

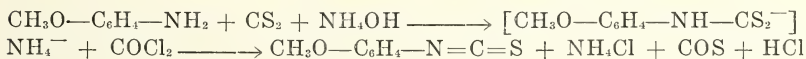
p-Methoxyphenylisothiocyanate as a Reagent for the Identification of Amines

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Phenylisothiocyanate is one of the most satisfactory reagents available for the identification of primary and secondary amines, since it reacts readily with them, and usually gives crystalline derivatives which are formed in good yield and are easily purified. Unlike its oxygen analog, phenylisothiocyanate does not react with water, and hence the amines do not have to be anhydrous; this is a distinct advantage in the case of many of the lower, water-soluble amines. There is, however, one draw-back to the general use of phenylisothiocyanate; the derivatives which it forms with the lower aliphatic amines are apt to be oils or low-melting solids, and consequently, are not ideal derivatives.

When a methoxyl group is introduced into an aromatic ring, it tends to raise the melting point of the compound, and to make it more crystalline. For this reason we considered it of interest to investigate the use of p-methoxyphenylisothiocyanate as a derivative reagent for amines. This compound has been prepared earlier,¹ but its reactions with amines were not studied.

We synthesized p-methoxyphenylisothiocyanate by the method previously described,¹ using p-anisidine, carbon disulfide and phosgene:



The product obtained by this reaction was a light yellow oil.

We found that p-methoxyphenylisothiocyanate reacted smoothly with most primary and secondary amines, both aliphatic and aromatic. In most cases the reaction was spontaneous and exothermic, and a solid derivative formed at once. The derivatives were usually obtained in good yield, and were easily purified to constant melting point by recrystallization from 95% alcohol.

About thirty amines were used in this work. Of this number two, namely propylamine and dipropylamine, gave oils which could not be made to solidify at room temperature, and two, m-nitroaniline and 2,4-dinitroaniline, failed to react with the reagent. The diamines gave the di-p-methoxyphenylthioureas, as shown by the analyses. The p-methoxyphenylthioureas were compared with the corresponding phenylthioureas; in most cases the p-methoxy compounds melted as high as, or higher than, the unsubstituted analogs. Since some of the phenylthioureas were not listed in Shriner and Fuson² we prepared them. The data are recorded in Table I.

Experimental Part

Reagents.—The p-methoxyphenylisothiocyanate was prepared by the method of Slotta and Dressler¹; it boiled at 129-130°/8 mm. The amines, and the phenylisothiocyanate were obtained from the Eastman Kodak Company, and were used without purification.

p-Methoxyphenylthioureas.—Approximately equal volumes of the amine and reagent were mixed in a 3-inch Pyrex test tube. Usually a reaction occurred spontaneously, with evolution of heat. When this had subsided, or if it did not occur, the mixture was warmed gently over a small free flame for a few minutes, and was then allowed to cool. If no solid separated the oil was rubbed with a glass rod, and was chilled in an ice bath. Usually at this point a solid product was obtained. Occasionally it was necessary to warm the mixture again for a few minutes.

The solid reaction product was washed with a few milliliters of cold 95% alcohol, and was then recrystallized from a small amount of the same solvent, until the melting point did not change. Representative derivatives were analyzed for nitrogen by the semi-micro Dumas procedure, and a close agreement was obtained in all cases between the observed and calculated values.

Phenylthioureas.—These were prepared by the same procedure described above for the p-methoxyphenylthioureas.

Summary

The use of p-methoxyphenylisothiocyanate as a reagent for the identification of amines is described. The p-methoxyphenylthioureas of about thirty amines have been prepared and their melting points tabulated. These derivatives have been compared with the corresponding unsubstituted phenylthioureas.

References

1. Slotta and Dressler, Ber. deutsch. Chem. Gesell., **63**, 888 (1930).
2. Shriner and Fuson, *The Systematic Identification of Organic Compounds*, 2nd ed., John Wiley and Sons, New York, p. 126 (1940).

TABLE I.—P-METHOXYPHENYLTHIOUREAS AND PHENYLTHIOUREAS

Amine	p-Methoxyphenylthiourea			Phenylthiourea
	M. P. °C.	% N obs'd	% N calc'd	M. P. °C.
Diethyl.....	104-105	.....	.....	34
n-Propyl.....	oil	.....	.....	63
Di-n-propyl.....	oil	.....	.....	69
n-Butyl.....	74	12.10	12.01	65
Di-n-butyl.....	82	.....	.....	86
iso-Butyl.....	112	.....	.....	82
n-Amyl.....	82.5	.....	.....	69
n-Heptyl.....	89	.....	.....	75
Cyclohexyl.....	135	10.41	10.60	148-149*
Dicyclohexyl.....	94-95	.....	.....	88-89*
Piperidine.....	145-146	10.95	11.10	98-99*
Benzyl.....	109	.....	.....	153-154*
Dibenzyl.....	117	7.64	7.73	144-145*
α -Phenylethyl.....	112.5	9.66	9.78	103-105*
Aniline.....	143	10.63	10.85	154
N-Methylaniline.....	102-103	.....	.....	87
N-Ethylaniline.....	99	9.69	9.78	89
o-Toluidine.....	139	.....	.....	136
m-Toluidine.....	139-140	.....	.....	94
p-Toluidine.....	148.5	10.53	10.29	141
p-Anisidine.....	187	9.93	9.72	157
p-Bromoaniline.....	178-179	.....	.....	148
o-Chloroaniline.....	155	9.82	9.57	156
α -Naphthylamine.....	162-163	.....	.....	165
β -Naphthylamine.....	160	8.91	9.09	182-183
p-Aminobiphenyl.....	193-194	8.27	8.38	.....
Ethylene diamine.....	189-190 d	14.17	14.35	187-190*
Piperazine.....	245-250 d	.....	.....	.....
Benzidine.....	235 d	10.91	10.89	304-305*

* These phenylthioureas were prepared in the course of the present work.