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.

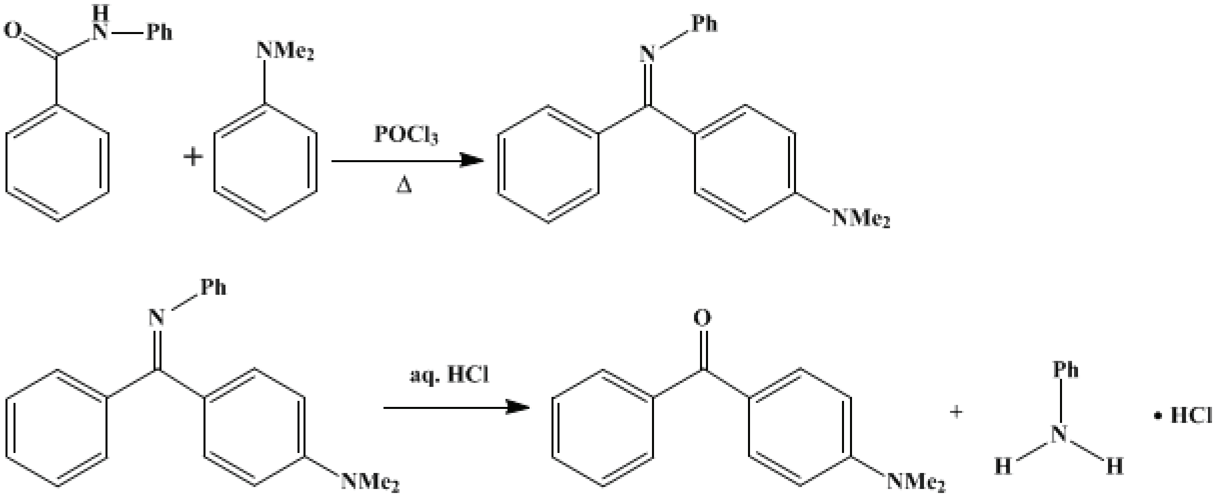
These paragraphs were added in September 2014. The statements above do not supersede any specific hazard caution notes and safety instructions included in the procedure.

DOI:10.15227/orgsyn.007.0024

Organic Syntheses, Coll. Vol. 1, p.217 (1941); Vol. 7, p.24 (1927).

p-DIMETHYLAMINOBENZOPHENONE

[Benzophenone, *p*-dimethylamino-]



Submitted by Charles D. Hurd and Carl N. Webb.
Checked by C. S. Marvel and P. L. Salzberg.

1. Procedure

Five hundred grams (2.5 moles) of dry, powdered benzanilide (p. 82), 1025 g. (8.5 moles) of technical dimethylaniline, and 525 g. (307 cc., 3.4 moles) of phosphorus oxychloride are mixed (Note 1) in a 3-l. round-bottomed Pyrex flask (Note 2). The flask is fitted with a two-holed cork stopper which carries a reflux condenser and a thermometer. The top of the condenser is provided with a calcium chloride tube; the bulb of the thermometer reaches beneath the surface of the liquid.

The flask is warmed in a water bath until the appearance of a sudden exothermic reaction (Note 3), at which point the flask must be cooled at once by rotating it underneath the surface of cold water. The cooling is continued until the thermometer indicates a temperature of 125° or less. The flask is then immersed in a bath of boiling water for about three hours, after which the mixture is cooled to about 50°, and poured slowly into 2.5 l. of warm (Note 4) dilute hydrochloric acid, made from 325 cc. (about 4 moles) of concentrated acid, contained in a large crock of about 15 l. (4 gal.) capacity. The mixture is left for about three hours until hydrolysis is complete (Note 5).

