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RESEARCH ARTICLE

INVESTIGATIVE ANALYSIS OF IED BLAST IN MANIPUR

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ABSTRACT

Central Forensic Science Laboratory Kolkata receives huge number of exhibits of pre /post blast explosive mixture and parts of Improvised Explosive Devices (IEDs) from eastern and north-eastern parts of India for examination. In most of the cases low or inorganic explosive mixture were used. Forensic exhibits of Manipur IED blasts were examined by the standard techniques of chemical and instrumental analysis. The results showed that in most of the explosions, high explosives or millitary explosives like Pentaerythritol tetranitrate (PETN), 2, 4, 6-trinitro toluene (TNT), Cyclotrimethylenetrinitramine (RDX) or Ammonium Nitrate and Fuel Oil (ANFO) based were used. These were probably smuggled. But the origin of the explosive could not be detected.

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INTRODUCTION

India is a vast country with a population of 132-133 crores living in 28 states and 9 union territories. India has 23 recognized languages (Hindi, English and other regional languages) and a large number of dialects. In spite of all these there is unity in diversity. However, the aims and objectives of peoples in different parts are different. The chord of unity is frequently threatened by some disgruntled people who spearheaded agitations and revolts for separate states for independence or other anti national activities. Therefore, extremist or terrorist activities are found in different parts or pockets in India. Manipur is one of the provinces where terrorist or rebel activities are prominent in spite of cordial attempts to initiate peaceful negotiations for the solution of the grievances of the extremists. However the success has been limited. Extremist activities led to sporadic explosions and arsons in selected localities causing the loss and destruction of valuable public properties (may even loss of life). The law enforcing authority or police investigated the cases and collected remnants of IEDs or explosives and related materials from the scene of explosions for proper analytical examination. Portions of the collected materials were put in plastic packets or covers, wooden box as the case may be, and were sealed properly. These were sent to Central Forensic Science Laboratory (CFSL) Kolkata for investigative forensic analysis and reports. The results of the investigation are reported in this communications.

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MATERIALS AND METHODS

Samples are mostly post-blast materials obtained from the investigating agencies by the Central Forensic Science Laboratory, Kolkata as exhibits. Samples are extracted and analysed as per the standard protocol of chemical and instrumental analysis of Explosive materials (1-4). All chemicals and reagents and solvents (Acetone, Diethyl ether, diphenylamine, Methanol, Potassium Hydroxide, Thymol, Pyridine, Sodium cobaltinitrite, Sodium Hydroxide, Potassium Hydroxide, Sodium Nitroprusside, Sodium Rhodizonate, Barium Chloride, Silver Nitrate, Aniline, Sulphuric Acid, Nitric Acid, Hydrochloric Acid, Acetic Acid etc.) used were of A.R. grade. Ultrapure deionised water of resistivity 18.2 MΩ of Merck (India) grade was used for extractions of the exhibits. The identification and characterization of the explosives and hydrocarbons present as petroleum base materials were made using Shimadzu model (QP 2020NX)

Gas Chromatograph-Mass Spectrometer (GC-MS) by injecting acetone extract (for detection of explosives) and in diethyl ether ((for detection of petroleum products) through DB-5MS column. Oven temperature was programmed between 70°C (1 minute hold) and 280°C (5 minute hold) with 15°C/minute increment (for explosive samples) and 10°C/minute increment (for petroleum product samples). The injector and interface temperatures were 180°C and 200°C respectively. The system was run at the rate of constant carrier gas (helium) flow 2.5 ml/min, MS parameters for the analysis of explosives were: El mode, source temperature 150°C, energy 70ev, mass range scanned 30-420amu. FTIR measurements were done by Bruker Alpha II and Thermo Scientific NICOLET-6700 FT-IR in the finger print region (4000 cm^{-1} to 500 cm^{-1}) in the transmittance mode using diamond-ATR and DTGS detector respectively. The methods applied for analysis and examination of exhibits are shown in Figure 1.

