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(12) # EUROPEAN PATENT APPLICATION

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(54) **High-density insensitive explosives.**

(57) High-density insensitive explosives including a binder and an oxidizer wherein the binder is selected from a halogenated polymer, a halogenated plasticizer and mixtures thereof. Such explosives display enhanced performance with decreased sensitivity.

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BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to explosive compositions of matter and is particularly directed to explosive compositions including halogenated components and organic nitramine compounds and other energetic chemical groups.

2. Description of Related Art

High energy explosives and propellants such as disclosed in U.S. Patent No. 5,045,132 are generally formulated to include a high energy binder and oxidizer, together with suitable plasticizers. These ingredients must have a favorable preferably positive heat of formation and be oxygen-rich in order for high performance to be met. Moreover, these ingredients must have thermal and shock stability in order to permit safe storage and handling.

The disadvantages of known explosive compositions such as thermal and shock instability are overcome with the new explosive compositions of the present invention.

BRIEF SUMMARY AND OBJECTS OF THE INVENTION

To improve the high energy potential and improve insensitivity of explosive compositions when the heat release factor is reduced, the present invention contemplates performance-improved, less detonation-sensitive formulations.

The advantages of the present invention are realized in explosive formulations utilizing a select binder and oxidizer in combination with high-energy constituents.

Accordingly, an object of the present invention is to provide improved high-energy explosive compositions or formulations.

Another object of the present invention is to provide high-energy explosive compositions having a lessened detonation sensitivity and enhanced performance.

These and other objects and features of the present invention will be apparent from the following detailed description.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a graph of the plate dent of the theoretical detonation velocity times the explosive mass for a selection of explosive materials.

DETAILED DESCRIPTION OF THE INVENTION

According to the present invention, new cast curable insensitive explosives are provided comprising select oxidizers with high density binders which binder constituent replaces a portion of the sensitive explosive. The binder constitutent further comprises a select halogenated polymer, a halogenated plasticizer, glycidyl azide polymer (U.S. Patent No. 4,268,450), and mixtures thereof. Additional ingredients, including a curative and a cure catalyst may be included in the explosive formulation. Substitution of all or a portion of the sensitive explosive with an elastomeric binder decreases the overall brittleness of the grain, leading to further reduced sensitivity of the explosive. In addition, select levels of binder allow for production of void-free grains, further reducing the sensitivity of the explosive grain by elimination of hot-spot sources of ignition.

The performance of an explosive is proportional to the square of the density of the explosive grain thus, the binder fraction should have a high density in order to maintain performance. A series of explosive formulations were prepared containing select halogenated ingredients to provide progressively higher density explosives. As can be seen in figure 1, a smooth linear correlation between performance improvement (related to the increase in density) and plate dent was observed.

The high-energy explosive compositions of the present invention include a binder and a nitramine oxidizer wherein the binder is selected from a halogenated polymer, a halogenated plasticizer and mixtures thereof with optionally a curative such as biuret trimer of hexamethylene diisocyanate (polyisocyanate curative).

Oxidizers which may be utilized in the high-energy explosive taught herein preferably include:
cyclotetramethylenetetranitramine (HMX),
1,3,5-trinitro-1,3,5-triazacyclohexane (RDX),
1,7-dibromo-2,4,6-trinitrazaheptane (DBTH),
1,9-dibromo-2,4,6,8-tetranitrazanonane (DBTN), or
bis(2-bromo-2,2-dinitroethyl)nitramine (BRDNEN).

The polymeric constituent of the binder may be selected from poly(epibromohydrin) (PEBH), 2,2-dinitro-2-bromoethyl glycidyl ether and poly(epichlorohydrin) (PECH), or mixtures thereof.

Plasticizers which may be utilized in the high-energy explosive compositions taught herein preferably include polybromo-aliphatic esters such as 2,3-dibromopropyl α-bromoacetate, polynitro-bromo esters such as 2-bromo-2,2-dinitroethyl α-bromoacetate, the bis(bromoacetate) ester of 2,2-dinitro-1,3-propanediol, the mono-ester of 2,2-dinitropropanol, trimethylolethane trinitrate (TMETN), bis(2-chloro-2,2-dinitroethyl) formal (CLEFO), and mixtures thereof.

