

RDX

From Wikipedia, the free encyclopedia
(Redirected from Cyclotrimethylene trinitramine)

Cyclotrimethylenetrinitramine, also known as **RDX**, **cyclonite**, **hexogen**, and **T4**, is an explosive nitroamine widely used by the military.

In its pure, synthesized state RDX is a white, crystalline solid. As an explosive it is usually used in mixtures with other explosives and plasticizers or desensitizers. It is stable in storage and is considered the most powerful and brisant of the military high explosives.

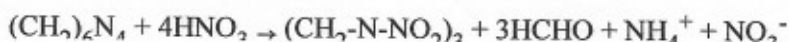
RDX forms the base for a number of common military explosives: Composition A (wax-coated, granular explosive consisting of RDX and plasticizing wax), composition A5 (mixed with 1.5% stearic acid), composition B (castable mixtures of RDX and TNT), composition C (a plastic demolition explosive consisting of RDX, other explosives, and plasticizers), composition D, HBX (castable mixtures of RDX, TNT, powdered aluminium, and D-2 wax with calcium chloride), H-6, Cyclotol and C4.

RDX is also used as a major component of plastic bonded explosives used in nuclear weapons.

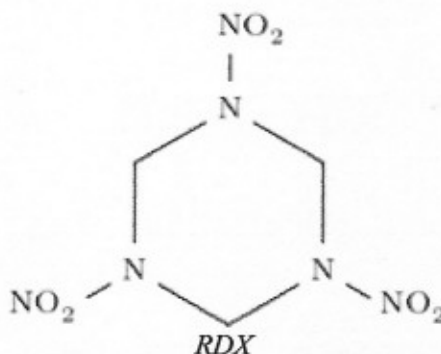
Properties

The velocity of detonation of RDX at a density of 1.76 grams/cm³ is 8,750 meters per second.

It is a colourless solid, of maximum theoretical density 1.82 g/cm³. It is obtained by reacting concentrated nitric acid on hexamine.



http://en.wikipedia.org/wiki/Cyclotrimethylene_trinitramine



1,3,5-trinitroperhydro-1,3,5-triazine
IUPAC name

Chemical formula	C ₃ H ₆ N ₆ O ₆
Molecular mass	222.117 g/mol
Shock sensitivity	Low
Friction sensitivity	Low
Density	1.82 g/cm ³
Explosive velocity	8,750 metres per second
RE factor	1.60
Melting point	205.5°C
Autoignition temperature	234°C
Appearance	colorless solid crystals
CAS number	121-82-4
PubChem	8490 (http://pubchem.ncbi.nlm.nih.gov/summary/summary.cgi?cid=8490)
SMILES	<chem>C1N(CN(CN1[N+](=O)[O-])[N+](=O)[O-])[N+](=O)[O-]</chem>



Wikibooks Chemical synthesis has more about this subject:
Cyclonite synthesis

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It is a heterocycle and has the molecular shape of a ring. It starts to decompose at about 170°C and melts at 204°C. Its structural formula is: hexahydro-1,3,5-trinitro-1,3,5-triazine or $(\text{CH}_2\text{-N-NO}_2)_3$.

At room temperature, it is a very stable product. It burns rather than explodes and only detonates with a detonator, being unaffected even by small arms fire. It is less sensitive than pentaerythritol tetranitrate (PETN). However, it is very sensitive when crystallized, below -4°C.

Under normal conditions, RDX has a Figure of Insensitivity of 80.

The manufacture of RDX can easily pollute soil and groundwaters.

History

The discovery of RDX dates from the 1890s when a German (Hans Henning) offered it as a medicine. Its explosive properties were not discovered until 1920 (Herz?). In the 1920s RDX was produced by the direct nitration of hexamine.

RDX was used by both sides in World War II. In the United Kingdom RDX was manufactured in pilot plants at Waltham Abbey in 1938 and at the Research Department at the Royal Arsenal, Woolwich. In 1939 a twin-unit industrial-scale plant was designed to be installed at a new site, ROF Bridgwater, away from London; and production of RDX started at Bridgwater in 1941. The United Kingdom attempted to be self-sufficient in the early stages of the war, and at this time the USA was still a neutral country; Canada, a member of the British Commonwealth, was looked upon to supply ammunition and explosives, including RDX. A slightly different method of production, but still using Hexamine, was found and used in Canada, possibly at the McGill University Department of Chemistry (Meissner?). Urbanski provides details of five methods of production. The American Bachmann process for RDX was found to be richer in HMX than the United Kingdom's RDX and there is a suggestion that this later led to a HMX plant being set up at ROF Bridgwater in 1955.

RDX was widely used during World War II, often in explosive mixtures with TNT such as Torpex (TNT (42%), RDX (40%) and aluminium (18%)). RDX was used in one of the first plastic explosives.

