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3,539,377

**METHOD FOR COATING OXIDIZER PARTICLES
WITH A POLYMER**

Melvin E. Steinle, San Jose, Calif., assignor, by mesne assignments, to the United States of America as represented by the Secretary of the Army

No Drawing, Filed May 7, 1968, Ser. No. 727,340

Int. Cl. B44d 1/06, 1/44

U.S. Cl. 117—62.2

7 Claims

ABSTRACT OF THE DISCLOSURE

A process for coating compound particles with a polymer comprising, dissolving the polymer in a solvent, adding the particles to the resultant solution and agitating while drawing off the solvent. On the substantial removal of the solvent, a non-solvent is added, and the coated particles recovered.

This invention relates to an improved process for coating compound particles and more specifically to an improved process for coating a solid oxidizer with a polymer utilizing a solvent-non-solvent technique.

Unstable combustion of solid propellants has at times presented serious problems in the development of operational solid propellant propulsion systems. Studies on the structure of a combustion zone has presented evidence that there are significant exothermic processes which occur on and within the solid phase propellant. The results of these studies indicate the combustion process is controlled by two interdependent exothermic reaction zones near and on the surface of the propellant. One zone is in the gas phase at a finite distance away from the solid propellant surface and is characterized by interdiffusion of gasified oxidizer and fuel species and combustion of particles of ejected matter from the surface. The secondary reaction zone occurs on and within the solid propellant surface. The primary release in this zone probably occurs from chemical reactions between the initial decomposition products of a solid oxidizer and an adjacent fuel surface.

The interfacial reactions at and within the surface release sufficient heat to expel partially combusted products, pyrolysis products, and fuel and oxidizer fragments into the gas zone above the surface where they intermix and burn completely. The maximum flame temperature is reached in the luminous zone where the largest portion of heat is released. However, because of the relatively large mass flow perpendicular to the surface, only a small amount of heat released in the luminous flame zone reaches the surface to supplement the heat generated by the interfacial reactions.

One method for controlling the contributions of interfacial reactions in the combustion process is to change the reactivity of the interface by coating the oxidizer particles. Because coating materials are available for both increasing and decreasing this reactivity, this approach represents a convenient method for varying the interfacial reactivity over a relatively wide range.

The present invention relates to an improved process for coating an oxidizer with a polymer utilizing a solvent-non-solvent technique. In the process, the coating polymer is first dissolved in a suitable solvent and the required amount of oxidizer added to the solution with agitation. The solvent is then evaporated from the solution until the gel state of the polymer appears. After the solvent has been substantially removed, a second liquid, which is a non-solvent for the polymer, is slowly added to the polymer solution with agitation. This forces the polymer out of solution, thereby coating the particles of the oxidizer.

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A sufficient quantity of non-solvent is added to harden the polymer. The liquid phase is removed by decantation and the coated material removed.

It is an object of this invention to provide and disclose an improved process for coating particles of a compound with a polymer.

It is a further object of this invention to provide and disclose an improved process for coating an oxidizer, utilized in a solid propellant system, with a polymer.

Other objects and a fuller understanding of the invention may be ascertained from the following description and claims.

In the process, 6 grams of ethyl cellulose is first dissolved in 300 grams of methylene chloride. The OH groups in the cellulose utilized have been partly or completely replaced by ethoxyl groups. The solution and 394 grams of ammonium perchlorate having a particle size of about 190 microns are added to a mixer bowl and agitated on a modified Hobart mixer at ambient temperature. During agitation, a nitrogen flush is utilized to draw off the excess methylene chloride. When methylene chloride has been substantially removed and the mixture has the appearance of a thick gel, an initial portion of a total of 1000 ml. of Freon (1,1,2-trichloro-1,2,2-trifluoroethane) is added slowly with agitation to bring the ethyl cellulose out of solution and to coat the ammonium perchlorate. At this point, a small amount of a hardening agent, e.g., 0.06 gram of tetrabutyl titanate, may be added. After the mixture is agitated for a period of fifteen minutes, the agitation is stopped and the liquid phase removed. A second portion of Freon is added and the coated ammonium perchlorate agitated for a period of ten minutes. Subsequently, the liquid phase is removed and the recovered wet polymer coated ammonium perchlorate dried.

The polymer coated onto an ammonium perchlorate particle by this method does not react with the ammonium perchlorate and therefore cannot alter the oxidizer in any chemical manner. By removing most of the solvent prior to adding a non-solvent, the removed solvent is immediately ready for reuse in the next batch. Furthermore, the polymer in the gel state will precipitate out in the non-solvent much faster with most of the solvent removed. In addition, a much larger quantity of material can be coated in a smaller volume container in that when the non-solvent is added, most of the solvent has been removed.

In addition to ethyl cellulose, other polymers, e.g., Kel-F-800 (polychlorotrifluoroethylene) and Hypalon (chorosulfonated polyethylene) may be utilized to coat the ammonium perchlorate. When Kel-F-800 is used, e.g., Freon is utilized as the solvent and methylene chloride as the non-solvent. Any solvent-non-solvent system is operable provided the polymer utilized is soluble in one and insoluble in the other, respectively.

Although I have described my invention with a certain degree of particularity, it is understood that the foregoing is made to set forth the best mode contemplated in carrying out the invention and not as a limitation thereof, in that many substitutions may be made, for example, in the utilization of polymers, particles of compounds to be coated, solvents and non-solvents, without the vitiation of the operability of the invention.

Having described my invention, I claim:

1. A process for coating solid particles of an oxidizer with a polymer selected from the group consisting of ethyl cellulose, polychlorotrifluoroethylene and chlorosulfonated polyethylene comprising the steps of: dissolving the polymer in a solvent which is a nonsolvent in relation to the oxidizer, adding the oxidizer to the resultant solution, agitating and substantially removing all of the solvent until the mixture has the appearance of a

gel, adding a liquid which is a nonsolvent in relation to the polymer along with a polymer hardening agent, agitating, and recovering the coated oxidizer.

2. A process in accordance with claim 1 wherein the oxidizer is ammonium perchlorate.

3. A process in accordance with claim 2 wherein the polymer is ethyl cellulose.

4. A process in accordance with claim 3 wherein the hardening agent is tetrabutyl titanate.

5. A process in accordance with claim 4 wherein the solvent is methylene chloride and the non-solvent 1,1,2-trichloro-1,2,2-trifluoroethane.

6. A process in accordance with claim 2 wherein the polymer is polychlorotrifluoroethylene.

7. A process in accordance with claim 6 wherein the solvent is 1,1,2-trichloro-1,2,2-trifluoroethane and the non-solvent is methylene chloride.

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WILLIAM D. MARTIN, Primary Examiner

15 M. R. P. PERRONE, Jr., Assistant Examiner

U.S. Cl. X.R.

117—100, 109, 161; 149—7, 19, 76