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REPORT: Performance of Insultec Membranes as Heat Rejecting Coatings

TO: Insulating Paint Pty Ltd., P.O. Box 87, Dubbo, NSW 2830

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Introduction

The range of products carrying the name "Insultec" consists of paint-like coatings that have been developed primarily to prevent the entry of heat from the environment into buildings. The products have been developed by Mr. Raymond Brooks, an experienced and innovative paint technologist.

It is well known that heat can pass from one place to another by three mechanisms, (1) radiation, (2) conduction and (3) convection. Insultec, when applied to the roof and walls of a building or other enclosure, reduces the temperature inside that enclosure by the following means:

- (1) Due to the specially selected pigments in the membrane, the surface becomes a good reflector of solar radiation (visible and near infrared) and a good radiator of terrestrial radiation (far infrared). This enables the building to radiate heat effectively while at the same time minimizing the influx of heat from the sun.
- (2) The selective radiative and reflective properties of Insultec explain no more than a fraction of its beneficial properties. Accordingly, I presume that, in spite of being relatively thin, an Insultec coating offers significant resistance to heat conduction. I understand that the constituents of Insultec were selected in the first place so that the membrane would offer substantial thermal resistance.
- (3) It is difficult to see any way in which Insultec could modify thermal convection through the surrounding air. Nevertheless, in the light of the outstanding behaviour of Insultec as a heat rejecting medium, I cannot dismiss the possibility that enhanced thermal convection may be playing some part.

Nature of the Tests

The initial tests on this type of product were carried out by Mr. Brooks and his assistants using small portable buildings. A comparison was made between buildings coated with the new membrane that had been developed by Mr. Brooks and other buildings that were either uncoated or coated with other finishes. The effect of internal thermally insulating batts on the same building was also investigated. I acted as an advisor in the setting up of the experiments to ensure that a fair comparison was being made. I advised, for example, on the location of the buildings with respect to one another and on the temperature monitoring.

Subsequently, I designed similar tests that were performed in association with colleagues in the School of Physics at the University of New South Wales. These tests used smaller enclosures with in-built heat capacity, the interior temperatures being monitored and recorded continuously. These experiments were aimed particularly at the testing of modified products that Mr. Brooks was developing over the years. Nevertheless, the real test of the membranes is their behaviour when applied to full size permanent buildings and Mr. Brooks has ensured that such field tests are performed as a matter of course, particularly when any modification is introduced.

Results of the tests:

As a result of the tests carried out both by Mr. Brooks and myself, I have become convinced of the remarkable properties of Insultec. This is in spite of the fact that I was most skeptical about the claims when I was first approached by Mr. Brooks.

The performance varies somewhat according to the external conditions. Thus, on cold, wet and cloudy day, there is little difference between the temperature of an uncoated enclosure and one that is coated with Insultec. However, under full sunlight with a clear sky and with a low humidity a building coated with Insultec would typically be well over 10C cooler than one which is not so coated. In my own experience, even when conditions were not so ideal (i.e. in central Sydney where the atmosphere is far from clean and the humidity is usually high) it is still possible to observe a typical temperature difference of 10C between Insultec coated and uncoated enclosures. In other words, the experiments with which I have been directly associated have confirmed all the claims made by Mr. Brooks about the thermal performance of his products.

A full statistical analysis of the results was not performed but it will be appreciated that such an analysis is not needed when an effect is very much greater than any estimated variance. Here, for example, when a lowering of temperature by say xC was observed, then a repeat experiment under the same conditions would yield a lowering of temperature of $(x \pm 1) \text{ C}$

Comparison with other products

I understand that Insulating Paint Pty Ltd are often asked to quote the R factor (if the thermal resistance rating) for Insultec so that this substance can be compared with other products such as insulating batts made of fibre glass or other fibrous materials. The use of an "R" value is unrealistic for Insultec since it does not rely solely on a reduction of thermal conduction for its operation. Suppose, for example, that an enclosure with no internal source of heat, were maintained in sunlit surroundings for an extended period of time. Even if the walls and roof were insulated with resistive batts, the interior of the enclosure would eventually reach the temperature of the external surface which would be substantially higher than the air temperature. On the other hand no matter how long one waited, an Insultec coated enclosure would remain at a much lower temperature since the external surface would stay cool, possibly even cooler than the surrounding air because of the selective radiating properties of the membrane. In other words, conventional heat insulating materials tend to delay the ingress of heat whereas Insultec also provides continuous rejection of heat.

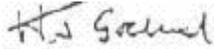
Of course it is possible to apply reflective coatings other than Insultec to building but, even if they are selective radiators in the same way as Insultec, ordinary paints are greatly inferior to Insultec in their overall heat rejection.

Modified Insultec Products.

The name "Insultec" refers not to a single product but to a range of products. Some differ from each other solely in their durability, their ease of application or their suitability for different substrates but others differ in their colour. I would expect the original white Insultec to give the best performance but I believe that tinted Insultec would still be effective and I understand that the company would not introduce modified Insultec until adequate tests, of the kind that I have described, had been performed.

Summary

I can confirm that the performance of Insultec membranes as heat reflecting coatings is substantially in accordance with the behaviour claimed by Mr. Ray Brooks and Insulating Paint Pty Ltd. the effect of applying Insultec to a typical building situated in full sunlight is to lower the interior temperature by some 10C or even more than this under favourable conditions, during the hottest part of the day.



H. J. Goldsmid.

Credentials of the Author of this report.

Dr. H.J. Goldsmid is Emeritus Professor of Experimental Physics at the University of NSW. He holds the degrees of Doctor of Philosophy and Doctor of Science at the University of London and is a fellow of the Australian Institute of Physics. He has experience as a Principal Research Scientist with the General Electric Co. Ltd and as Reader in Solid State Physics at the University of Bath. At present he is Chairman of the Australian National Standards Commission. He has acted as consultant to many overseas organisations including AERE, Harwell, De La Rue Ltd., IBM (UK) Ltd. Marlow Industries and the Italian Atomic Energy Commission.

As the author of over 150 publications, including text books, Dr. Goldsmid is recognized as an authority on the physics of materials, particularly in the fields of thermo-electricity and heat conductivity. In 1987 he was elected to Fellowship of the International Thermal Conductivity Conferences, an honour that is bestowed on only one or two specialists each year.