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NASA TECH BRIEF

Marshall Space Flight Center

Improved Thermal Paint Formulation

The problem:

To develop a stable thermal-control coating with low solar energy absorption. Zinc oxide (ZnO) based silicone coatings were thought to be the best available in terms of hemispherical spectral reflectance stability to ultraviolet radiation. However, when tested, they were considerably less stable than predicted. This discrepancy was attributed to the fact that ZnO exhibits bleachable degradation in the infrared absorption region.

The solution:

The S-13G formulation, a potassium silicate-treated ZnO paint, which effectively stabilizes the pigment against ultraviolet-induced, bleachable degradation in the infrared region of the solar spectrum. This formulation provides the most satisfactory optical and physical characteristics, and permits the use of ZnO as a pigment in ultraviolet-stable coatings based upon polymethylsiloxane elastomers and resins. An emittance of 0.88 appears to be average compared to many black or colored paint systems, but slightly higher than most white systems. The low absorptance of 0.19 makes the low absorptance/emittance ratio of the material especially attractive.

How it's done:

Factors considered in developing S-13G included: (1) initial ZnO-silicate reaction parameters; (2) pigment filtration and silicate extraction (washing) procedure; (3) pigment drying and grinding procedures; (4) silicone paint manufacturing procedure; and (5) optimization of paint formula relative to pigment volume concentration, solvents employed, and catalyst concentration.

S-13G is prepared from SP500 zinc oxide, which is slurried with PS-7 potassium silicate at −196K (77°C) for 20 minutes. The slurry is diluted with distilled water, vacuum filtered, wrapped in aluminum foil, and allowed to sweat for 16 hours. The sweated pigment is then redispersed in distilled water and filtered two more times. The resulting cake is spread out to dry in an oven at −173K (100°C) for 16 hours, after which it is hand-mulled, sieved (80 mesh), and packaged, ready for manufacture into paint.

The RTV-602 silicone-based S-13G coating is prepared at 30% pigment-to-volume concentration by milling for 3 1/2 hours in a porcelain ball mill with a minimum of grinding media. The solvent system currently used is 50% toluene, 25% xylene, 15% isopropanol, and 10% n-butanol. Paints, catalyzed with SRC-05 catalyst at 0.4% by weight based on RTV-602 solids, cure to the touch in 4 to 6 hours and can be handled in 16 hours. The uncured paint possesses a shelf life of over 3 months.

The engineering values of solar absorptance, α, and hemispherical emittance, ϵ, currently quoted for 2.03 mm (8 mil) films of S-13G are 0.19 ± 0.02 and 0.88 ± 0.05, respectively. (To prevent heat buildup under radiation, α should be low and ϵ should be high.) The engineering value currently quoted for $\Delta\alpha$ is 0.03 for 1000 equivalent sun hours (ESH) of simulated space ultraviolet radiation employing *in situ* postexposure reflectance measurements and AH-6 lamp irradiation.

Notes:

1. Possible applications include coatings for optical instruments to minimize dimensional variations, and coatings to keep structures in the tropics cooler during sunlit hours.

(continued overleaf)

2. Requests for further information may be directed to:

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Patent status:

No patent action is contemplated by NASA.

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