Thermal and Kinetic Studies of Octahydro-1, 3, 5, 7-tetranitro-1, 3, 5, 7-tetrazocine (HMX)

A Thesis Submitted to the Department of Chemical Engineering, School of Chemical and Materials Engineering(SCME),NUST, Islamabad, in the partial fulfillment of the requirements for the degree of

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In

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Submitted by

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Declaration

I Amir Mukhtar, hereby declare that I have produced the work presented in this thesis, during the scheduled period of study. I also declare that I have not taken any material from any source except referred to wherever due. If a violation of HEC rules on research has occurred in this thesis, I shall be liable to punishable action under the plagiarism rules of the HEC.

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Certificate

It is certified that Amir Mukhtar has carried out all the work related to thisthesis under my supervision at the School of Chemical and Materials Engineering (SCME) National University of Sciences and Technology (NUST).

Supervisor

Prof. Dr. Abdul Qadeer Malik

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IN THE NAME OF ALLAH

THE MOST MERCIFUL

THE MOST BENEFICIENT

Our Lord!

Grant us good in this world and good in

the life to come and keep us safe from the torment of fire.

(2:201)

DEDICATED TO MY

Dearest Parents and Pakistan Army

ABSTRACT

HMX is a very powerful secondary high explosive used in specific military munitions due to its exceptional high velocity of detonation and stability at high temperatures. It is produced as a white crytalline solid and commonly used as polymer bonded explosives filler. Research on thermal decomposition of Octogen has been under progress for quite many years. Since it's a very powerful explosive used in shaped charges mainly and other important military applications. We carried out thermal and kinetic characterization of this explosive to study its thermal decomposition behavior as well as its kinetic parameters. We studied two different samples, a pure fresh one and a 15 years old HMX sample by using Diamond TGA/DTA thermal analyzer and FTIR. Thermal decomposition behavior and the kinetics of both the samples were studied and compared which was also found in line with the values of pure sample given in literature. This work is of exceptional nature since we could not find any such work done where two different sample of HMX were characterized by thermal analysis. The upshot of the present work is that, the HMX explosive is safe and reliable in high temperature climate storage conditions for long duration. The military munitions be used reliably which have been in storage for long.

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(Amir Mukhtar)

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ABBREVIATIONS

HMX	High Melting Explosive (Cyclotetramethylenetetranitarmine)
TGA	Thermo gravimetric Analysis
DTA	Differential Thermal Analysis
PBX	Plastic Bonded Explosives
RDX	Royal Development Explosive (Cyclotrimethylenetrinitramine)
Ea	Activation Energy
STA	Simultaneous Thermal Analysis
NVR	Non-Volatile Residue
ICTA	International Confederation of Thermal Analysis
FT-IR	Fourier Transform Infrared Transmission Spectroscopy