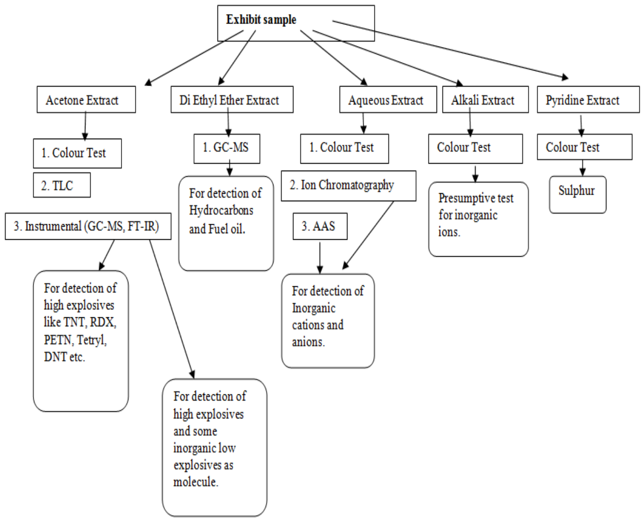


Figure 1. A view of methods applied for the analysis and examination of the exhibits

RESULTS AND DISCUSSION

In most of the cases the exhibits were small broken and deformed metallic pieces obtained as parts of IEDs (Improvised explosive devices) after blast or small metallic pieces of blasted hand grenade and in few cases pre blasted gel materials. Examination of these samples showed presence of Cyclotrimethylenetrinitramine (RDX), Pentaerythritol tetranitrate (PETN) and 2, 4, 6-trinitro toluene (TNT) and Ammonium Nitrate and high boiling fractions of petroleum hydrocarbons. Results of some representative samples are shown in Table 1.

FTIR analysis of mixtures is usually not feasible but some of the mixtures were analysed by separating the components by recrystallization of the filtrate available after following the chemical tests with the aqueous extract. The instrumental data of the recrystallized aqueous extracts were compared with the peaks of the standards and also with the available library data. Some representative analytical data of GC-MS and FT-IR are given in Figure 2 to Figure 6. Explosives used by terrorists are diverse in nature and can be classified or categorised mainly in four groups.

Explosives prepared from common ingredients like $K/NaNO_3$, $K/NaClO_4$, As_2S_3, S, C, Al, Glycerine, H_2O_2, sugar and starch etc. The IEDs consisting of ordinary chemicals were instrumental for most of the high profile explosions in Spain, Indonesia, India, Pakistan and other countries. More than 80% of explosions (by IEDs) all over the world were based on common inorganic chemicals and these are relevant even today. Dicinoski (5) et al. and Kuila (6) et al. gave detailed accounts on these aspects.

However discovery of ammonium nitrate (NH_4NO_3) and urea nitrate made a complete change in the scenario of IED blasting.

Ammonium Nitrate (NH_4NO_3) based explosives (7, 8, 9).

Uronium nitrate based powerful explosives used in Peru, Palestine, World Trade Centre (New York, 1993) (10, 11, 12, 13).

