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POLYBUTADIENE ROCKET PROPELLANT COMPOSITIONS

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This invention relates to new and useful improvements in rocket propellant compositions, and methods of preparing same.

Objects of the invention are: the provision of a rocket propellant composition having stable physical and chemical characteristics; the provision of a composition suitable for casting in a rocket case; the provision of a liquid or plastic composition that, following its introduction into the rocket case, may be subjected to a curing operation whereby there is effected a solidification or conversion of the composition into an elastomeric body having desirable combustion characteristics; the improvement in methods of preparing cast bodies of rocket propellant composition which involves casting the composite material directly in a rocket case and thereafter subjecting the material, in situ, to a heat curing operation to convert said material into an elastomeric body.

An important limitation on the availability of propellant compositions of matter suitable for loading in the motor compartments of rocket structures, consists in the susceptibility of the material to change in performance characteristics in response to ambient temperaure conditions. In view of this consideration it has been a goal, to develop rocket propellant compositions that would be independent of varying conditions encountered in the field.

It is known to prepare rocket propellant compositions in the form of shaped bodies, and to this end the compositions may be pressed or extruded or otherwise prepared in definite shapes and sizes, and in this prepared condition, loaded in rocket casings.

This invention relates to improved compositions which are adapted to direct casting in the rocket shell; and further relates to the method of production of a cast body of propellant that is predominately elastomeric, and that remains so, over a range of low temperatures, and to methods of casting and curing same.

According to the present invention it has been found possible to prepare homogeneous compositions having elastomeric properties, that satisfactorily retain their properties, even when subjected to low temperatures that render hard plastic substances brittle.

Compositions according to the present invention are prepared from a material having properties rendering it useful as an oxidizable fuel, and having further properties imparting to the composition, a characteristic ability to form an elastomeric body. This material in its initial form, may be a heat convertible polymer, or polymeric substance, and may consist of liquid polybutadiene. An example of a liquid polybutadiene, found suitable for the purpose, has the following physical and chemical properties:

Viscosity, Saybolt Furol Seconds at 100° F.	1500
Ash, percent	0.62
Volatile matter A 10 mm., 300° F., percent	0.39
Iodine number	About 360
Color, Gardner scale	14
Specific gravity, 60/60 F.	0.9138

It was found upon investigation that this polymer could be converted to a rubbery material at 140° F. to 158° F.

An oxidizing agent is incorporated with the fuel material and for this purpose a compound containing available oxygen may be used. Especially suitable are inorganic nitrates or perchlorates such as, ammonium nitrate, potassium perchlorate, or ammonium perchlorate. The oxidizing agents may be incorporated either as single compounds, or in the form of admixture of several oxygen-yielding compounds.

Additional suitable materials may be incorporated in the composition, as, for example, lubricants, coloring agents, curing agents, or cure activators.

The following example illustrates a specific embodiment of a composition according to the invention:

	Grams	Percent
Ammonium Perchlorate	950.00	65.9
Liquid Polybutadiene	425.00	29.47
Stearic Acid	4.25	0.295
Zinc Dibutyl Dithiocarbamate	21.25	1.474
Sulfur	40.25	2.792
Carbon Black	1.00	.069
		100.000

An internal burning grain containing this fuel, having a six pointed star perforation, was cast directly into a rocket case. The rocket was cured for 72 hours at 158° F. The rocket case had been coated on the inside with an adhesive, and the end surfaces of the grain were coated with the same material.

The rocket was fired at K_n=350. It burned for 3.5 seconds at an average uncorrected chamber pressure of 285 p.s.i. with a maximum uncorrected chamber pressure of 305 p.s.i.

The example cited is not intended to restrict this invention to the stated proportions of components, or to the particular oxidizer used, or to the above combination of fuel, oxidizer, and chemicals useful in the conversion of the polymer to an elastomer. Other combinations of sulfur and rubber accelerators, and other proportions have been found that render feasible the conversion at higher and lower temperatures. The properties of the polymer listed above are descriptive only and are not intended to restrict the invention to this particular polymer. The coating material used on the inside of the rocket case, and on the end surfaces of the grain, may consist of any material adapted to the purpose, and having suitable adhesive properties. Where propellant compositions involving constituents other than those specifically exemplified, are employed, the temperatures and times necessary for effectively curing the compositions, while generally within the limits above set forth, will be subject to adjustments that can be determined by experiment, for optimum results.

Having thus for purposes of illustration described an example of the invention it will be understood that same is not limited by the terms of description, but what we claim is:

1. A rocket propellent grain consisting essentially of a homogeneous elastomeric mixture in cured solid state of about 30% polybutadiene and about 66% of an oxidizing agent selected from the group consisting of inorganic salts of nitric acid, inorganic salts of perchloric acid, and mixtures thereof.

2. A rocket propellent composition consisting essentially of a homogeneous mixture in cured solid state of about 66 percent of an oxidizer selected from the group consisting of inorganic salts of nitric acid, inorganic salts of perchloric acid, and mixtures thereof, about 30 percent polybutadiene stearic acid and zinc dibutyl dithiocarbamate.

3. A rocket propellent composition in cured solid state containing the following ingredients in the following proportions:

	Percent
Ammonium perchlorate	65.900
Liquid polybutadiene	29.470
Stearic acid	0.295
Zinc dibutyl dithiocarbamate	1.474
Sulfur	2.792
Carbon black	0.069

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