



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.

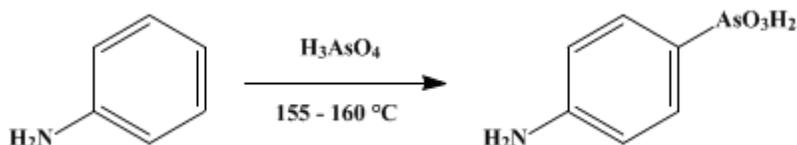
In some articles in *Organic Syntheses*, chemical-specific hazards are highlighted in red "Caution Notes" within a procedure. It is important to recognize that the absence of a caution note does not imply that no significant hazards are associated with the chemicals involved in that procedure. Prior 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.

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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.

Organic Syntheses, Coll. Vol. 1, p.70 (1941); Vol. 3, p.13 (1923).

ARSANILIC ACID



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1. Procedure

To 1035 g. of sirupy **arsenic acid** (80–85 per cent, sp. gr. 2.00/20°; **Note 1**) in a 12-inch evaporating dish, is added 828 g. (800 cc.) of **aniline** (**Note 2**) in 100-cc. portions; meanwhile the lumps of **aniline arsenate** which are formed are broken up by rapid stirring with a porcelain spatula. When all the **aniline** has been added, the powdered solid is transferred to a 3-l. round-bottomed flask equipped with a mechanical stirrer, a thermometer reaching to the lower part of the vessel, and a condenser arranged for downward distillation (**Note 3**); an additional 800 cc. of **aniline** is added and the flask heated on an oil bath at 155–160° with stirring for four and one-half hours. The mass will have assumed an intense violet color.

The reaction mixture is poured into 700 cc. of water and the flask is washed out with a portion of a previously prepared solution of 330 g. of **sodium hydroxide** in 1400 cc. of water, the washings being added to the reaction mixture. The remainder of the alkali is then added and the mixture agitated and cooled under the tap. At this point two distinct layers are present, a lower pink-colored alkaline water layer, and an upper strongly colored **aniline** layer. The water layer is, while warm, carefully separated from the purple-colored oil by means of a separatory funnel (heated to prevent the separation of **sodium arsanilate**) and after treatment with 15 g. of **decolorizing carbon** is filtered through paper.

The **arsanilic acid** can be obtained from the aqueous alkaline solution either as the free acid or as the sodium salt. To obtain the free acid the solution is acidified with concentrated **hydrochloric acid** until the purple color of **tetrabromophenolsulfonphthalein** is changed to a faint yellow. Care should be taken in the addition of the acid not to overstep the end-point (**Note 4**). Crystallization is stimulated by scratching, and the flask is allowed to stand overnight to complete the precipitation. The crystals of pinkish-yellow acid (**Note 5**) are filtered off, digested with 340 cc. of **ethyl alcohol**, filtered, and recrystallized from 2.5 l. of boiling water, adding 5–6 g. of **Norite** and filtering hot. This crystallization always produces a white product. The yield of thoroughly dry **arsanilic acid** is 147–184 g. (10.9–14.5 per cent of the theoretical amount) (**Note 6**), (**Note 7**) and (**Note 8**).

2. Notes

1. **Arsenic acid** obtained by oxidizing arsenious acid with **nitric acid** is satisfactory, providing all oxides of nitrogen are removed. If commercial **arsenic acid** is used it should be evaporated first on the water bath and then with a free flame practically to the stage of the anhydrous acid, when most of the oxides of nitrogen are driven out. water is added just before the material solidifies, and if necessary, the acid is again concentrated.
2. A good commercial grade of **aniline**, light in color and boiling with not more than a 1° range, may be used. It is not necessary to use a freshly distilled product.
3. During the reaction a considerable amount of water escapes, together with **aniline** vapors, from the reaction flask. The condenser is provided to condense and collect the distillate outside the reaction flask, and thus minimize any danger from the **aniline** vapors. About 200 cc. of distillate will be obtained.
4. The precipitation of **arsanilic acid** from the reaction mixture may cause difficulty if care is not taken to attain a definite hydrogenion concentration. The indicator consists of a 0.5 per cent solution of bromophenol blue. Filter paper dipped into this solution and dried forms a convenient test paper. That

concentration of hydrogen ion at which the color of this indicator changes from purple to a faint yellow is considered the end-point. Congo red paper may also be used, but it is somewhat less sensitive.