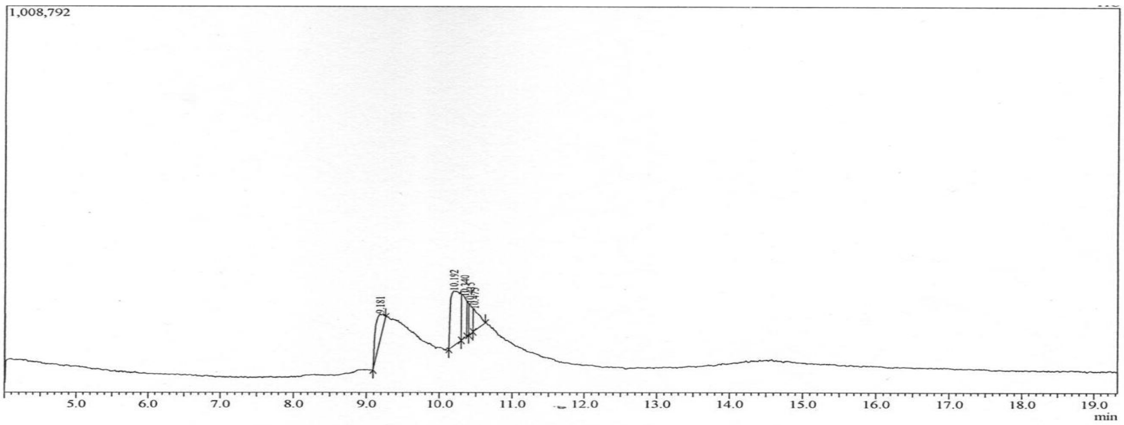
Peroxide based explosives like triacetone triperoxide (TATP), diacetone diperoxide (DADP) and hexamethylene triperoxide diamine (HMTD) (Richard Reid's shoe bombs) were used in USA, London, Morocco and Israel by the Palestinians (10, 11).

High or military explosives like nitroglycerine, nitrocellulose, trinitrotoluene (TNT), Tetryl, RDX, HMX and CL 20 etc.

More than 10,000 pre-blast and post-blast exhibits were examined and analysed by routine procedure in Central Forensic Science Laboratory Kolkata. They were further examined by advanced techniques like IC, SEM-EXDA, FT-IR, AAS, HPLC, HPTLC, GC-MS. These were reported by Bagchi et al. (12). The results show that peroxide explosives were not used in India. Moreover, military explosives were rarely used except in preparations of detonators, hand grenade or mortars etc. However, explosives collected and identified in Manipur states were all high explosives or military explosives like TNT, Tetryl, PETN and RDX. Naturally, these are factory made and collected from elsewhere. It is expected that the rebels though may have sufficient experience in handling these explosives but the resources and expertise in manufacturing explosives are remote. In forensic investigation it is desirable to trace the origin of explosives i.e., explosives were of Indian origin or procured from foreign sources. The sources of these compounds can be identified using isotopic signatures or isotopic ratios of N/O or C/N etc. of the explosives. The isotopic ratios of N, C etc. in different explosives were determined by Sharma et al. using FTIR measurements at 77K with MCT detectors (13, 14). The instrument was utilised in a number of cases but in many cases the method failed. The specific instrument for this purpose is IRMS i.e., isotopic mass ratiospectroscopy non available for use. No local or foreign explosives were available; the aspect is of theoretical interest. No further examination was possible due to limited resources like chemicals, solvents and standard explosives. But it is certain that all the explosives are military explosives.

Table 1. Showing the results of the chemical and instrumental analysis of the Exhibit 1 to Exhibit 14

Exhibit Nos.	Description	Method Of Examination	Results
Exhibit 1	Three small broken and deformed metallic pieces	Chemical Tests, TLC and GC-MS	PETN, RDX and elemental Sulphur.
Exhibit 2	One broken and deformed metallic piece	Chemical Tests, TLC, GC-MS and FT-IR	Ammonium, Nitrate and Nitrite ions, PETN, RDX and elemental Sulphur.
Exhibit 3	Four small metal pieces	TLC and GC-MS	PETN
Exhibit 4	One broken and deformed metallic piece	GC-MS and FT-IR	Ammonium, Nitrate and Nitrite ions, and High boiling fractions of Petroleum Hydrocarbons
Exhibit 5	Two small broken and deformed metallic pieces & soil materials	TLC and GC-MS	TNT
Exhibit 6	Soil materials	TLC and GC-MS	TNTandRDX
Exhibit 7	Three small metallic and deformed metallic pieces	TLC and GC-MS	TNT and PETN
Exhibit 8	Soil materials	TLC and GC-MS	TNT
Exhibit 9	One broken and deformed metallic piece	TLC and GC-MS	TNT and PETN
Exhibit 10	Soil materials	TLC and GC-MS	TNT
Exhibit 11	Soil materials	TLC and GC-MS	TNT, DNT and RDX
Exhibit 12	soil materials	GC-MS	High boiling fractions of Petroleum hydrocarbons.
Exhibit 13	Broken and deformed metallic pieces	GC-MS	High boiling fractions of Petroleum hydrocarbons.
Exhibit 14	Some tiny broken and deformed metallic pieces	GC-MS	TNT and RDX



