

# REACTION OF CYANURIC ACID AND ITS AMIDES WITH AMMONIA

V. A. Gal'perin and A. I. Finkel'shtein

UDC 547.491.8:543.422.4

The amination of solid cyanuric acid, cyanuramide, and cyanurodiamide by ammonia in autoclaves for 1-3 h at a molar ratio of the starting materials to ammonia of 1:3 and a total charge of 0.1 g/cm<sup>3</sup> at 200-270°C demonstrated the erroneousness of the conclusions of Giger [1] and Kinoshita [2] regarding the formation, under the indicated conditions, of urea as the product of amination of cyanuric acid.

Using IR spectroscopy and spectrophotometric methods of analysis [3,4], we have established that at 200-250° the monoammonium salt of cyanuric acid, first obtained by direct interaction of ammonia with solid cyanuric acid, is obtained. (Found %: NH<sub>3</sub> 12.6; C<sub>3</sub>H<sub>3</sub>N<sub>3</sub>O<sub>3</sub> 87.5%. C<sub>3</sub>H<sub>3</sub>N<sub>3</sub>O<sub>3</sub> · NH<sub>3</sub>. Calculated %: NH<sub>3</sub> 13.1; C<sub>3</sub>H<sub>3</sub>N<sub>3</sub>O<sub>3</sub> 86.9.) The minima on the pressure-time curves observed by Kinoshita [2] should be explained by the formation of this salt rather than by the formation of urea.

Above 250°, cyanuric acid is aminated, i.e., the carbonyl groups are replaced by amine groups. Thus, at 270° and 80 atm the percentage of cyanuric acid, cyanuramide, cyanurodiamide, and melamine in the reaction products after 2 h were, respectively, 10.3, 42.2, 44.2, and 3.3%. Urea was not detected.

At 270° and below, the starting cyanuramide and cyanurodiamide are not aminated, but the product of the reaction of cyanuramide with ammonia is the first obtained monoammonium salt. (Found %: NH<sub>3</sub> 12.5; C<sub>3</sub>H<sub>4</sub>N<sub>4</sub>O<sub>2</sub> 86.0. C<sub>3</sub>H<sub>4</sub>N<sub>4</sub>O<sub>2</sub> · NH<sub>3</sub>. Calculated %: NH<sub>3</sub> 13.2; C<sub>3</sub>H<sub>4</sub>N<sub>4</sub>O<sub>2</sub> 86.8.) The IR spectra confirm the formation of this salt. The ammonium salts of cyanuric acid and cyanuramide are stable in the absence of traces of moisture. The products of the reaction of cyanurodiamide with ammonia were not detected under the indicated reaction conditions.

The temperature interval selected for the investigation completely excluded the decomposition of the starting substances, as demonstrated by preliminary experiments.

## LITERATURE CITED

1. P. Giger, Zum Reaktionsmechanismus der Bildung von Melamin aus Harnstoff, Diss. E. T. H. Nr. 2755, Zurich (1958).
2. H. Kinoshita, Rev. Phys. Chem. Japan, 24, 21 (1954).
3. E. N. Boitsov and A. I. Finkel'shtein, Zh. Analit. Khim., 17, 748 (1962).
4. Analytical Monitoring of Production in the Nitrogen Industry, Vol. 14 [in Russian], Khimiya (1965), p. 31.

---

Dzerzhinsk Branch, State Scientific-Research and Design Institute of the Nitrogen Industry and Products of Organic Synthesis. Translated from Khimiya Geterotsiklicheskikh Soedinenii, No. 7, p. 1002, July, 1971. Original article submitted November 23, 1970.

© 1974 Consultants Bureau, a division of Plenum Publishing Corporation, 227 West 17th Street, New York, N. Y. 10011. No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, electronic, mechanical, photocopying, microfilming, recording or otherwise, without written permission of the publisher. A copy of this article is available from the publisher for \$15.00.