There are many interpretations of its acronym including (but not limited to) Royal Demolition eXplosive, Research Department (composition) X, and Research Department eXplosive. The latter is most likely correct. In the United Kingdom, new military explosives were given an identification number preceded by the letters 'RD' indicating 'Research Department No.'. For some reason, this explosive was unable to be given a number (the story goes that the department that issued the numbers had just blown itself up, but this may be apocryphal). Instead, the letter 'X' was appended to indicate 'unknown' with the intention of adding the number later. Although a number was issued, the term 'RDX' stuck.

References

- Cooper, Paul W. (1996). *Explosives Engineering*, New York: Wiley-VCH. ISBN 0471186368.
- Urbanski, Tadeusz (1967). *Chemistry and Technology of Explosives, Vol. III*, Warszawa: Polish Scientific Publishers.
- Meyer, Rudolf (1987). *Explosives, 3rd Edition*, VCH Publishers. ISBN 0-89573-600-4.

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HMX

From Wikipedia, the free encyclopedia

HMX, also called **octogen** or **cyclotetramethylene-tetranitramine**, is a powerful, and relatively insensitive, nitroamine high explosive, chemically related to RDX.

History

First made in 1930, it is used almost exclusively in military applications including as the detonators in nuclear weapons, in the form of plastic bonded explosive, and as a solid rocket propellant.

Its molecule is an eight-membered ring made of four carbon and four nitrogen atoms, with a nitro group hanging off of each nitrogen atom. Because of its high molecular weight, it is one of the most powerful chemical explosives manufactured, although a number of newer ones, including HNIW and octanitrocubane are more powerful and less sensitive.

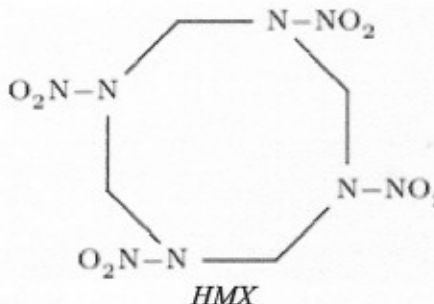
There are other names occasionally used for it — octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine, tetrahexamine tetranitramine, or cyclotetramethylene tetranitramine. It may be produced by nitration of hexamine in the presence of acetic anhydride, paraformaldehyde and ammonium nitrate. RDX produced using the Bachmann Process usually contains 8-10% HMX.

Like RDX, it has various mistranslations of its acronym including High Melting eXplosive, Her Majesty's eXplosive or even High velocity Military eXplosive. In fact the acronym simply means 'High Molecular weight rdX'.

Properties

The velocity of detonation of HMX at a density of 1.90 g/cm³ is 9,100 meters per second.

<http://en.wikipedia.org/wiki/HMX>

 <p style="text-align: center;">HMX</p>	
<p style="text-align: center;">1,3,5,7-tetranitroperhydro -1,3,5,7-tetrazocine <i>IUPAC name</i></p>	
Chemical formula	C ₄ H ₈ N ₈ O ₈
Molecular mass	296.20 g/mol
Shock sensitivity	Low
Friction sensitivity	Low
Density	1.91 g/cm ³
Explosive velocity	9,100 m/s
RE factor	1.70
Melting point	276 to 286 °C
Autoignition temperature	Decomposes at 280°C
Appearance	colorless solid crystals
CAS number	2691-41-0
PubChem	17596 (http://pubchem.ncbi.nlm.nih.gov/summary/summary.cgi?cid=17596)
SMILES	C1N(CN(CN(CN1[N+](=O)[O-])[N+](=O)[O-])[N+](=O)[O-])[N+](=O)[O-]

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Its CAS Number is 2691-41-0. The chemical formula is $C_4H_8N_8O_8$. It is a colorless solid with a melting point of 276 to 286 °C, although it usually decomposes at 280 °C. Its molecular weight is 296.20 and its practical maximum density is 1.91 g/cm³, with a theoretical maximum crystal density of 1.96. It is slightly soluble in water.

HMX is used in melt-castable explosives when mixed with TNT, which as a class are referred to as "octols." Octol itself is 75% HMX, 25% TNT.

References:

- Cooper, Paul W., *Explosives Engineering*, New York: Wiley-VCH, 1996. ISBN 0-471-18636-8
- Urbanski, Tadeusz. *Chemistry and Technology of Explosives. Vol. III.*, Warszawa: Polish Scientific Publishers, 1967

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Category: Explosive chemicals

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Trinitrotoluene

From Wikipedia, the free encyclopedia

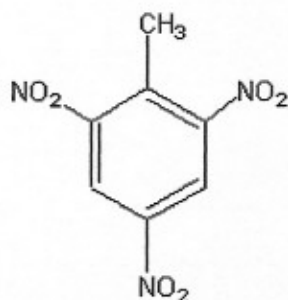
Trinitrotoluene (**TNT**, or **Trotyl**) is a pale yellow crystalline aromatic hydrocarbon compound that melts at 354 K (178 °F, 81 °C). Trinitrotoluene is an explosive chemical used on its own or in many explosive mixtures, such as Torpex, Tritonal, Composition B

(http://en.wikipedia.org/wiki/Composition_B) or Amatol. It is prepared by the nitration of toluene $C_6H_5CH_3$; it has a chemical formula of $C_6H_2(NO_2)_3CH_3$, and IUPAC name **2,4,6-trinitrotoluene**.

