A Publication
of Reliable Methods
for the Preparation
of Organic Compounds

Working with Hazardous Chemicals

The procedures in *Organic Syntheses* are intended for use only by persons with proper training in experimental organic chemistry. All hazardous materials should be handled using the standard procedures for work with chemicals described in references such as "Prudent Practices in the Laboratory" (The National Academies Press, Washington, D.C., 2011; the full text can be accessed free of charge at http://www.nap.edu/catalog.php?record_id=12654). All chemical waste should be disposed of in accordance with local regulations. For general guidelines for the management of chemical waste, see Chapter 8 of Prudent Practices.

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These paragraphs were added in September 2014. The statements above do not supersede any specific hazard caution notes and safety instructions included in the procedure.

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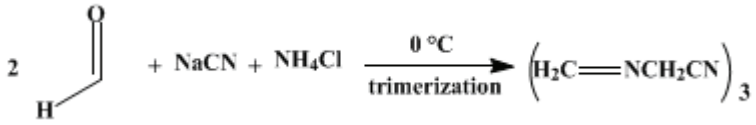
Organic Syntheses, Coll. Vol. 1, p.355 (1941); Vol. 4, p.47 (1925).

METHYLENEAMINOACETONITRILE

[α-Hydroformamine cyanide]



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1. Procedure

In a 5-l. round-bottomed flask, fitted with a mechanical stirrer and surrounded by an ice-salt bath, are placed 1620 g. (1.5 l., 18.9 moles) of technical formaldehyde (sp. gr. 1.078/20°) (Note 1) and 540 g. (10 moles) of ammonium chloride. A thermometer is placed in the liquid, which is cooled to 0°. This temperature is maintained throughout the entire reaction (Note 2). Stirring is commenced (Note 3), and a solution of 490 g. (9.8 moles) of 98 per cent sodium cyanide in 850 cc. of water is dropped into the mixture of ammonium chloride and formaldehyde at such a rate (about 90 drops per minute) that at least six hours will be required for this addition.

When one-half the sodium cyanide solution has been added, all the ammonium chloride will be in solution. At this point, the addition of 380 cc. of glacial acetic acid is started at such a rate (2–2.5 cc. per minute) that the addition of both the acid and the remainder of the sodium cyanide solution will be completed at the same time. The methyleneaminoacetonitrile begins to separate in white crystals shortly after the addition of the glacial acetic acid has commenced. After all the sodium cyanide solution and acetic acid have been added, the mixture is stirred for one and one-half hours longer; then the precipitate is filtered off, transferred to a beaker, and stirred with 1.5 l. of water. The product is filtered with suction, washed with 500 cc. of water (Note 4), and dried on filter paper. The yield is 410–475 g. (61–71 per cent of the theoretical amount) of a product melting at 129° (Note 5), (Note 6), and (Note 7).

2. Notes

1. The formalin should contain no suspended paraformaldehyde. An aqueous formaldehyde solution of specific gravity 1.078/20° contains 35 per cent formaldehyde by weight. As pointed out in Note 1, p. 378, however, technical formalin contains methanol, and the formaldehyde content of technical formalin is greater than that calculated from the specific gravity of methanol-free formaldehyde solutions. Accordingly, the figure 18.9 moles for the amount of formaldehyde present is too low. The exact amount of formaldehyde present cannot be given, but formaldehyde in excess is used and the percentage yield is based on the sodium cyanide.
2. During the reaction, the temperature should be kept as near 0° as possible and should never rise above 5°. If the temperature goes higher, a heavy oil is sometimes obtained instead of the crystalline product. It is not difficult to maintain the low temperature when the formaldehyde and ammonium chloride are cooled to 0° before any of the sodium cyanide is added.
3. In order to obtain good yields, the stirring must be vigorous throughout the entire reaction.
4. With careful washing, 500 cc. of cold water should be sufficient to remove all chlorides.
5. For most purposes, the product is pure enough as it is obtained from the reaction mixture, but it may be crystallized from water. This recrystallization, however, is attended with considerable loss.
6. It is suggested that like yields may be obtained by the following modifications: Instead of chilling the formaldehyde-ammonium chloride mixture from the outside, ice is added during the addition of the sodium cyanide to keep the temperature down, and the first half of the sodium cyanide is added during fifteen to twenty minutes. The remainder of the sodium cyanide and the acetic acid are added during thirty to forty-five minutes, the temperature being kept below 5° throughout by means of cracked ice. The slight solubility of methyleneaminoacetonitrile in the liquor makes a larger final volume of no

particular disadvantage (W. W. Hartman, private communication).
7. If a less pure product in lower yield is satisfactory the following procedure, which effects a considerable saving in time, may be used. The mixture of formaldehyde and ammonium chloride is cooled by the addition of crushed ice or solid carbon dioxide, and the acetic acid is added rapidly. Then, the temperature being maintained below 20° by adding ice or solid carbon dioxide, the sodium cyanide solution is added from a dropping funnel over a period of fifteen to twenty minutes. Stirring is continued for fifteen minutes after the cyanide has been added; then the product is filtered. The yield is 200–267 g. (45–55 per cent of the theoretical amount) of a product melting at 126–128°. (Lawrence H. Amundsen and Ruth Velitzkin, private communication.[1])

3. Discussion

Methyleneaminoacetonitrile can be prepared by the action of formaldehyde on a mixture of ammonium chloride, potassium cyanide, and acetic acid,[1] and by the action of formaldehyde on aminoacetonitrile.[2]

This preparation is referenced from:

- Org. Syn. Coll. Vol. 1, 298
- Org. Syn. Coll. Vol. 2, 310

References and Notes

1. Jay and Curtius, Ber. **27**, 59 (1894); Klages, Ber. **36**, 1507 (1903); Curtius and Welde, Ber. **43**, 868 (1910); Johnson and Rinehart, J. Am. Chem. Soc. **46**, 768, 1653 (1924); Amundsen and Velitzkin, ibid. **61**, 212 (1939).
2. Klages, J. prakt. Chem. (2) **65**, 192 (1902).

Appendix
Chemical Abstracts Nomenclature (Collective Index Number); (Registry Number)

α-Hydroformamine cyanide

acetic acid (64-19-7)

methanol (67-56-1)

ammonium chloride (12125-02-9)

formaldehyde,
formalin (50-00-0)

sodium cyanide (143-33-9)

cyanide (57-12-5)

carbon dioxide (124-38-9)

Methyleneaminoacetonitrile (109-82-0)

formaldehyde-ammonium chloride

ammonium chloride, potassium

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