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.

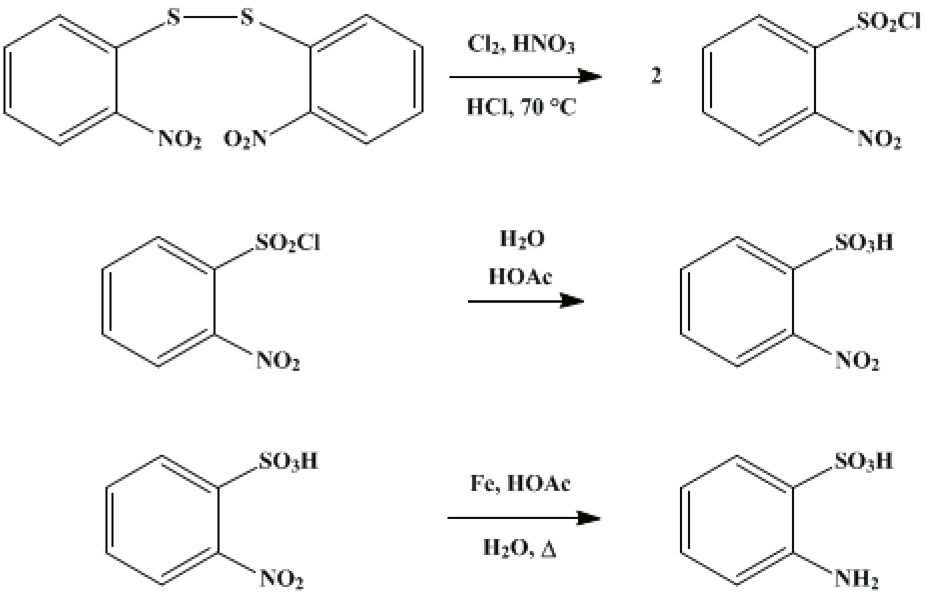
These paragraphs were added in September 2014. The statements above do not supersede any specific hazard caution notes and safety instructions included in the procedure.

DOI:10.15227/orgsyn.015.0055

Organic Syntheses, Coll. Vol. 2, p.471 (1943); Vol. 15, p.55 (1935).

ORTHANILIC ACID

[Benzenesulfonic acid, *o*-amino-]



Submitted by E. Wertheim
Checked by Reynold C. Fuson and R. S. Schreiber.

1. Procedure

(*A*) *o-Nitrobenzenesulfonyl Chloride*.—A 3-l. three-necked, round-bottomed flask is fitted with an efficient liquid-sealed stirrer, a reflux condenser, and an inlet tube for introducing chlorine well beneath the surface of the liquid. A glass outlet tube leads from the reflux condenser to the hood. In the flask are placed 200 g. (0.65 mole) of di-*o*-nitrophenyl disulfide (Org. Syn. Coll. Vol. I, **1941**, 220), 1 l. of concentrated hydrochloric acid (sp. gr. 1.18), and 200 cc. of concentrated nitric acid (sp. gr. 1.42). A stream of chlorine is passed into the mixture at the rate of about two bubbles per second, and the solution is warmed on a steam bath to 70°. In about thirty minutes the disulfide melts and the solution becomes orange-red in color. After the disulfide has melted, the heating and addition of chlorine are continued for one hour. The sulfonyl chloride is separated immediately from the supernatant liquid by decantation, washed with two 300-cc. portions of warm water (70°), and allowed to solidify. The water is drained from the solid mass as completely as possible.

The washed chloride is dissolved in 140 cc. of glacial acetic acid at 50–60°, and the solution is quickly filtered by suction. The filtrate is chilled by immersing the flask in cold water and is vigorously stirred in order to cause the sulfonyl chloride to separate in fine crystals. The mixture is now triturated thoroughly with a liter of cold water which is then decanted into a large Büchner funnel. The process is repeated twice. Finally, a liter of cold water is added to the mixture, and then 10 cc. of concentrated ammonium hydroxide (sp. gr. 0.90) is added, with stirring. The crystals are collected at once on the filter, washed with 200 cc. of water, and allowed to dry in the air. The yield is 240 g. (84 per cent of the theoretical amount) of a light yellow product, melting at 64–65°. This material may be used without further purification (and without being dried) for the preparation of orthanilic acid.

