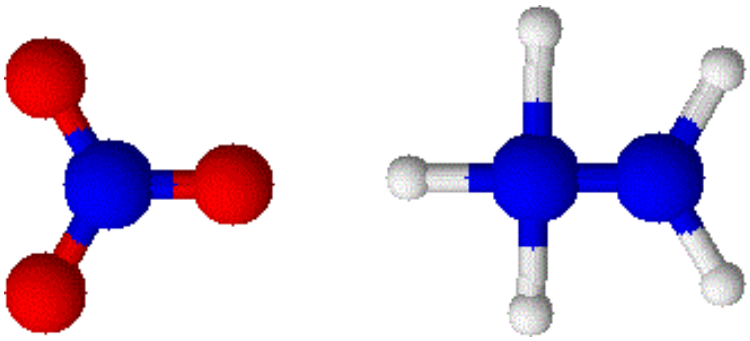
Astrolite

05.02.2014
Studienprojekt DaMocles Gruppe_E
Wintersemester 2013/14
Mieger, Plank, Postulka und Rein

Astrolite is a liquid secondary explosive, which consists of two ingredients. It is assembled with two parts of ammonium nitrate and one part anhydrous hydrazine, measured in weight. Upon mixture, it is reacting into hydrazine nitrate, which is a crystalline solid and dissolved in remaining hydrazine. When exposed to a source of convenient heat, it is able to cause a devastating detonation. [1]



Data relating to hydrazine nitrate: [2]

- Elemental formula: $N_2H_5NO_3$
- Molar weight: 95,07 g/mol
- Density: 1,64 g/cm³
- Enthalpy of formation: -2940,0 kJ/kg
- Regular gas volume: 1006 l/kg
- Detonation heat (in $H_2O_{(l)}$): 4774 kJ/kg
- Melting point: 70,7°C
- Trauzl lead block test: 408 cm³
  (compared to TNT: 300 cm³)
- Detonation velocity: 8690 m/s
- Impact sensitivity: 7,4 Nm

Discovery and Production

Astrolite explosives were discovered in the 1960's by the chemist Gerald Hurst, who was hired at the Atlas Powder Company, in the search for alternative rocket propellant technology. It attracted a lot of military interest, as it has extraordinary power and was easier to control compared to other conventional explosives. [3] It is resistant against water and shock (friction and knock) and can remain detonable in the ground for around 4 days, even if the soil gets soaked by water. An antipersonnel or antivehicular mine would require 4 ounces (approximately 113,4g). [6]
The Astrolite family contains 2 sorts of explosives. Mixing two parts of ammonium nitrate and one part anhydrous hydrazine results in the creation of a clear, liquid solution, Astroilte G.
Adding aluminum powder (weight gain = 20%) with the particle size < 150 μm leads to the production of Astrolite A-1-5, which is a muddy suspension.

Comparison to other explosives

Astrolite offers a very high detonation velocity in contrast to other conventional explosives, but is furthermore easy to handle.

Name of the explosive	Detonation velocity (m/s)
Astrolite G	8600
Astrolite A	7800
TNT	6900
Black Powder	1100
Oxyhydrogen	2820

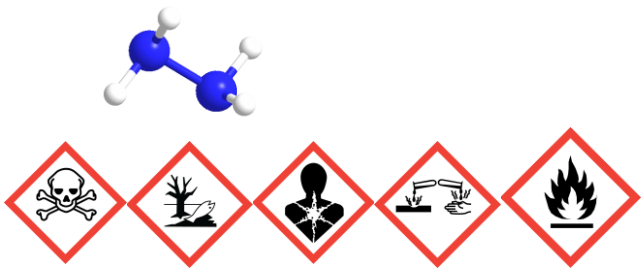
[5]

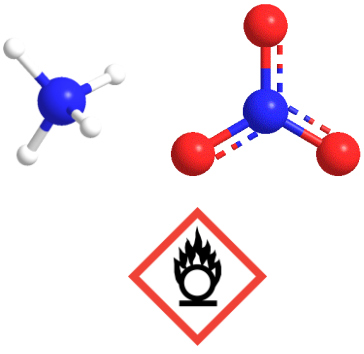
Regarding the resistance against shock, Astrolite is far less fragile than Nitroglycerine for example:

- Critical pressure (Astrolite) = 7.4 Nm (Equal to a 2 kg hammer impact when dropped from 37cm)
- Critical pressure (Nitroglycerine) = 0.8 Nm (Equal to a 2 kg hammer impact when dropped from 4 cm)

Reaction

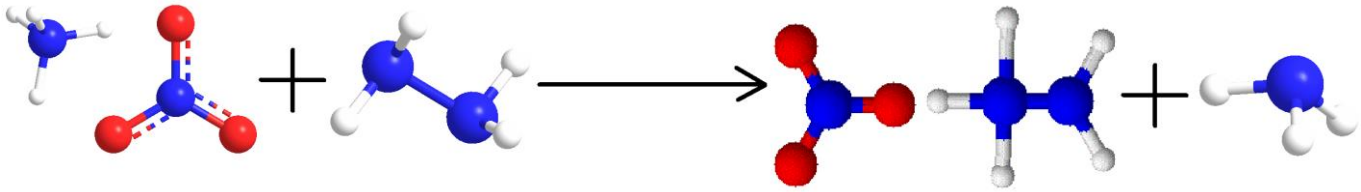
When handling with both educts, it is advised to produce the Astrolite in a well-ventilated room, to prevent the accumulation of ammonia gas. Over the top it is necessary to handle the hydrazine with caution, as it is corrosive, toxic and carcinogenic. As ammonium nitrate is a strong explosive on its own, it is important to keep fire spots away from the educts. [7], [8]





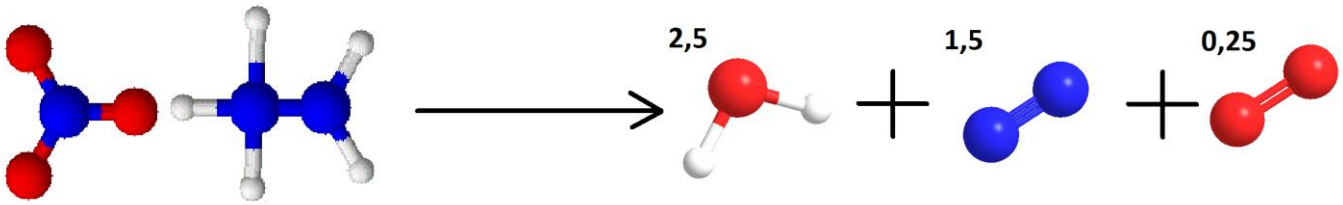
To create the explosive compound, it is essential to use a big container, because of the releasing ammonia gas:

$$NH_4NO_3 + N_2H_4 \rightarrow N_2H_5NO_3 + NH_3 \uparrow$$



The refined hydrazine nitrate is a crystalline solid, which is dissolved in the remaining hydrazine, forming a clear, viscous solution. This mixture can be stored safely, as it a secondary explosive. To initiate the explosion, a blasting cap is required. Upon detonation the mixture dissipates into harmless gases:

$$N_2H_5NO_3 \rightarrow 2.5\ H_2O\uparrow + 1.5\ N_2\uparrow + 0.25\ O_2\uparrow$$



The reaction offers 4.25 mol Gas out of 1 mol explosive. This is a volume equal to 95.3L and a volume of 1006L out of 1kg Hydrazine nitrate.

Conclusion

In summary Astrolite is a remarkable explosive, which deals high detonation velocity, despite its simple structure and easy synthesis. Nevertheless nowadays it's not known to be widely used, according to its hazardous components and the possibility to take advantage of modern technologies.

References

[1]: Dessert Publications „Two Component High Explosive Mixtures“;1982
[2]: WILEY-VCH „Explosivstoffe: Zehnte, vollständig überarbeitete Auflage“; Josef Köhler, Rudolf Meyer, Axel Homburg; Juli 2008
[3]: http://gizmodo.com/5832006/astrolite-the-liquid-land-mine
[4]: http://www.aiexplosives.com/inspections_articles.asp?id=23
[5]: Cooper, Paul W. (1996). Explosives Engineering, New York: Wiley-VCH
[6]: http://www.iraq-war.ru/article/98329
[7]: http://gestis.itrust.de/nxt/gateway.dll/gestis_de/002010.xml?f=templates$fn=default.htm$3.0
[8]: http://gestis.itrust.de/nxt/gateway.dll/gestis_de/003750.xml?f=templates$fn=default.htm$3.0