Specific formulations of high-energy explosive compostions and their physical characteristics such as density, electrostatic detonation (ESD), and the like, according to the present invention are provided in the TABLE I and II respectively.

TABLE I

EXPLOSIVE FORMULATIONS

(Weight Percent)

INGREDIENTS	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
GAP	6.24	8.52			8.52	8.52	8.52	8.52	7.09	
N-100	1.09	1.48	1.22	1.69	1.48	1.48	1.48	1.48	1.24	1.50
SYEP		20.00			20.00	20.00	20.00	20.00		
TMETN	14.67							16.67		
PECH			6.78							8.50
PEBH				8.31						
TBP				10.00						
HMX A	54.60	49.00	56.00	56.00	42.00	35.00	42.00	35.00	52.50	
HMX E	16.90	21.00	24.00	24.00	18.00	15.00	18.00	15.00	22.50	
TEFLON (23)	6.50									
1205					10.00	20.00				
CLEFD			12.00							15.00
CDNEN										75.00

TABLE II

EXPLOSIVE FORMULATIONS

(Physical Properties)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
IMPACT (In-lbs)	50	40	35	40	45	35	35	25	35	
FRICTION (kg)	>36	>36	>36	>36	>24<36	>16.8	>36	>36	>36	
ESD, joules	>18.75	<18.75	<18.75	<12.5			>18.7	>18.7	>18.7	
DENSITY He Dens	1.73	1.785	1.77	1.88	1.86	1.96				
DENSITY Theo	1.776	1.765	1.808	1.915	1.869	1.986				
Dv (THEO) M/S	7970	8450	8490	8410	8534	8624				
DENSITY (g/cc)	1.734	1.729	1.787	1.850	1.82	1.96	1.897	1.805	1.744	

Obviously, numerous variations and modifications may be made without departing from the present invention. Accordingly, it should be clearly understood that the embodiments of the present invention disclosed hereinabove are not intended to limit the scope of the present invention.

Claims

1. An explosive composition including a binder and an oxidizer wherein the binder is selected from a halogenated polymer, a halogenated plasticizer, and mixtures thereof.

2. An explosive composition according to Claim 1 wherein the halogenated polymer is a brominated polymer.

3. An explosive composition according to claim 1 wherein the halogenated plasticizer is a brominated plasticizer.

4. An explosive composition according to Claim 1 wherein the oxidizer is:
   cyclotetramethylenetetranitramine (HMX),
   1,3,5-trinitro-1,3,5-triazacyclohexane (RDX),
   1,7-dibromo-2,4,6-trinitrazaheptane (DBTH),
   1,9-dibromo-2,4,6,8-tetranitrazanonane (DBTN), or
   bis(2-bromo-2,2-dinitroethyl)nitramine (BRDNEN).

5. An explosive composition according to Claim 1 wherein the halogenated polymer is poly-(epibromohydrin) (PEBH).

6. An explosive composition according to Claim 1 wherein the halogenated polymer is poly(2,2-dinitro-2-bromoethyl glycidyl ether).

7. An explosive composition according to Claim 1 wherein the halogenated plasticizer is a polybromo-aliphatic ester.

8. An explosive composition according to Claim 1 wherein the halogenated plasticizer is a polynitro-bromo ester.

9. An explosive composition according to Claim 1 wherein the halogenated plasticizer is 2,3-dibromopropyl-α-bromoacetate.

10. An explosive composition according to Claim 1 wherein the halogenated plasticizer is the bis-(bromoacetate)ester of 2,2-dinitro-1,3-propanediol.

11. An explosive composition according to Claim 1 wherein the halogenated plasticizer is the mono-bromoacetate ester of 2,2-dinitropropanol.

12. A cast-cure insensitive explosive composition including a binder and an oxidizer wherein the binder is selected from a halogenated polymer, a halogenated plasticizer, and mixtures thereof.

