NASA TECH BRIEF

Ames Research Center

Phosphonium Chloride for Thermal Storage

Many systems used in space as well as on earth involve the storage of heat. For example, solar heating systems depend heavily upon the efficient storage of the heat collected when the sun shines and the restitution of stored heat at night or over those intervals when solar radiation is obscured.

Materials containing water of crystallization, or materials which have high heats of fusion or undergo reversible dissociation near room temperature, are found to be most efficient for storage of heat; cheap materials which have high densities and heat capacities are especially attractive.

The results of an extensive survey have indicated that scarcely any substance with a melting point between 50° and 150°F (10° and 66°C) has a heat of fusion greater than that of water. However, it has been found that phosphonium chloride, PH_4Cl, has a heat of fusion several times larger than that of water and thus it is appropriate to consider it a candidate material for thermal storage systems; a number of designs which take advantage of the thermal properties of phosphonium chloride have been studied. The following table contrasts some of the pertinent properties of phosphonium chloride and water.

Phosphonium chloride is formed at low temperature by combining equimolar quantities of phosphine (PH_3) and hydrogen chloride (HCl). Solid phosphonium chloride sublimes at pressures below 500 psia (3.5 MN/m^2) at room temperature; if the pressure is decreased, the substance dissociates into phosphine and hydrogen chloride. Systems employing the compound must be carefully designed to minimize the probability of failures which may lead to release of highly toxic phosphine.

Property	Water	PH_4Cl
Melting point, °C	0	28
Triple point	0.01°C, 4.5 mm Hg (599 N/m^2)	28°C, 48 atm (100 kN/m^2)
Specific gravity	1	1.7–2.0 (est.)
Heat of fusion, cal/g	80	180
Hazards	none	toxicity
Dissoc. pressure	none	1 atm (10^5 N/m^2) below 0°C

Note:

Requests for further information may be directed to:
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Patent status:

No patent action is contemplated by NASA.

Source: James G. Sutton, Philip F. Heimlich, and Edward H. Tepper of United Aircraft/Hamilton Standard Division under contract to Ames Research Center (ARC-10572)

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