Formula for the Removal and Remediation of Polychlorinated Biphenyls in Painted Structures

John F. Kennedy Space Center, Florida

An activated metal treatment system (AMTS) removes and destroys polychlorinated biphenyls (PCBs) found in painted structures or within the binding or caulking material on structures. It may be applied using a "paint-on and wipe-off" process that leaves the structure PCB-free and virtually unaltered in physical form. AMTS is used in conjunction with a solvent solution capable of donating hydrogen atoms. AMTS as a treatment technology has two functions: first, to extract PCBs from the material, and second, to degrade the extracted PCBs.

The process for removing PCBs from structures is accomplished as an independent step to the degradation process. The goal is to extract the PCBs out of the paint, without destroying the paint, and to partition the PCBs into an environmentally friendly solvent. The research to date indicates this can be accomplished within the first 24 hours of AMTS contact with the paint. PCBs are extremely hydrophobic and prefer to be in the AMTS over the hardened paint or binder material. The solvent selected must be used to open, but not to destroy, the paint's polymeric lattice structure, allowing pathways for PCB movement out of the paint and into the solvent. A number of solvent systems were tested and are available for use within the AMTS. The second process of the AMTS is the degradation or dehalogenation of the PCBs. The solvent selection for this process is limited to solvents that are capable of donating a hydrogen atom to the PCB structure.

Additional AMTS formulation properties that must be addressed for each site-specific application include viscosity and stability. The AMTS must be thick enough to remain where it is applied. Several thickening agents have been tested. Adding a stabilizing agent ensures that the AMTS will not evaporate and leave unprotected, activated metal exposed. During AMTS formulation testing, a number of reagents were evaluated to ensure the rate of dehalogenation was not inhibited by its addition to the system.

This work was done by Jacqueline Quinn and Kathleen Loftin of Kennedy Space Center and Cherie Geiger and Christian Clausen of Scientific Specialists Inc. For further information, contact the Kennedy Innovative Partnerships Program Office at (321) 867-5033. KSC-12878

Integrated Solar Concentrator and Shielded Radiator

Lyndon B. Johnson Space Center, Houston, Texas

A shielded radiator is integrated within a solar concentrator for applications that require protection from high ambient temperatures with little convective heat transfer. This innovation uses a reflective surface to deflect ambient thermal radiation, shielding the radiator. The interior of the shield is also reflective to provide a view factor to deep space. A key feature of the shield is the parabolic shape that focuses incoming solar radiation to a line above the radiator along the length of the trough. This keeps the solar energy from adding to the radiator load. By placing solar cells along this focal line, the concentration of solar energy reduces the number and mass of required cells.

By shielding the radiator, the effective reject temperature is much lower, allowing lower radiator temperatures. This is particularly important for lower-temperature processes, like habitat heat rejection and fuel cell operations where a high radiator temperature is not feasible. Adding the solar cells in the focal line uses the concentrating effect of the shield to advantage to accomplish two processes with a single device. This shield can be a deployable, lightweight Mylar structure for compact transport.

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Water Membrane Evaporator

Lyndon B. Johnson Space Center, Houston, Texas

A water membrane evaporator (WME) has been conceived and tested as an alternative to the contamination-sensitive and corrosion-prone evaporators currently used for dissipating heat from space vehicles. The WME consists mainly of the following components:

- An outer stainless-steel screen that provides structural support for the components mentioned next;
- Inside and in contact with the stainless-steel screen, a hydrophobic membrane that is permeable to water vapor;
- Inside and in contact with the hydrophobic membrane, a hydrophilic membrane that transports the liquid feedwater to the inner surface of the hydrophobic membrane;

- Inside and in contact with the hydrophilic membrane, an annular array of tubes through which flows the spacecraft coolant carrying the heat to be dissipated; and
- An inner exclusion tube that limits the volume of feedwater in the WME.

In operation, a pressurized feedwater reservoir is connected to the volume between the exclusion tube and the coolant tubes. Feedwater fills the volume, saturates the hydrophilic membrane, and is retained by the hydrophobic membrane. The outside of the WME is exposed to space vacuum. Heat from the spacecraft coolant is conducted through the tube walls and the water-saturated hydrophilic membrane to the liquid/vapor interface at the hydrophobic membrane, causing water to evaporate to space. Makeup water flows into the hydrophilic membrane through gaps between the coolant tubes.

This work was done by Eugene K. Ungar of Johnson Space Center and Jay C. Almlie of Hernandez Engineering. For further information, contact the JSC Innovation Partnerships Office at (281) 483-3809. MSC-23250-1