13. A cast-cure insensitive explosive composition according to Claim 12 wherein the halogenated polymer is a brominated polymer.

14. A cast-cure insensitive explosive composition according to claim 12 wherein the halogenated plasticizer is a brominated plasticizer.

15. A cast-cure insensitive explosive composition according to Claim 12 wherein the oxidizer is:
   cyclotetramethylenetetranitramine (HMX),
   1,3,5-trinitro-1,3,5-triazacyclohexane (RDX),
   1,7-dibromo-2,4,6-trinitrazaheptane (DBTH),
   1,9-dibromo-2,4,6,8-tetranitrazanonane (DBTN), or
   bis(2-bromo-2,2-dinitroethyl)nitramine (BRDNEN).

16. A cast-cure insensitive explosive composition according to Claim 12 wherein the halogenated polymer is poly(epibromohydrin) (PEBH).

17. A cast-cure insensitive explosive composition according to Claim 12 wherein the halogenated polymer is poly(2,2-dinitro-2-bromoethyl glycidyl ether).

18. A cast-cure insensitive explosive composition according to Claim 12 wherein the halogenated plasticizer is a polybromo-aliphatic ester.

19. A cast-cure insensitive explosive composition according to Claim 12 wherein the halogenated plasticizer is a polynitro-bromo ester.

20. A cast-cure insensitive explosive composition according to Claim 12 wherein the halogenated plasticizer is 2,3-dibromopropyl-α-bromoacetate.

21. A cast-cure insensitive explosive composition according to Claim 12 wherein the halogenated plasticizer is the bis(bromoacetate)ester of 2,2-dinitro-1,3-propanediol.

22. A cast-cure insensitive explosive composition according to Claim 12 wherein the halogenated plasticizer is the mono-bromoacetate ester of 2,2-dinitropropanol.

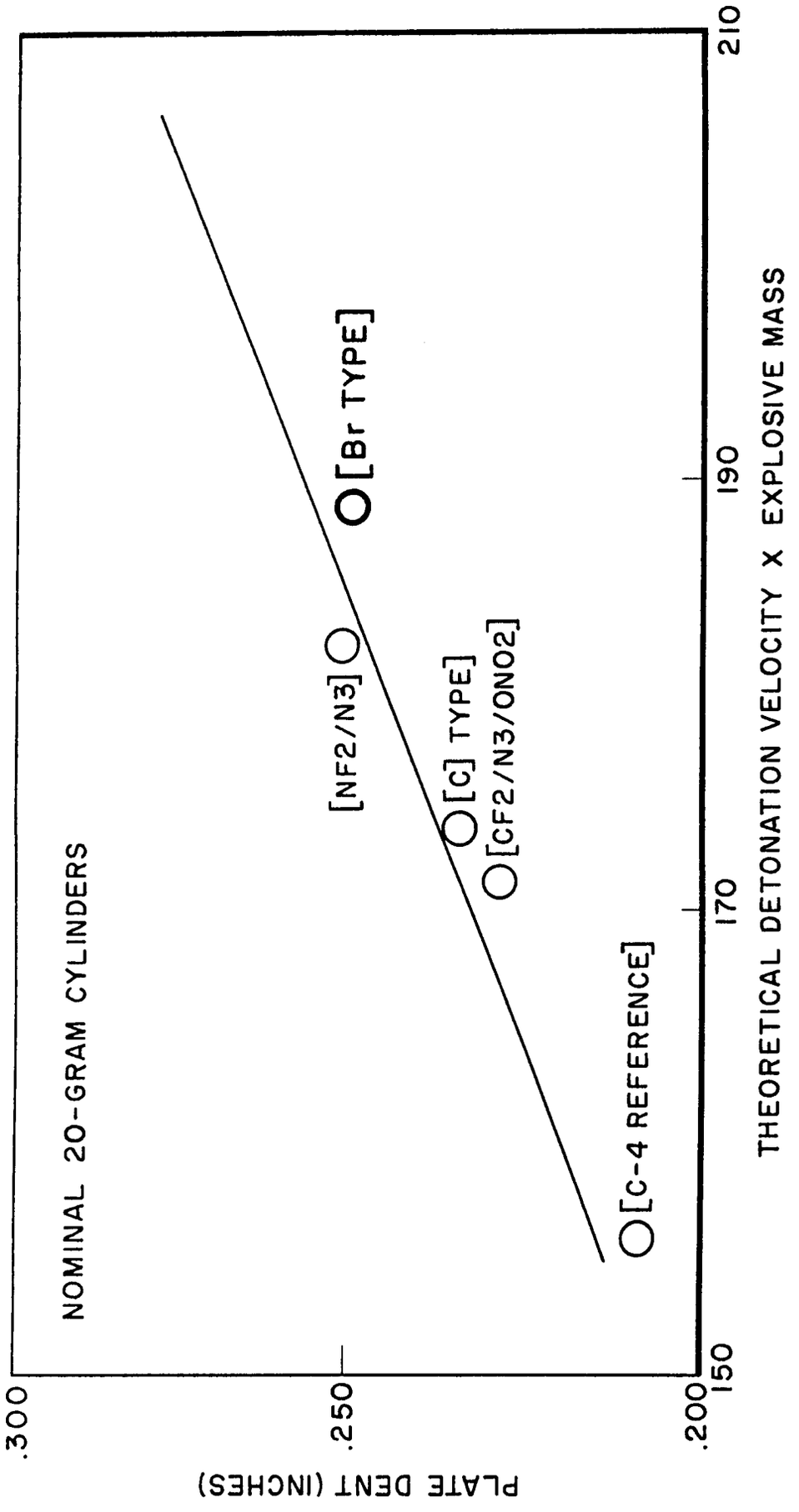
PLATE DENT (INCHES)
.300
.250
.200
150
170
190
210
THEORETICAL DETONATION VELOCITY X EXPLOSIVE MASS
NOMINAL 20-GRAM CYLINDERS
[NF2/N3]
[Br TYPE]
[C] TYPE
[CF2/N3/ONO2]
[C-4 REFERENCE]

