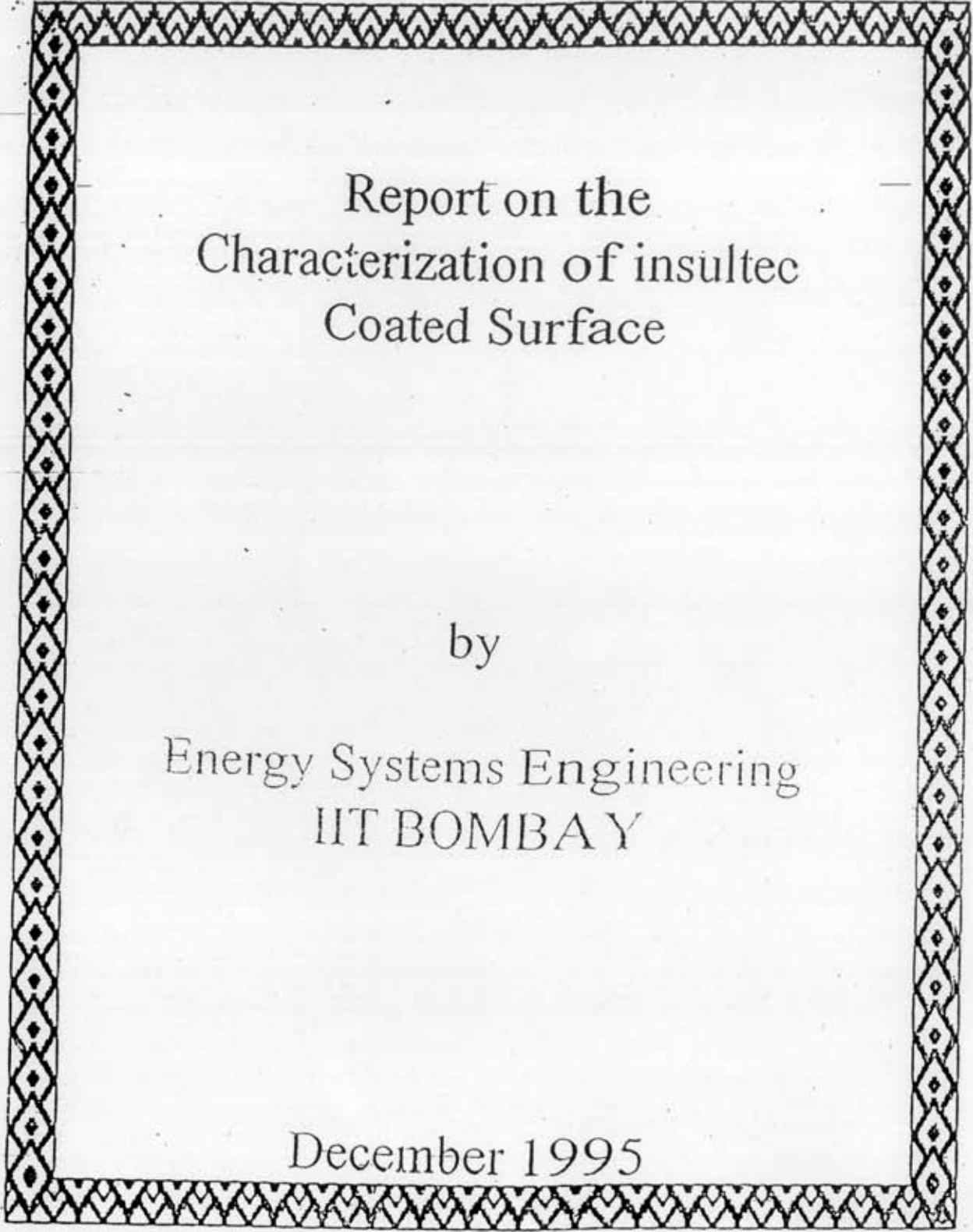
Thanking you and with regards,

Yours sincerely,

(J. K. Nayak)

Encl: Report

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Report on the
Characterization of insultec
Coated Surface

by

Energy Systems Engineering
IIT BOMBAY

December 1995

Emissivity Test:

The instrument used for emissivity measurement is Emissometer model AE of Devices and Services Co, USA. The materials to be tested are flat samples as per the requirement of the instrument. The detector portion of the sensor is heated so that the sample does not have to be heated. After allowing a warm-up period of about 30 minutes, the sensor is calibrated with samples of known emittance. Then the detector is used for actual measurements. The detector's voltage output is linear with emittance. The emissivity values referred to the room temperature conditions of the samples.

Absorptivity Test :

Albedometer CM14 of Kipp and Zonen, Netherlands is used for measuring reflectivity of surface. It has two pyranometers, one measures the incident radiation while the other records the reflected radiation. The ratio gives the reflectivity of the surface.

For opaque surfaces such as the insultec coated G.I. sheets, the absorptivity is calculated by subtracting reflectivity from unity.

IR Spectral Reflectivity Measurements :

Global Infrared source is used for IR spectral reflectivity measurements. The IR beam from the source is made to incident on the sample. The reflected radiation in various wavelength regions is measured. The spread of the spectral distribution of IR beam used in the experiment is from $2.5 \mu\text{m}$ to $25 \mu\text{m}$.