Peak Report TIC

Peak#	R.Time	I.Time	F.Time	Area	Area%	Height	Name
1	9.181	9.090	9.260	590689	20.12	72117	
2	10.192	10.130	10.300	1303564	44.41	143766	Cyclonite
3	10.340	10.300	10.375	479505	16.33	108507	
4	10.415	10.400	10.460	255342	8.70	79286	
5	10.475	10.460	10.630	306444	10.44	57518	Cyclonite
				2935544	100.00	461194	

Figure 2. GC-MS chromatogram of RDX/Cyclonite and 2, 4, 6 trinitrotoluene

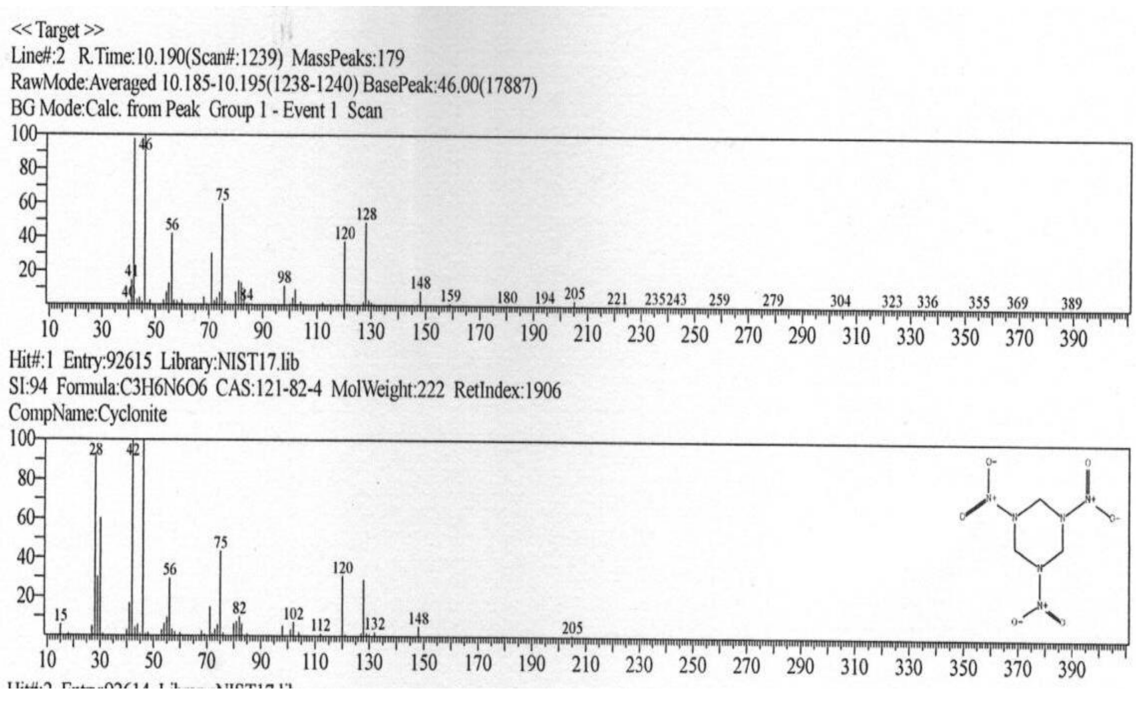


Figure 3. GC-MS spectra (mass/charge ratio) of RDX/Cyclonite in GC-MS

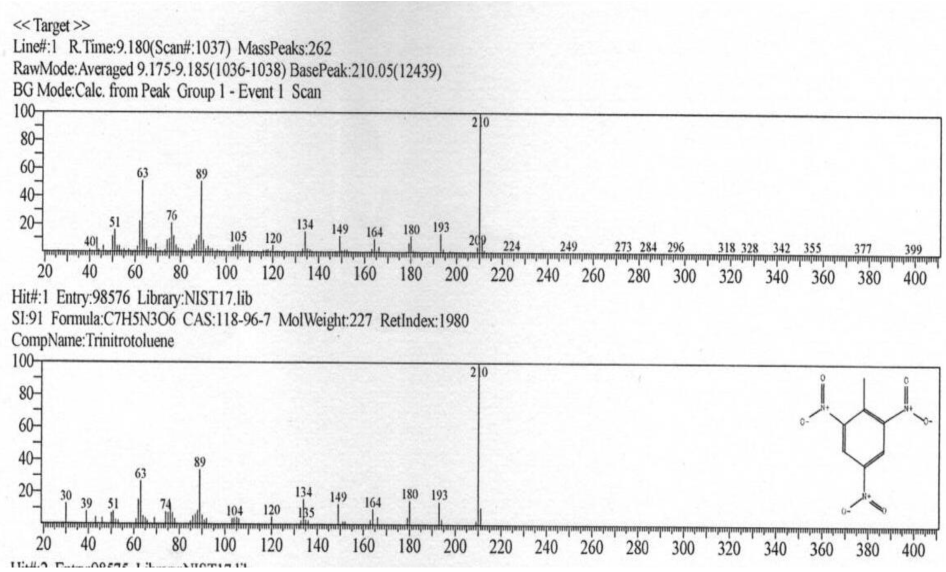
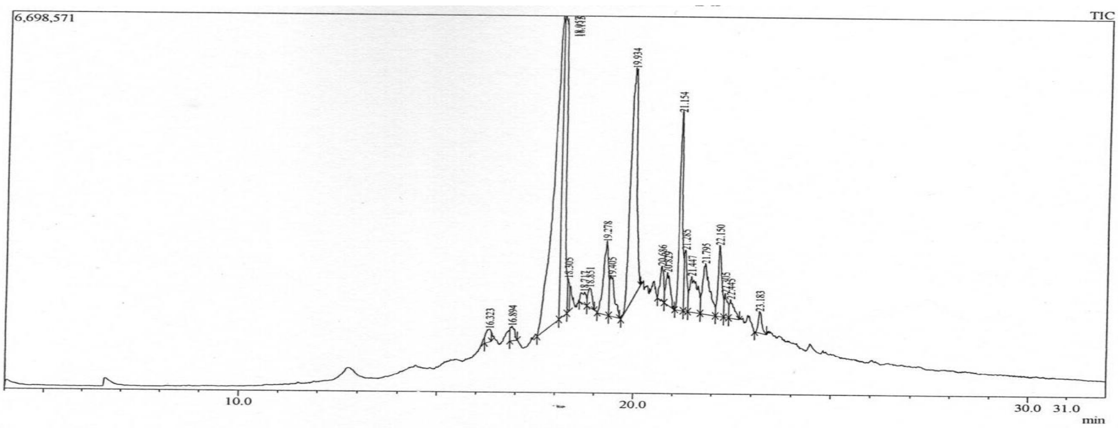