Fig. 1.

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 93 11 6979

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.5)
X	US-A-5 049 213 (M.L. CHAN ET AL.) * column 1, line 45 - line 65; claims * * column 3, line 48 - column 4, line 40 *	1,4,12, 15	C06B45/10 C06B25/34
X	US-A-3 907 907 (M.B. FRANKEL ET AL.) * column 2, line 1 - line 32; claims * * column 8, line 45 - column 9, line 5 *	1,4,12, 15	
X	US-A-4 988 397 (H.G. ADOLPH ET AL.) * column 2, line 4 - line 13 * * column 5, line 47 - column 6, line 8; claims *	1,4,12, 15	
X	US-A-3 808 182 (H.G. ADOLPH) * column 1, line 23 - line 59; claims *	1,2,12, 13	
X	US-A-4 341 712 (M.B. FRANKEL ET AL.) * column 1, line 20 - line 26; claims * * column 4, line 3 - line 8 *	1,3	TECHNICAL FIELDS SEARCHED (Int.Cl.5) C06B
A	US-A-3 399 235 (M.B. FRANKEL) * column 3, line 67 - column 4, line 10; claims; table 1 *	1,12	
A	GB-A-1 195 558 (NORTH AMERICAN ROCKWELL CORPORATION) * page 1, line 9 - line 26; claims *	1,12	
X	US-A-3 488 396 (M.B.FRANKEL ET AL.) * column 1, line 57 - line 61; claims *	1,2,12, 13	

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	4 July 1994	Schut, R

CATEGORY OF CITED DOCUMENTS

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DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.5)
X	US-A-3 590 067 (M.H. GOLD ET AL.) * column 1, paragraph 31 - column 2, line 36 * * column 8, line 69 - column 9, line 15 * -----	1,3,12, 14	
			TECHNICAL FIELDS SEARCHED (Int.Cl.5)

The present search report has been drawn up for all claims

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D : document cited in the application
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