5. A highly colored acid is occasionally obtained; under such circumstances it may become necessary to effect its purification by conversion into the sodium salt, followed by precipitation of the hot concentrated solution with alcohol, and regeneration of the acid. Colored impurities may also be eliminated by a process of fractional precipitation during the decomposition of the sodium salt, the impurities being separated with the first 25 g. fraction of the acid.

6. It is necessary to air dry the crystals of [arsanilic acid](#) at least twenty-four hours before they come to constant weight.

7. Additional amounts of [arsanilic acid](#) may be obtained from the various mother liquors. The products thus obtained are usually rather impure and hence are not considered in the yields quoted. On larger-scale production it would be economical to recover this material as well as excess [aniline](#).

8. In preparing [arsanilic acid](#) upon a larger scale it was found that doubling the amount of [aniline](#) used and continuing the heating at 155° during twelve to sixteen hours resulted in a yield of 190–240 g. of recrystallized acid. For small-scale work, when [aniline](#) is not recovered and time is an important factor, the directions as presented seem preferable, particularly so since the [arsanilic acid](#) prepared during a short heating period is purified more readily.

3. Discussion

[p-Arsanilic acid](#) can be prepared from [aniline](#) and [arsenic acid](#).¹ Various temperatures ranging from 150–200° and various ratios of [aniline](#) and [arsenic acid](#) have been recommended. From most of the published methods it might be inferred that this is a smooth reaction; whereas an important side reaction consists in the oxidizing action of [arsenic acid](#) on [aniline](#), with the production of a deeply purple-colored dye as well as much tarry material and some diarylarsonic acid. It can also be prepared by the reduction of [p-nitrobenzenearsonic acid](#) with [iron](#) and [hydrochloric acid](#),² or by reduction of the salts of [p-nitrobenzenearsonic acid](#) in the presence of a [nickel](#) catalyst.³

This preparation is referenced from:

- [Org. Syn. Coll. Vol. 1, 488](#)

References and Notes

1. Fichter and Elkind, *Ber.* **49**, 239 (1916); Kober and Davis, *J. Am. Chem. Soc.* **41**, 451 (1919); Cheetham and Schmidt, *ibid.* **42**, 828 (1920); Nijk, *Rec. trav. chim.* **41**, 484 (1922).
2. Les Etablissements Poulenc Frères, *Ger. pat.* 408,575 [*C. A.* **23**, 849 (1929)]; *Fr. pat.* 636,660 [*C. A.* **23**, 848 (1929)].
3. Inoue and Kimura, *J. Pharm. Soc. Japan* **53**, 1105 (1933) [*C. A.* **28**, 3391 (1934)]; Stevinson and Hamilton, *J. Am. Chem. Soc.* **57**, 1298 (1935).

Appendix

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

oxides of nitrogen

arsenious acid

bromophenol blue

ethyl alcohol (64-17-5)

hydrochloric acid (7647-01-0)

aniline (62-53-3)

sodium hydroxide (1310-73-2)

iron (7439-89-6)

nitric acid (7697-37-2)

Arsanilic acid,
p-Arsanilic acid (98-50-0)

arsenic acid (1327-52-2)

aniline arsenate

sodium arsaniolate (127-85-5)

tetrabromophenolsulfonphthalein

nickel (7440-02-0)

decolorizing carbon,
Norite (7782-42-5)

p-nitrobenzenearsonic acid (98-72-6)