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Intumescent Coatings as Fire Retardants

The development of fire-retardant coatings to protect surfaces which may be exposed to fire or extreme heat is a subject of intense interest to many industries. A fire-retardant paint has been developed which represents a new chemical approach for preparing intumescent coatings, and potentially, is very important to fire-prevention authorities.

The requirements for a superior coating include ease of application, suitability to a wide variety of surfaces and finishes, and stability over an extended period of time within a broad range of ambient temperature and humidity conditions.

These innovative coatings, when activated by the heat of a fire, react to form a thick, low-density, polymeric coating or char layer. Water vapor and sulphur dioxide are released during the intumescent reaction. Two fire-protection mechanisms thus become available: (1) the char layer retards the flow of heat, due to the extremely low thermal conductivity; and (2) water vapor and sulfur dioxide are released, providing fire-quenching properties. Still another mechanism functions in cases where the char, by virtue of its high oxidation resistance and low thermal conductivity, reaches a sufficiently high temperature to re-radiate much of the incident heat load.

The coatings consist of dispersions of selective salts of a nitro-amino-aromatic compound. Specifically, para-nitroaniline bisulfate and the ammonium salt of para-nitroaniline-ortho suphuric acid (2-amino-5-nitrobenzenesulphuric acid) are used. Suitable vehicles are cellulose nitrate of lacquer grade, a nitrile-phenolic modified rubber, or epoxy-polysulfide copolymer. Three separate formulations have been developed. A solvent is usually employed, such as methylethyl ketone, butyl acetate, or toluene, which renders the coatings suitably thin and which evaporates after the coatings are applied. Generally, the intumescent material is treated as insoluble in the vehicle, and is ground and dispersed in the vehicle and solvent like an ordinary coating pigment.

The char found on intumescence is better in terms of yield and physical properties than chars obtained from many previously known intumescent materials. Prior to intumescence, the coating has a density of 85 pounds per cubic foot. After intumescence, the density is approximately 0.3 pound per cubic foot. The linear expansion of the coatings ranges from 70 to 200 times the applied coating thickness.

Notes:

1. Despite the fact that the char yield has better physical properties than those of previously known intumescent materials, a problem of char retention in some environments still exists. High-velocity air flow and high acceleration can cause the very light char to fall off. One approach under study to resolve the problem is to include fibrous material in the coating mix.
2. One of the intumescent coatings has been shown to retain both mechanical and thermal properties when exposed to a high humidity/temperature environment. In addition, the other coatings retain some utility at limited humidity/temperature ranges.
3. A specific paint developed at Ames Research Center extended the time for the backface of a steel disk to reach a temperature of 400°F to more than 4 minutes. An unprotected disk reached 400°F in 21 seconds.
4. An interesting application of one of the coatings is in small compartments, where, in the event of a fire, the coating swells, filling the compartment or void completely. Experiments have shown that this technique will extinguish the fire.

(continued overleaf)

5. Requests for further information may be directed to:

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Patent status:

Inquiries about obtaining rights for the commercial use of this invention may be made to NASA, Code GP, Washington, D.C. 20546.

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