Report on the Characterization of Insultec Coated Surface By Energy Systems Engineering IIT BOMBAY

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INTRODUCTION

Chitra Insultec Pvt. Ltd. Ahmedebad is marketing a new paint called “Insultec” India. In order to characterize surfaces coated with Insultec, the company contacted us and investigations were conducted in our laboratories.

SCOPE OF WORK

The scope of work consists of the following test:

1. Emissivity test (the total emissivity of samples at room temperature).

2. Absorptivity test (Absorptivity of surfaces for solar radiation).

3. Infrared spectral reflectivity between 2.5μm to about 25μm

4. Measurement of temperatures attainted by the surfaces. (painted and unpainted) when exposed to the sun.

TESTS:

The company supplied us samples of G.I. sheets with and without Insultec paint. The relevant tests were carried out in various laboratories of IIT Bombay.

EMMISIVITY TESTS:

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 detectors 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:

Globar Infrared source is used for IR spectral reflectivity measurements. The IR beam from the source is made from 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 μm to 25 μm.

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 30cm x 30cm 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 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 (^{0}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 0.889 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 55^0 . 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 unpainted surface is shown in Fig.3. It is seen that the IR reflectivity of the painted surface between wavelength regions of about 2.65 μm to 14.5 μm is more or less constant and it is much less than the corresponding values of unpainted surface; it suddenly shoots up to beyond 14.5 μm.

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

TABLE 2 MAXIMUM TEMPERATURES ATTAINED.

Sr. No.	Solar Radiation on horizontal surface W/m^2	Ambient temperature (^0C)	Temperatures attained (^0C)		lower
			Unpainted	Painted	by
1	571	30.5	54.4	32.8	22
2	684	32.5	57.5	33.8	24
3	400	29.5	49.3	31.0	18

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 30^0C 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 the heat gain and would find application for cooling purposes.