TNT is a popular explosive because of its many virtues. In its refined form, trinitrotoluene is very stable, and, unlike nitroglycerin, is insensitive to friction, blows, and jarring. TNT does not react with metals or absorb water, and so, unlike dynamite, it can be safely stored for many years without losing its explosive power. It is however readily acted upon by alkalis to form unstable compounds that are very sensitive to heat and impact.

Amounts of TNT are used as units of energy, especially for expressing nuclear weapon yield, based on a specific combustion energy of TNT of 4.184 MJ/kg (or one calorie—specifically a *thermochemical* calorie—per milligram). Hence, 1 kt TNT = 4.184 TJ, 1 Mt TNT = 4.184 PJ. Note that chemical explosives release less energy per kilogram than everyday household

products like fat (38 MJ/kg) and sugar (17 MJ/kg); they do, however, release their combustion energy much more rapidly. One reason for their low power is that they contain their oxidant as well as the fuel — an explosive does not use atmospheric oxygen. The density of pure TNT (without any additives like sawdust or aluminium) is 1.654 g/cm³.



Trinitrotoluene

2,4,6-trinitrotoluene
IUPAC name

Chemical formula	$C_7H_5N_3O_6$
Molecular mass	227.131 g/mol
Shock sensitivity	Insensitive
Friction sensitivity	Insensitive
Density	1.654 g/cm ³
Explosive velocity	6,900 m/s
RE factor	1.00
Melting point	81 °C
Autoignition temperature	Decomposes at 295 °C
Appearance	Pale yellow crystals.
CAS number	118-96-7
PubChem	8376 (http://pubchem.ncbi.nlm.nih.gov/summary/summary.cgi?cid=8376)
SMILES	<chem>CC1=C(C=C(C=C1[N+](=O)[O-])[N+](=O)[O-])[N+](=O)[O-]</chem>

Toxicity

Some military testing grounds are contaminated with TNT. Wastewater from munitions programs including contamination of surface and subsurface waters may be colored pink as the result of TNT and RDX contamination. Such contamination, called pinkwater, may be difficult and expensive to remediate.

TNT is quite toxic. It can also be absorbed through the skin, and will cause irritation and bright yellow staining. During the First World War, munition workers who handled the chemical found that their skin turned bright yellow, which led to the nickname "canary girls" or simply "canaries" to describe such workers. TNT would also eventually make ginger hair turn green. A 1916 British Government inquiry on female workers at the Royal Arsenal, Woolwich found that 37% had severe pains due to loss of appetite, nausea and constipation, 25% suffered from dermatitis, and 34% experienced changes in menstruation. Before respirators and protective grease applied to the skin were introduced, about 100 workers died from the disease.

People exposed to Trinitrotoluene over a prolonged period tend to experience anemia and abnormal liver functions. Blood and liver effects, spleen enlargement and other harmful effects on the immune system have also been found in animals that ingested or breathed trinitrotoluene. There is evidence that TNT adversely affects male fertility, and TNT is listed as a possible human carcinogen. Consumption of TNT produces black urine.

History

TNT was first made in 1863 by a German chemist Joseph Wilbrand, but its potential was not seen for several years, mainly because it was so hard to detonate and because it was less powerful than other explosives. Among its advantages, however, is its ability to be safely melted using steam or hot water, and so poured molten into shell cases. It is also so insensitive that, for example, in 1910 it was exempted from the British 1875 Explosives Act from actually being considered an explosive for the purposes of manufacture and storage.

The German armed forces adopted it as an artillery shell filling in 1902, and the British gradually started using it as replacement for lyddite in 1907. A particular advantage that it gave the German Navy in the First World War was to detonate after the TNT-filled armour-piercing shells had penetrated the armour of British capital ships, whereas the British lyddite-filled shells tended to explode as soon as they struck the German armour, and thus expended their energy outside of the ship.

Because of the insatiable demand for explosives during the second world war, TNT was frequently mixed with 40%-80% ammonium nitrate, producing an explosive called amatol. Though nearly as powerful as TNT (and much less expensive) amatol suffered from the slight disadvantage of being hygroscopic. Another variation called *minol*, consisting of amatol mixed with about 20% aluminum powder, was used by the British in mines and depth charges. Although blocks of pure TNT are available in various sizes eg 250g, 500g and 1kg etc, it is more commonly encountered in explosive blends which comprise a variable percentage of TNT plus other ingredients eg Torpex, Tritonal and Composition B (http://en.wikipedia.org/wiki/Composition_B).