Organic Syntheses

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.

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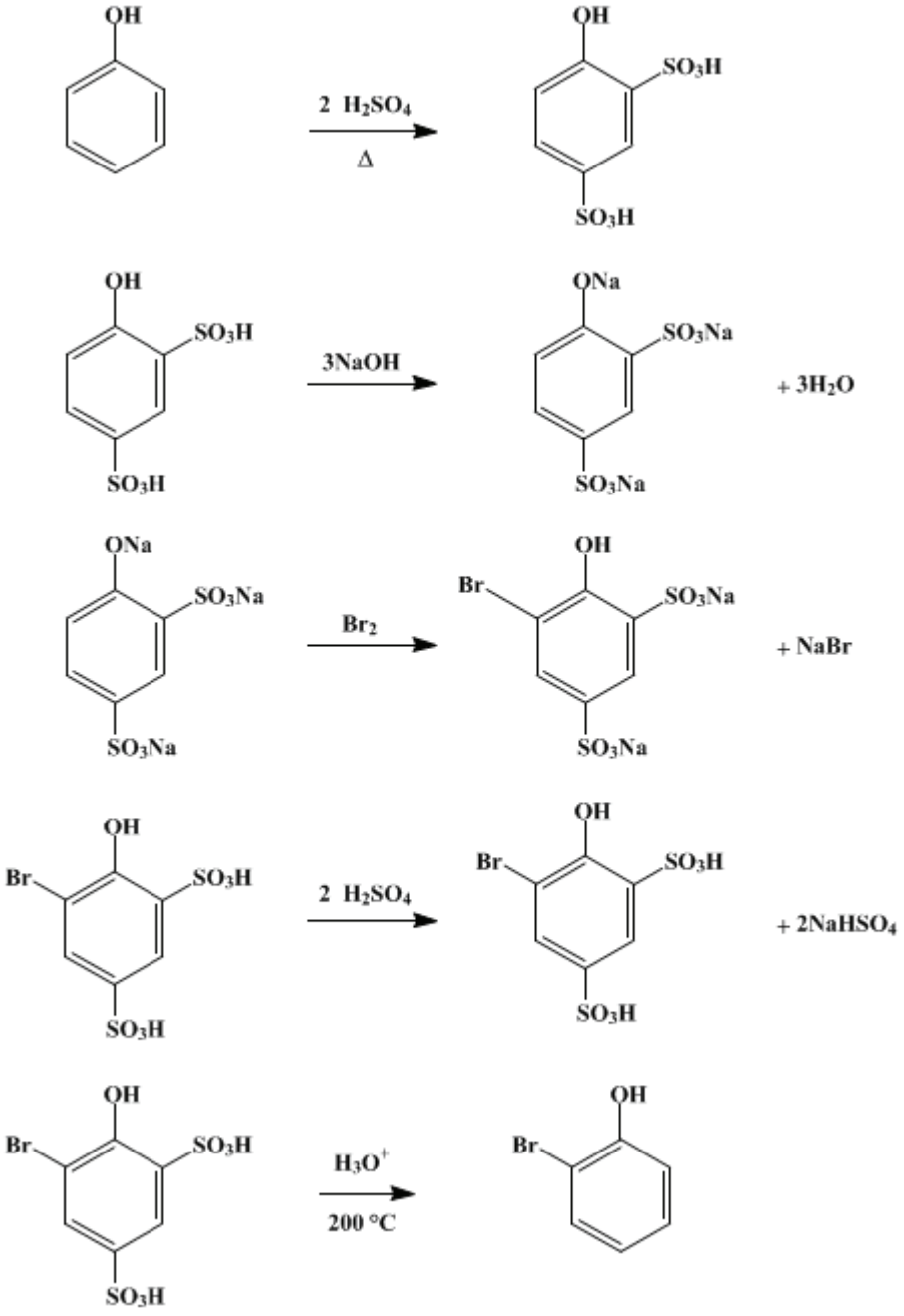
o-BROMOPHENOL

[Phenol, *o*-bromo-]