(*B*) *Orthanilic Acid*.—A 3-l. flask, fitted with a reflux condenser and a liquid-sealed stirrer, is placed on a hot plate. In the flask is placed a mixture of 200 g. (0.90 mole) of *o*-nitrobenzenesulfonyl chloride, 100 g. of anhydrous sodium carbonate, and 600 cc. of water. The mixture is heated to boiling and stirred in order to promote the hydrolysis, which is complete within forty-five minutes after the compound has melted. The orange-red solution is filtered, and the filtrate is made just acid to litmus by the addition of acetic acid, about 25 cc. being required. The solution is transferred to a 3-l. three-necked flask which is provided with a reflux condenser and an efficient liquid-sealed stirrer. The solution is heated to boiling on the hot plate, and iron filings (about 20-mesh) are added, with vigorous stirring, at the rate of about 25 g. every fifteen minutes. A total of 350 g. of iron is used. In a few minutes the mixture becomes very deep brown in color and has a tendency to foam. After stirring for four hours, a sample when filtered should yield an almost colorless filtrate; if the filtrate is red or orange, stirring and heating must be continued. When a light-colored filtrate is obtained, 2 g. of decolorizing carbon is added, the hot mixture is filtered by suction, and the residue is washed several times with small amounts of hot water which are added to the main solution. The filtrate is chilled to about 15°, and 95 cc. of concentrated hydrochloric acid is slowly added. The orthanilic acid separates in fine colorless crystals which appear as hexagonal plates under the microscope (Note 1). When the temperature has again fallen to about 15°, the mass is filtered and the precipitate is washed with water and then with ethyl alcohol. If about 20 cc. of concentrated hydrochloric acid is added to the filtrate, an additional deposit of about 1 g. will be obtained after a few hours' standing. The yield is 89 g. (57 per cent of the theoretical amount). The compound is 97–100 per cent pure and for many purposes will not require recrystallization. Material of analytical purity may be obtained by one recrystallization from hot water. The decomposition point is about 325° (bloc Maquenne).

2. Notes

1. Solutions of orthanilic acid, when chilled below 13.5°, yield the hydrated form of the acid, which crystallizes as needles (see photographs in the paper by Fierz-David and others).[1]

3. Discussion

Orthanilic acid was first made by the reduction of nitrobenzenesulfonic acid by ammonium sulfide.[2] This reduction has also been carried out electrolytically, and by the use of iron or zinc.[3] The acid has also been made by the rearrangement of phenylsulfamic acid;[4] by the action of sodium hypobromite upon potassium *o*-carbaminebenzenesulfonate;[5] by the reduction of the mixed nitrobenzenesulfonic acids followed by separation of the isomers;[6] by the action of methyl alcohol upon *o*-nitrophenylsulfur chloride;[7] by the action of acid upon diacetyl diphenylsulfamide;[8] by the debromination of *p*-bromoaniline-*o*-sulfonic acid;[9] by the reduction of 1,2,6-aminothiophenolsulfonic acid;[10] and by the hydrolysis and reduction of *o*-nitrobenzenesulfonyl chloride, which was obtained from di-*o*-nitrophenyl disulfide.[11]

References and Notes

1. Fierz-David, Schlittler, and Waldemann, Helv. Chim. Acta **12**, 663 (1929).
2. Limpricht, Ann. **177**, 79, 98 (1875).
3. Wohlfahrt, J. prakt. Chem. (2) **66**, 556 (1902); Goldschmidt and Eckardt, Z. physik. Chem. **56**, 411 (1906); Holleman and Polak, Rec. trav. chim. **29**, 419 (1910); Sharvin, Arbuzov, and Varshavskii, J. Chem. Ind. (Moscow) **6**, 1409 (1929) [C. A. **25**, 501 (1931)].
4. Bamberger and Hindermann, Ber. **30**, 654 (1897); Bamberger and Kunz, ibid. **30**, 2276 (1897); Bretschneider, J. prakt. Chem. (2) **55**, 286 (1897); Bamberger and Rising, Ber. **34**, 249 (1901); Baumgarten, ibid. **59**, 1976 (1926).
5. Bradshaw, Am. Chem. J. **35**, 339 (1906).
6. Bahlmann, Ann. **186**, 307 (1877); Franklin, Am. Chem. J. **20**, 457 (1898); Obermiller, Ger. pat. 281,176 [Frdl. **12**, 125 (1914-16)].
7. Zincke and Farr, Ann. **391**, 59, 66 (1912).
8. Wohl and Koch, Ber. **43**, 3301 (1910).
9. Thomas, Ann. **186**, 128 (1877); Baseler Chem. Fabrik Bindschedler, Ger. pat. 84,141 [Frdl. **4**, 90 (1894-97)]; Kreis, Ann. **286**, 377 (1895); Bradshaw, Am. Chem. J. **35**, 340 (1906); Boyle, J. Chem. Soc. **95**, 1698 (1909); Scott and Cohen, ibid. **121**, 2042 (1922).
10. Rassow and Döhle, J. prakt. Chem. (2) **93**, 188, 203 (1916).
11. Elgersma, Rec. trav. chim. **48**, 752 (1929).

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

nitrobenzenesulfonic acids

1,2,6-aminothiophenolsulfonic acid

potassium o-carbaminebenzenesulfonate

ethyl alcohol (64-17-5)

hydrochloric acid (7647-01-0)

acetic acid (64-19-7)

methyl alcohol (67-56-1)

iron,
iron filings (7439-89-6)

nitric acid (7697-37-2)

sodium carbonate (497-19-8)

decolorizing carbon (7782-42-5)

chlorine (7782-50-5)

zinc (7440-66-6)

ammonium hydroxide (1336-21-6)

ammonium sulfide

sodium hypobromite

Orthanilic acid,
Benzenesulfonic acid, o-amino- (88-21-1)

o-Nitrobenzenesulfonyl chloride (1694-92-4)

nitrobenzenesulfonic acid (80-82-0)

phenylsulfamic acid

diacetyl diphenylsulfamide

Di-o-nitrophenyl disulfide (1155-00-6)

o-Nitrophenylsulfur chloride (7669-54-7)

p-bromoaniline-o-sulfonic acid