Figure 4. GC-MS spectra (mass/charge ratio) of 2, 4, 6-trinitrotoluene in GC-MS



Peak Report TIC

Peak#	R.Time	I.Time	F.Time	Area	Area%	Height	Name
1	16.323	16.200	16.370	1973356	0.77	225801	2-Methylheptacosane
2	16.894	16.840	17.030	1860280	0.73	253798	3-Methyldotriacontane
3	18.057	17.535	18.085	70223727	27.51	5392800	Octacosane, 2-methyl-
4	18.115	18.085	18.285	40402369	15.83	5361638	
5	18.305	18.285	18.345	1909873	0.75	603002	
6	18.717	18.590	18.790	1854411	0.73	212796	Tetrapentacontane, 1,54-dibromo-
7	18.851	18.790	18.980	2505421	0.98	342979	
8	19.278	19.060	19.355	11316096	4.43	1290163	Octacosane, 2-methyl-
9	19.405	19.355	19.625	6193558	2.43	668921	
10	19.934	19.665	20.145	46431112	18.19	4115506	Hexatriacontane
11	20.686	20.585	20.755	3869085	1.52	610772	2-Methylheptacosane
12	20.829	20.755	21.015	4546566	1.78	558369	Tetrapentacontane
13	21.154	21.025	21.245	20685265	8.10	3520703	Hexatriacontane
14	21.285	21.245	21.365	5528780	2.17	1080556	
15	21.447	21.365	21.675	8767382	3.43	619401	Hexacontane
16	21.795	21.675	22.065	11183312	4.38	893347	Pentatriacontane
17	22.150	22.065	22.275	8456897	3.31	1253132	Tetrapentacontane
18	22.305	22.275	22.405	2388738	0.94	425136	Cyclohexane, pentacosyl-
19	22.445	22.405	22.675	2732543	1.07	328364	;ulfurous acid, cyclohexylmethyl octadecyl este
20	23.183	23.065	23.365	2458743	0.96	379886	Tetrapentacontane
				255287514	100.00	28137070	

Figure 5. GC-MS chromatogram of Hydrocarbons obtained through etheral extract of sample

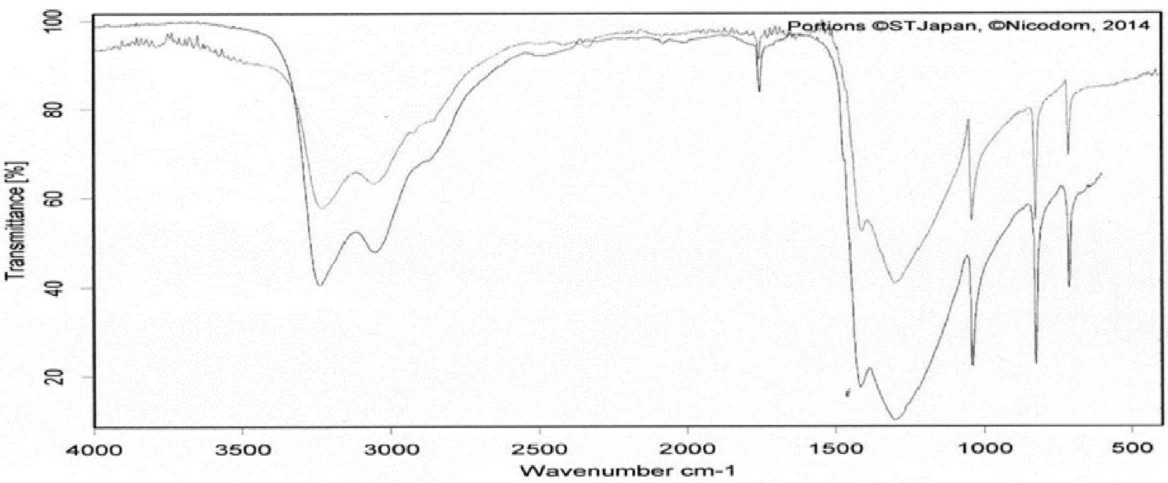


Figure 6. FT-IR spectra of Ammonium Nitrate

Conclusion

Blasts in Manipur were IED varieties. Most of the explosions were of high explosives. But no idea about the source of the explosive could be detected non availability of proper instruments.

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