SYNTHESIS AND CHARACTERIZATION OF NOVEL OXIDIZER FOR COMPOSITE PROPELLANTS

By

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IN THE NAME OF ALLAH
THE COMPASSIONATE
THE MERCIFUL

Praise to be Thee; we do not know anything except What Thou hast made known to us: indeed Thou art the best knower, the wisest.

(Al-Quran 2-32)

DEDICATION

To

All Those Who Sacrifice Their Present for the Better Future of Pakistan!

ABSTARCT

Enhanced performance of propellants and explosives is the most sought-after attribute for ambitious research progress in the field of high energy materials. Defense and space sector priorities have always kept research and development efforts active in the area of propellants and explosives. The use of chlorine free high performance oxidizers in solid rocket propellants may reduce launch cost while producing less polluting exhaust products. Considerable effort has been expended in the search for high energy oxidizers that are useful in rocket propellant formulation. These oxidizers should be dense, thermally stable and relatively shock insensitive. It has now been found that hydrazinium nitformate (HNF) has the required properties. Nitroform is a very valuable compound for use in the preparation of HNF due to its high oxygen contents and labile hydrogen atom. Many methods have been tried to obtain HNF of desired quality.

Present work deals with a new method of producing trinitromethane (nitroform) by the nitration of isopropyl alcohol with a mixture of fuming nitric acid and concentrated sulphuric acid and the isolation of nitroform with the help of dichloroethane. To the best of our knowledge these two approaches have been employed for the first time. Further the present work relates to a method of preparing HNF by the addition of 96% hydrazine to a solution of nitroform in dichloroethane followed by the purification of the product by means of recrystallization, a solution being made in methanol. Various instrumental techniques have been employed to characterize HNF prepared during the present work, which confirm the purity of the compound.

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ABBREVIATIONS

ADN	ammonium dinitramide
Al	aluminium
AN	ammonium nitrate
AP	ammonium perchlorate
BAMO	poly 3,3-bis(azidomethyl) oxetane
CMDB	composite modified double base
CTPB	carboxyl-terminated polybutadiene
DCE	dichloroethane
DTA	differential thermal analysis
DOA	dioctyl adipate
DSC	Differential Scanning Calorimeter
FTIR	Fourier transform infrared spectroscopy
GAP	Glycidyl Azide Polymer
HAN	hydroxylammonium nitrate
HAP	hydroxylammonium perchlorate
HMDI	hexamethylene diisocyanate
HMX	tetraethylene tetranitramine
HNF	Hydrazinium Nitroformate
HNIW	Hexanitrohexaazaisowurtzitane, (CL-20)
HTPB	hydroxy-terminated polybutadiene
I_{sp}	specific impulse
I_{vac}	specific impulse in vacuum
IDP	iso decyl pelargonate
IPDI	iso phoron di-iso-cyanate
LD_{50}	Lethal Doses for 50% of the cases
NG	nitroglycerine
NC	nitrocellulose
NF	nitroform (trinitromethane)
NIMMO	nitramethylmethoxetane
NP	nitronium perchlorate
PBAA	polybutadiene-acrylic acid
PBAN	acrylic acid, acrylonitrile, and butadiene terpolymer
PGN	polyglycidal nitrate
PolyGlyn	polyglycidal nitrate
PLN	polynitromethyl oxetane
RDX	Cyclotrimethylene trinitramine
T_{gl}	glass transition temperature
T_{mp}	melting point temperature
TGA	thermogravimetric analysis
TMD	Theoretical Maximum Density
TMETN	trimethylolethane trinitrate