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Special Coatings Control Temperature of Structures

The problem: To control, by passive means, the temperature of structures in space flight, that are exposed to sunlight. Certain areas or components of such structures may also require selective temperature control to ensure the adequate functioning of the vehicle or its instrumentation.

The solution: Special coatings in the form of paints that exhibit controlled ratios of sunlight absorptivity to grey-body emissivity. A given coating having a very low ratio will maintain a structure or component at a relatively low temperature in brightest sunlight. Another coating having a high ratio will maintain a relatively high temperature in bright sunlight even though the ambient is quite low.

How it's done: One coating is a brilliant white paint having a pigment of 94% TiO_2 (rutile form) and 6% Al_2O_3 and SiO_2 . One part of lecithin is added per 150 parts of the dry pigment and the pigment is ground to a particle size of approximately 0.1 micron. The paint is made by mixing two parts by weight of a silicone resin vehicle with one part pigment. This thermal coating has an absorptivity-to-emissivity ratio of approximately 0.3:1 and is useful in maintaining surfaces at a low temperature in strong incident sunlight.

Another coating is aluminum in color and its pigment is 99% aluminum flakes with 1% impurities.

A minimum of 98.5% of the flakes is passed through a fine mesh (No. 325 on the Tyler Standard Screen Scale). A slurry is made by mixing the dry pigment with xylene. The slurry is mixed with silicone resin in proportion based upon 126 g of dry pigment to 1000 ml of resin. This coating has an absorptivity-to-emissivity ratio of approximately 1:1 and can be used to maintain surfaces at moderately warm temperatures in strong incident sunlight although the ambient is relatively low.

Notes:

1. Both of these finishes exhibit good resistance to ultraviolet radiation and do not discolor. Their absorptivity-to-emissivity ratios, therefore, remain constant over long exposure.
2. The silicone resin vehicle has a very low vapor pressure and so is not subject to serious "out-gassing" in a vacuum environment.

Patent status: Title to this invention has been waived under the provisions of the National Aeronautics and Space Act (42 U.S.C. 2457 (f)), to Ball Brothers Research Corporation, Boulder Industrial Park, Boulder, Colorado.

Source: Marion M. Fulk and Robert W. Mayer
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