About 8 l. of water is added to precipitate the *p*-dimethylaminobenzophenone. The solution, milky at first, soon deposits sandy crystals of light green color, which are collected on a 20-cm. Büchner funnel. They are transferred to a beaker and washed with 1.5 l. of water, after which they are again collected on the filter, washed, pressed as dry as possible, and air dried. With no further purification the melting point is 88–90°. The yield is 350–390 g. An additional 85–100 g. of inferior product, m.p. 70–80°, is obtained by treating the combined filtrates with a solution of 250 g. (6.2 moles) of sodium hydroxide. This product, air-dried as before, is dissolved in 300–400 cc. of hot alcohol from which, by partial evaporation and cooling, more than half separates in good crystalline form, m.p. 88–90.5°. This material may be combined with the first product of similar melting point. The total yield is 410–440 g. (72–77 per cent of the theoretical amount) (Note 6).

The crude product melts fairly sharply, but it is colored light green. The color may be almost completely removed by recrystallization from hot alcohol. The best result is obtained by dissolving 100 g. of the crude product in 600 cc. of boiling alcohol, heating with 5 g. of decolorizing carbon (Norite), filtering, and cooling the solution in an ice-salt bath. The crystals are then separated from the mother liquor by centrifuging (Note 7). The yield of almost colorless crystals melting at 89.5–90.5° is 80 g.

2. Notes

1. This causes an elevation in temperature to about 50°.
2. Pyrex is essential to avoid breakage when the hot flask is cooled rapidly.
3. This exothermic reaction usually begins at 90–110°, and the temperature rises in a few seconds to about 180°. In smaller runs, e.g., with 100 g. of benzanilide, it is not advisable to cool the flask before the temperature has reached about 180°, as some benzanilide may remain unchanged. The flask and the attached condenser should be readily detachable from the supporting ringstand so that the whole can be lifted and cooled quickly. A pail of cold water should be at hand for this purpose.
4. The temperature of the acid is 50° at the start and about 80° during the addition.
5. This should give a homogeneous solution. Should there be unused benzanilide, it will appear at this point and should be removed by filtration.
6. It is impracticable to obtain a further yield of ketone by the addition of more sodium hydroxide to the filtrate. Nor does it seem practical to recover the aniline and the excess of dimethylaniline.
7. If the crystals are separated by suction filtration, it is very hard to remove all the mother liquor. When such crystals are air-dried, the alcohol evaporates and leaves the outer layer of material colored deep green.

3. Discussion

p-Dimethylaminobenzophenone can be prepared from benzanilide, dimethylaniline, and phosphorus oxychloride;[1] from malachite green by prolonged exposure to direct sunlight,[2] or by heating with concentrated hydrochloric acid to 180°;[3] from the imide chloride of benzanilide with dimethylaniline;[4] and by methylation of *p*-aminobenzophenone with methyl iodide at 180°,[5] or with methyl sulfate.[6] The ketone has not been prepared by methods involving the use of zinc chloride, and attempts to prepare it by the Friedel-Crafts reaction have given very poor yields.[4]

This preparation is referenced from:

- Org. Syn. Coll. Vol. 1, 82

References and Notes

1. Meister, Lucius, and Brüning, Ger. pat. 41,751 [Frdl. **1**, 44 (1877–87)]; Meisenheimer, Budkewicz and Kananow, Ann. **423**, 84 (1921).
2. Iwamoto, Bull. Chem. Soc. Japan **10**, 420 (1935) [C. A. **30**, 1235 (1936)].
3. Doebner, Ann. **217**, 257 (1883); Ber. **13**, 2225 (1880).
4. Shah and Chaubal, J. Chem. Soc. **1932**, 650.
5. Doebner, Ann. **210**, 269 (1881); Doebner and Weiss, Ber. **14**, 1837 (1881).
6. Baeyer, Ann. **354**, 190 (1907).

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

malachite green

imide chloride of benzanilide

alcohol (64-17-5)

hydrochloric acid (7647-01-0)

aniline (62-53-3)

sodium hydroxide (1310-73-2)

Benzanilide (93-98-1)

decolorizing carbon (Norite) (7782-42-5)

Phosphorus Oxychloride (21295-50-1)

zinc chloride (7646-85-7)

dimethylaniline (121-69-7)

Methyl iodide (74-88-4)

methyl sulfate (75-93-4)

p-Dimethylaminobenzophenone,
Benzophenone, p-dimethylamino- (530-44-9)

p-aminobenzophenone (1137-41-3)