



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.

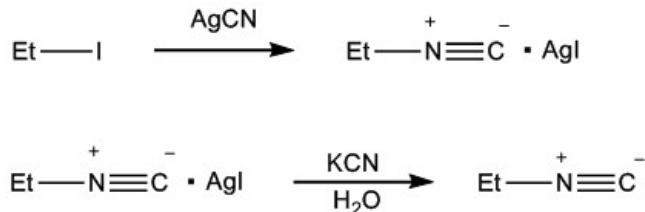
In some articles in *Organic Syntheses*, chemical-specific hazards are highlighted in red "Caution Notes" within a procedure. It is important to recognize that the absence of a caution note does not imply that no significant hazards are associated with the chemicals involved in that procedure. Prior to performing a reaction, a thorough risk assessment should be carried out that includes a review of the potential hazards associated with each chemical and experimental operation on the scale that is planned for the procedure. Guidelines for carrying out a risk assessment and for analyzing the hazards associated with chemicals can be found in Chapter 4 of Prudent Practices.

The procedures described in *Organic Syntheses* are provided as published and are conducted at one's own risk. *Organic Syntheses, Inc.*, its Editors, and its Board of Directors do not warrant or guarantee the safety of individuals using these procedures and hereby disclaim any liability for any injuries or damages claimed to have resulted from or related in any way to the procedures herein.

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.

Organic Syntheses, Coll. Vol. 4, p.438 (1963); Vol. 35, p.62 (1955).

ETHYL ISOCYANIDE



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Checked by N. J. Leonard and L. E. Coleman, Jr..

1. Procedure

Caution! This preparation should be carried out in a well-ventilated hood because ethyl isocyanide has a vile odor. Since ethyl isocyanide has been known to explode,² all operations in which it is heated, including its distillation, should be carried out behind a shield of safety glass.

Silver cyanide (454 g., 3.40 moles) is added with stirring to 530 g. (3.40 moles) of ethyl iodide in a 3-l. three-necked round-bottomed flask, equipped with a reflux condenser and a sealed Hershberg stirrer. The third neck of the flask is closed with a stopper. The lower third of the flask is immersed in a steam bath, and the mixture is stirred vigorously until it turns to a viscous, homogeneous, brown liquid (1.7–2.3 hours). Stirring is interrupted, the steam bath is removed, and the stirrer is raised to a position just above the liquid (Note 1). Water (300 ml.) is added through the condenser to avoid loss of product during the addition. Potassium cyanide (610 g., 9.37 moles) and 260 ml. of water are then added through the third neck of the flask, and the mixture is stirred for about 10 minutes, during which the heavy brown liquid below the aqueous solution disappears and a brown layer of ethyl isocyanide appears above the aqueous solution. Stirring is discontinued, the reflux condenser is replaced by one arranged for distillation, and a thermometer extending into the aqueous layer is placed in the third neck. A receiver immersed in an ice bath is attached to the condenser, and the reaction mixture is heated by means of an electric heating mantle, causing a mixture of oil and water to distil. When the distillate contains almost no oil (Note 2), the distillation is discontinued (Note 3). The receiver contains about 200 ml. of crude ethyl isocyanide and 50 ml. of water. Sodium chloride (7 g.) is dissolved in the aqueous layer, and the ice-cold mixture is poured into a separatory funnel. The aqueous layer is separated and discarded. The ethyl isocyanide is washed with two 50-ml. portions of ice-cold saturated aqueous sodium chloride solution and is dried overnight with 10 g. of anhydrous magnesium sulfate. The decanted material is distilled through a 5- to 10-plate column (Note 4), giving 88–102 g. (47–55% yield) of ethyl isocyanide, b.p. 77–79°/760 mm., n_D^{20} 1.3632. The fore-run, b.p. 63–77°/760 mm., amounts to 15–46 g. and contains 10–15% of ethyl iodide and possibly a few drops of water. Additional pure ethyl isocyanide can be obtained by drying and redistilling this fore-run.

2. Notes

1. Sometimes the liquid crystallizes to a dense solid which immobilizes the stirrer if it has not been raised. The crystallization has no effect on subsequent steps except to necessitate a longer period of stirring after the potassium cyanide is added.
2. The temperature of the residual mixture is 115–120° at this point.
3. The aqueous cyanide solution, which is very toxic, can be disposed of by flushing it down the drain with a large volume of water.
4. The submitters used an 18-in. spinning-band column (inside diameter 10 mm.). The checkers employed a 12-in. helix-packed column.

3. Discussion

Ethyl isocyanide has been obtained by treating ethylamine and chloroform with potassium hydroxide,³ by pyrolyzing the complex between ethyl isothiocyanate and triethylphosphine,⁴ by heating cyanocobaltic (III) acid with ethanol,⁵ by passing ethylene and hydrogen cyanide through an electric discharge,⁶ or by heating ethyl iodide with silver cyanide^{7,8,9} or other metal cyanides.^{8,10} The present procedure differs from earlier ones using silver cyanide mainly in that a stirrer is employed. By this modification more than half of the silver cyanide can be converted to ethyl isocyanide, contrary to the belief of the earlier workers, who thought that this was precluded by formation of a complex, C₂H₅NC·AgCN.

This preparation is referenced from:

- [Org. Syn. Coll. Vol. 5, 772](#)
- [Org. Syn. Coll. Vol. 7, 27](#)

References and Notes

1. Chemical Department, Experimental Station, E. I. du Pont de Nemours and Company, Wilmington, Delaware.
2. Lemoult, *Compt. rend.*, **143**, 902 (1906).
3. Hofmann, *Ann.*, **146**, 109 (1868).
4. Hofmann, *Ber.*, **3**, 766 (1870).
5. Hölzl, Meier-Mohar, and Viditz, *Monatsh.*, **53–54**, 237 (1929).
6. Francesconi and Ciurlo, *Gazz. chim. ital.*, **53**, 327 (1923).
7. Gautier, *Ann. chim. et phys.*, [4] **17**, 233 (1869).
8. Guillemand, *Ann. chim. et phys.*, [8] **14**, 363 (1908).
9. Lowry and Henderson, *Proc. Roy. Soc. (London)*, **A136**, 487 (1932).
10. Guillemand, *Bull. soc. chim. France*, [4] **1**, 530 (1907).

Appendix

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

cyanocobaltic (III) acid

[ethanol \(64-17-5\)](#)

[chloroform \(67-66-3\)](#)

[sodium chloride \(7647-14-5\)](#)

[hydrogen cyanide \(74-90-8\)](#)

[potassium cyanide \(151-50-8\)](#)

[potassium hydroxide \(1310-58-3\)](#)

[ethylene \(9002-88-4\)](#)

[magnesium sulfate \(7487-88-9\)](#)

Ethyl iodide (75-03-6)

ethyl isothiocyanate (542-85-8)

silver cyanide (506-64-9)

Ethyl isocyanide (624-79-3)

ethylamine (75-04-7)

triethylphosphine (554-70-1)