



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.101 (1963); Vol. 36, p.1 (1956).

BISCHLOROMETHYL ETHER

[Ether, bis(chloromethyl)-]



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1. Procedure

Caution! It has been reported that exposure to bischloromethyl ether in low concentrations has caused severe irritation of the eyes and respiratory tract, and perhaps pulmonary edema.

Proper safeguards should be taken to prevent exposure to this material both during and after its preparation. It is recommended that all operations involving this compound be carried out in a good hood.

In a 1-l. three-necked flask immersed in an ice bath and provided with a stirrer, thermometer, and dropping funnel are placed 168 ml. (200 g.) of concentrated (37–38%) hydrochloric acid (2 moles) and 240 g. of paraformaldehyde (effectively 8 moles of formaldehyde). While the temperature is maintained below 10°, 452 ml. (6.9 moles) of chlorosulfonic acid is added dropwise at such a rate that gaseous hydrogen chloride is not lost from the mixture. This requires about 5.5 hours. The mixture is stirred for 4 hours in the melting ice bath and comes to room temperature. It may be allowed to stand overnight. The layers are separated, and the product (upper layer) is washed twice with ice water. Ice is added to the product, and 250 ml. of 40% sodium hydroxide is then added to the mixture slowly with vigorous agitation until the aqueous phase is strongly alkaline (Note 1). The product is separated and dried rapidly over potassium carbonate and then over potassium hydroxide, keeping the product cold during drying (Note 2). After separation of the drying agent by filtration, 350–370 g. (76–81%) of product sufficiently pure for many purposes is obtained. On distillation there is obtained 330–350 g. (72–76%) of bischloromethyl ether, boiling at 100–104°. Approximately 95% boils at 101–101.5°, n_D^{25} 1.4420 (Note 3).

2. Notes

1. Local overheating must be carefully avoided during the alkaline washing, since it may result in vigorous decomposition.
2. The washing and drying are carried out as rapidly as possible to avoid hydrolysis of the product.
3. The submitter reports that operation of this procedure on a scale of 72 moles of paraformaldehyde gave a crude yield of 3601 g. (87%) and a distilled yield of 3519 g. (85%).

3. Discussion

Bischloromethyl ether has been prepared by saturation of formalin with dry hydrogen chloride,^{2,3,4} by the reaction of paraformaldehyde with phosphorus trichloride^{5,6} or phosphorus oxychloride,^{7,8} by solution of paraformaldehyde in concentrated sulfuric acid and treatment with ammonium chloride or dry hydrogen chloride,⁹ and by suspension of paraformaldehyde in seventy¹⁰ or eighty¹¹ percent sulfuric acid and treatment with chlorosulfonic acid. It is formed together with the asymmetrical isomer when methyl ether is chlorinated¹² and when paraformaldehyde is treated with chlorosulfonic acid.¹³ It also is obtained when chloromethyl methyl ether is chlorinated by means of chlorine¹⁴ or sulfuryl chloride.¹⁵ The present method has been published.¹⁶

This preparation is referenced from:

- [Org. Syn. Coll. Vol. 5, 218](#)

References and Notes

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Appendix

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

[potassium carbonate](#) (584-08-7)

[sulfuric acid](#) (7664-93-9)

[hydrogen chloride](#),
[hydrochloric acid](#) (7647-01-0)

[ammonium chloride](#) (12125-02-9)

[sodium hydroxide](#) (1310-73-2)

[chlorosulfonic acid](#) (7790-94-5)

[formaldehyde](#),
[formalin](#) (50-00-0)

[methyl ether](#) (115-10-6)

[Phosphorus Oxychloride](#) (21295-50-1)

sulfuryl chloride (7791-25-5)

chlorine (7782-50-5)

potassium hydroxide (1310-58-3)

phosphorus trichloride (7719-12-2)

Ether, bis(chloromethyl)- (542-88-1)

chloromethyl methyl ether (107-30-2)

Bischloromethyl ether

paraformaldehyde (30525-89-4)