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1. Procedure

In a 3-l. three-necked flask is placed a mixture of 94 g. (1 mole) of phenol and 350 g. (190 cc., 3.5 moles) of concentrated sulfuric acid, and the mixture is heated on a boiling water bath for three hours with constant mechanical stirring. At the end of this time the boiling water bath is replaced by an ice bath. When the reaction mixture has been cooled to room temperature it is made alkaline by the careful

addition of a solution of 280 g. (7 moles) of sodium hydroxide in 700 cc. of water (Note 1). This must be done slowly and with good cooling to prevent boiling. A solid salt, which at first separates, largely dissolves at a later stage.

The alkaline solution is cooled to room temperature; with the stirrer still in constant operation, and after inserting a thermometer, 160 g. (1 mole) of bromine is added from a dropping funnel in the course of twenty to thirty minutes. During this operation the temperature is allowed to rise to 40–50°. Stirring is continued for one-half hour after all the bromine has been added. The solution should still be alkaline and should contain only a small amount of suspended material.

In order to evaporate the solution, the flask is then placed in an oil bath, which is brought to a temperature of 150–155°. As soon as solid material begins to separate, the mixture will bump badly unless a rather rapid current of air is passed through the reaction mixture. This has the further advantage of hastening the evaporation (Note 2). The heating is continued until a thick, pasty, gray mass is left as a residue, the process requiring thirty to forty minutes. The mixture is allowed to cool and then made strongly acid by the addition of 800 cc. of concentrated sulfuric acid. This must be done slowly and under a hood on account of the rapid evolution of hydrogen bromide.

The flask is then heated in an oil bath maintained at a temperature of 190–210° and the mixture is distilled with steam. The sulfonate groups are hydrolyzed in this process, and the bromophenol passes over as a heavy, colorless or pale yellow oil. In about one hour the distillate is clear. The product is extracted with ether, the ether is removed by distillation from the steam bath, and the residue is distilled at atmospheric pressure (Note 3). The fraction boiling at 194–200° represents practically pure *o*-bromophenol. The yield is 70–75 g. (40–43 per cent of the theoretical amount) (Note 4). *o*-Bromophenol is a colorless liquid with a very characteristic odor. It is rather unstable and decomposes on standing, becoming brown or red in color.

2. Notes

1. Too great an excess of water in the reaction mixture appears to result in the formation of higher bromination products. Insufficient water causes the reaction mixture to solidify during bromination, preventing efficient agitation.
2. A small amount of tribromophenol is eliminated in the evaporation, the substance being volatile with steam.
3. Distillation should be as rapid as possible, as the *o*-bromophenol is somewhat unstable and decomposes rapidly at the high temperature. Distillation at reduced pressure has not been found to offer much improvement.
4. The rather large residue of higher-boiling material probably contains higher bromination products of phenol.

3. Discussion

o-Bromophenol has been prepared by the bromination of phenol in various solvents and with various brominating agents,[1] and at high temperature in the absence of a solvent.[2] It has been obtained by the decarboxylation of 2-bromo-3-hydroxybenzoic acid,[3] by the diazotization of *o*-bromoaniline,[4] and from *o*-aminophenol by the Sandmeyer reaction.[5] The method given here, which is an adaptation of the procedure of Takagi and Kutani[6] for the preparation of 2-chlorophenol, has been improved by using nitrobenzene as a solvent in the bromination of the phenolsulfonic acid.[7]

References and Notes

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

sulfuric acid (7664-93-9)

ether (60-29-7)

sodium hydroxide (1310-73-2)

phenol (108-95-2)

hydrogen bromide (10035-10-6)

bromine (7726-95-6)

o-aminophenol (95-55-6)

Nitrobenzene (98-95-3)

phenolsulfonic acid

bromophenol,
o-Bromophenol,
Phenol, o-bromo- (95-56-7)

tribromophenol

2-bromo-3-hydroxybenzoic acid

2-chlorophenol (95-57-8)

o-bromoaniline (615-36-1)