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Fig. 1. Detonation velocity of liquid  $\text{HN}_3$  and its aqueous solutions. 1—authors' data; 2—Joyner' s data.

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## Abstract

## Full Text

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## PHYSICAL CHEMISTRY

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# ON THE DETONATION VELOCITY OF LIQUID HYDRAZOIC ACID

*(Presented by Academician V. N. Kondrat' ev, 30 XII 1963)*

It is known that hydrazoic acid,  $\text{HN}_3$ , is a very sensitive explosive compound. It can explode as a result of a very slight action.  $\text{HN}_3$  exhibits explosive properties and high sensitivity in all states of aggregation.  $\text{HN}_3$  itself is not used in practice as an explosive substance. Nevertheless, determination of the detonation characteristics—detonation velocity, temperature, and pressure—for liquid  $\text{HN}_3$  is of interest. Measurements of detonation characteristics are often used in studies devoted to the equation of state of gases at high pressures (hundreds of thousands of atmospheres) and temperatures (several thousand degrees). In processing experimental data one has to deal with multicomponent systems, since most explosives contain at least four types of atoms; as a result, several types of molecules are present in the explosion products. In this respect  $\text{HN}_3$  differs favorably from other explosives. It may be expected that the detonation products of liquid  $\text{HN}_3$  will consist mainly of molecular nitrogen and hydrogen.

**Fig. 1.** Detonation velocity of liquid  $\text{HN}_3$  and its aqueous solutions. 1—authors' data; 2—Joyner' s data.

In the present work we give the results of measurements of the detonation velocities of liquid  $\text{HN}_3$  and some of its aqueous solutions.

In the book [1] results are given for measurements of the detonation velocities of aqueous  $\text{HN}_3$  solutions obtained by Joyner (see Fig. 1). Extrapolation of these results to the one-hundred-percent acid gives a value of about 9500 m/sec, which is inconsistent with the energy content and density of  $\text{HN}_3$ . The heat

of explosive transformation of liquid  $\text{HN}_3$  is 1497 kcal/kg [2], and its density is equal to

**Table 1**

Concentration of $\text{HN}_3$ , wt. %	Charge diameter, mm	Detonation velocity, m/sec	Number of experiments
100	3-10	$7537 \pm 14$	10
90	7.4	$7440 \pm 25$	2
80	11	$7060 \pm 11$	5

1.10 g/cm<sup>3</sup> [3]. For nitroglycerin the heat of explosion is 1490 kcal/kg (water–vapor), density 1.60 g/cm<sup>3</sup>. The detonation velocity of nitroglycerin is 7650 m/sec [4]. It is difficult to expect that  $\text{HN}_3$ , having a lower density, would detonate at a higher velocity than nitroglycerin.

We prepared hydrazoic acid by the action of sulfuric (93%) or orthophosphoric (75%) acid on dry sodium azide. The  $\text{HN}_3$  formed was distilled off from the reaction vessel by heating in a water bath.

(50–60° C) and was collected in a receiver—a glass test tube with a wall thickness of 1.2 mm. The height of the  $\text{HN}_3$  column in the test tube was 10–18 cm. In preparing aqueous solutions of  $\text{HN}_3$ , the calculated amount of water was introduced into the test tube in advance, and then the necessary amount of  $\text{HN}_3$  was added. The process of preparing  $\text{HN}_3$  was controlled remotely.

The detonation velocity was recorded by an optical method using an SFR photorecorder. Initiation was carried out by a cap detonator through the bottom of the test tube.

The results of the experiments are given in Table 1 and in Fig. 1.

In our experiments we did not determine the purity of the liquid  $\text{HN}_3$ . It could have contained traces of water. That the amount of water in this case was insignificant is confirmed by the absence of any difference in the detonation velocities of liquid  $\text{HN}_3$  obtained by treating the azide with different acids (sulfuric and orthophosphoric). The detonation velocity we obtained is in full agreement with the energetics and density of liquid hydrazoic acid.

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## REFERENCES

1. J. Taylor, *Detonation in the Condensed Explosives*, Oxford, 1952.

2. K. K. Andreev, A. F. Belyaev, *Theory of Explosives*, Moscow, 1960.
3. P. Gunter, R. Meyer, F. Müller-Skjold, *Zs. Phys. Chem.*, **175**, 154 (1935).
4. A. F. Belyaev, V. M. Karasev, L. N. Azbukina, in: *Physics of Explosion*, No. 5, Publishing House of the Academy of Sciences of the USSR, 1956.

*Note: Figure translations are in progress. See original paper for figures.*

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