Short Communication

A Nitrate Salt of a Hydrazine-Formaldehyde Polymer

S. Narasimhan, A. S. Kumar, and N. Venkatasubramanian

IDL-Nitro Nobel Basic Research Institute, Malleswaram, Bangalore-560 003 (India)

The reaction of formaldehyde with hydrazine produces different products such as tetraformaltrisazine (TFTA) and formalazine (FA) depending on the reaction conditions[1,2]. The importance of these compounds as fuels in propellant systems and their thermal degradation properties were recently discussed by Nambiar[3]. During the course of our studies on the hydrazine formaldehyde reaction under altered conditions we obtained a polymer (when two moles of formaldehyde are added to one mole of hydrazine under cooling) which was different from the reported product as evidenced by the I.R. spectrum (product 1, Table 1). This product, unlike formalazine dissolves easily in concentrated nitric acid without decomposition. More curiously, a solid precipitated from this nitric acid solution (product 2, Table 1 for I.R.) gives two exotherms, one at 100 °C and another at 230 °C. Also, this solid is sensitive to No. 6 detonator and exhibits good explosive characteristics (Table 2).

We believe that this product is a nitrate salt of a hydrazine-formaldehyde polymer, which is structurally different from formalazine.

Table 1. I.R. Spectra

Compound	ν [cm^{-1}]
Formalazine	3400, 2960, 2860, 2760, 1477, 1442, 1349, 1196 (no peak below 1000)
Product 1 from present study	3395, 3224, 2954, 2889, 2774, 1624, 1470, 1437, 1347, 1195, 1091, 934, 825, 633
Product 2 from present study	3324, 2996 to 2361 (complex series of absorption) 1600 (broad), 1384, 1207, 1050, 991, 912, 825, 805, 750

Table 2. Explosive Properties of Product 2

Test	Remarks Product 2	PETN
1. Friction test (5 kg weight on pistil load and 3 m/s velocity)	negative	negative
2. Impact test (94.8 g steel ball height 1.5 m)	negative	negative
3. Fall Hammer test (30 kg weight 2 m height, anvil diameter 50 mm)	negative	positive
4. Lead block Expansion	430 ml	512 ml
5. Velocity of detonation Dautriche-method (25 mm diameter, 0.8 density)	4375 m/s	8400 m/s (density 1.7)*

* Data from "Explosives" by R. Meyer, 2nd edition, Verlag Chemie, Weinheim.

References

(1) J. F. Walker, *"Formaldehyde"*, 3rd edition, Reinhold Publishing Company, New York 1964, p. 239.
(2) Mitsuo Mashima, *Bull. Chem. Soc. Japan 39,* 504 (1966).
(3) P. R. Nambiar, *Propellants, Explos., Pyrotech. 10,* 39 (1985).

Acknowledgements

The authors wish to thank Mr. D. K. Chatterjee, IDL Chemicals Ltd. Hyderabad, for measuring the explosive properties, Dr. Arshad Ahmed and Mr. R. Vedam for useful discussions.

(Received April 30, 1986; Ms 14/86)