Heat Gain :

In order to find out the reduction in heat gain due to the paint, the temperatures attained by the painted and unpainted surfaces are recorded. Two G.I. plates of $30 \text{ cm} \times 30 \text{ cm}$ are taken; one is painted with insultec. The surfaces are kept horizontal and are exposed to solar radiation; Copper-Constantan thermocouples are fixed, one each to the center of the unexposed side of the plates. The unexposed sides are insulated by glass-wool insulation. The steady temperatures attained by the sheets are recorded; the corresponding solar radiation incident on a horizontal surface and shade ambient temperatures are also measured.

Results

1. For the measurement of the emissivity, two samples supplied by the company are tested; two samples are prepared by us using the paint given to us by the company. The emissivity of an unpainted surface (supplied to us by the company) is also measured. The values are presented in Table 1. The ambient temperature to which these measurements correspond, is also mentioned in the table.

Table 1: EMISSIVITY VALUES

Sample	Emissivity	Ambient temperature ($^{\circ}C$)
Painted		
1 *	0.89	29.5
2 *	0.90	29.5
3	0.88	29.5
4	0.89	29.5
unpainted	0.11	

* Samples 1 and 2 are supplied by the company.

It is seen that the average emissivity is 0.89 and it is much higher than that of an unpainted G.I. sheet.

2. The total absorptivity of the painted surface for solar radiation is 0.24 corresponding to an angle of incidence of 55° . The ratio of emissivity (ϵ) to absorptivity (α) is about 3.7. On the other hand, the absorptivity of an unpainted surface is found to be 0.74 for the same angle of incidence. Consequently, the ratio of emissivity to absorptivity is about 0.15. Clearly the paint is selective in nature.
3. The IR spectral reflectivity of painted surface is shown in Fig. 1 and 2 for two painted surfaces. The same result for an un-painted surface is shown in Fig. 3. It is seen that the IR reflectivity of the painted surface between wavelength regions of about $2.65 \mu m$ to $14.5 \mu m$ is more or less constant and it is much less than the corresponding values of unpainted surface; it suddenly shoots up beyond $14.5 \mu m$.

4. The temperatures attained by the painted and unpainted surfaces are shown in table 2. The corresponding solar radiation incident on the surfaces and the ambient temperatures are mentioned.

Table 2: MAXIMUM TEMPERATURES ATTAINED

Sr. No.	Solar Radiation on horizontal surface ($\frac{W}{m^2}$)	Ambient temperature ($^{\circ}C$)	Temperatures attained ($^{\circ}C$)	
			Unpainted	Painted
1	571	30.5	54.4	32.8
2	684	32.5	57.5	33.8
3	400	29.5	49.3	31.0

The temperature of the painted surface is significantly lower than that of unpainted surface. Clearly, heat gain would be much less in the former case.

Conclusion:

Based on the results obtained in the tests it is found that the absorptivity of insultec paint is low (about 0.24) and emissivity at about $30^{\circ}C$ is 0.89. The ratio of emissivity to absorptivity is about 3.7 and it is selective in nature. The temperature attained by a painted surface is much less than the unpainted one. It is only marginally higher than the ambient temperature. Clearly, heat gain through a painted surface would be much less.

It can be concluded that the paint can provide a significant benefit in reducing heat gain and would find application for cooling purposes.



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Solar Agni International
COMMUNITY AND ENERGY SYSTEMS
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Ref.....

Date.....

Insultec/Test/01/95

26th July 1995

RESEARCH
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INSTALLATION

TEST REPORT Continued

breast level. The exact magnitude will depend upon location, surface, orientation, type of material and details of enclosure.

In conditioned rooms, it will cut down solar part of sensible heat gain by almost seventy percent as compared to non coated surfaces.

FOR

SOLAR
WIND
BIOGAS
BIOMASS
&
WASTE
SYSTEMS

IN

COMMUNITY
DESIGN
&
PLANNING

By SOLAR AGNI INTERNATIONAL
COMMUNITY AND ENERGY SYSTEMS

[Signature]
(Dr. C.L. Gupta) 26/7/95

c/o Sri Aurobindo Ashram, Pondicherry - 605 002, India
Technical Director — Dr. C. L. Gupta



Solar Agni International

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TEST REPORT

SAMPLE - INSULTEC x 300 μ m thick on GI sheet applied by brush in 3 coats of 100 microns each as per application instructions by the proprietary manufacturer.

COMPANY - M/S Chitra Insultec Pvt (Ltd), "ASHISH", 2nd Floor, Swastik Junction, Navrangpura, AHMEDABAD 380 009.

RESULT - It is a mildly selective white surface with double action of solar reflector and high quality emitter. The value (ϵ/α) is :

$$\frac{\epsilon \text{ (low temperature heat radiation)}}{\alpha \text{ (solar radiation flux)}} = 4.6$$

EFFECT - * This will reduce ceiling temperature appreciably (particularly of sheet roofing) for all kinds of sun exposed surfaces.

- * In non-conditioned rooms, it will reduce the air temperature gradient from ceiling to floor considerably and also reduce the temperature at

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