# PRODUCTS OF THE REACTION OF ANABASINE WITH PHOSGENE

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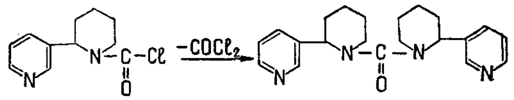
UDC 547.944+547.492

When reacted with phosgene, pyridine forms a yellow-orange addition product which is known as the dipyridinium salt of phosgene [1, 2]. Piperidine and morpholine on reacting with phosgene give acid chlorides, piperidine–N–carbonyl chloride [3] and morpholine-N-carbonyl chloride [4], or the corresponding symmetrical ureas [5].

Anabasine is a secondary-tertiary heterocyclic amine containing pyridine and piperidine rings in the molecule. Consequently, in its reaction with phosgene one may expect the formation of the anabasinium salt of phosgene (I), anabasine-N-carbonyl chloride (II), and N,N'-carbonyldianabasine (III). In addition, it is known that when anabasine reacts with phosgene an intense red color is formed, which is used for the qualitative detection of phosgene [6]. The red color shows that the pyridine ring of anabasine opens with the formation of substance IV, which has a completely conjugated system with strong absorption in the visible region of the spectrum. The color is intensified in the presence of moisture and alkalis.

Mixing of equimolecular amounts of toluene solutions of anabasine and phosgene cooled to −15°C gives an amorphous substance, the anabasinium salt of phosgene $C_{10}H_{14}N_2 \cdot COCl_2$, which with aniline forms diphenylurea and the initial anabasine. At room temperature this salt gradually becomes yellow-orange, and in time forms a dark red product V, from which the acid chloride II and substance IV have been isolated. The acid chloride II is stable under the usual conditions only in the form of the hydrochloride since, in the free state, it decomposes according to the following reaction:



Reaction of II with ethanol has given ethyl anabasine-N-carboxylate (VI), identical with the reaction product of anabasine with ethyl chloroformate [7].

Oxidation of IV with potassium permanganate in an acid medium gives pipecolinic acid, confirming the fact that, under the action of phosgene, the opening of the pyridine ring of anabasine takes place. Compound IV is 1-chloro-5-chloroformylamino-2-(piperidin-2-yl)penta-1,3-diene, whose structure and composition were shown by its IR spectra and by elementary analysis, respectively. The complex absorption spectrum in the 1600-1660 $cm^{-1}$ region, having three bands (the strongest at 1605 $cm^{-1}$ and weak bands at 1640 and 1660 $cm^{-1}$), shows the presence of conjugated C = C bonds. The peak in the 1680 $cm^{-1}$ region shows the presence of a −C = N− group, and there is an absorption band in the 1820 $cm^{-1}$ region corresponding to an acid chloride group. The presence of a piperidine ring was shown by the absorption bands for $CH_2$ groups of saturated six-membered rings and for an NH group in the 2920 and 3150 $cm^{-1}$ regions, respectively.

The IR spectra of the adduct of anabasine with phosgene have no absorption bands characteristic for the stretching vibrations of a C = O group (1810-1710 $cm^{-1}$). A band appears in the 1900-2200 $cm^{-1}$ region, reflecting an increase in the order of the C = O bond which results from conversion of phosgene into an ion which forms a salt with the anabasine. For substances II and III, absorption bands appear corresponding to

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Zaporozhe Branch, Donets Institute of Soviet Trade. Translated from Khimiya Prirodnykh Soedinenii, No. 5, pp. 571-574, September-October, 1970. Original article submitted March 9, 1970.

TABLE 1. Some Properties of the Products of the Reaction of Anabasine with Phosgene

| Compound | External form | bp (p, mm), mp, deg | $n_D^{20}$ | Yield | Found % |  |  |  | Formula | Calculated % |  |  |  | Hydrochloride, mp, °C | $R_f$ $C_6H_6-CHCl_3-CH_3OH$ system (18:15:1) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  |  |  | C | H | N | Cl |  | C | H | N | Cl |  |  |
| I | White amorphous substance | — | — | 98 | — | — | 10,56 | 27,58 | $C_{11}H_{14}N_2OCl_2$ | — | — | 10,73 | 27,20 | — | Start |
| II | Colorless liquid | 105–106 (1·10⁻⁴) | 1,5416 | 27 | 58,92 | 5,88 | 12,24 | 16,12 | $C_{11}H_{13}N_2OCl_2$ | 58,80 | 5,74 | 12,47 | 15,81 | 196 | 0,76 |
| III | Crystals in form of needles | 188 | — | 32 | 72,18 | 7,36 | 15,76 | — | $C_{21}H_{26}N_4O$ | 72,00 | 7,43 | 16,00 | — | Did not melt below 320 | 0,53 |
| IV | Dark-red viscous oil | 127–123 (1·10⁻⁴) | — | 20 | 55,92 | 5,28 | 10,60 | 27,41 | $C_{11}H_{14}N_2OCl_2$ | 55,75 | 5,36 | 10,73 | 27,20 | 284 | 0,40 |
| VI | Colorless liquid | 146–147 (2 mm) | 1,5241 | 58 | — | — | — | — | — | — | — | — | — | 197 | 0,49 |
| VII | Crystals in form of needles | 238–239 | — | — | — | — | — | — | — | — | — | — | — | — | 0,47 |
|  | Anabasine | — | — | — | — | — | — | — | — | — | — | — | — | 194 | 0,27 |

the C=O group of a carbonyl chloride and of a urea at 1740 and 1610 $cm^{-1}$, respectively.

In order to isolate the pure substances obtained in the reaction of anabasine with phosgene, micropreparative synthesis was carried out in a nonfixed layer of alumina. By the comparison method it was found that if the anabasine deposited on the sorbent is treated with phosgene, substances II, III, and IV, with $R_f$ 0.76, 0.53, and 0.73, respectively, are formed. Consequently, under the usual conditions, in addition to the formation of the phosgene salt (I), the acid chloride (II), and the urea (III), the pyridine ring-opening reaction takes place giving the colored substance IV.

The purity and individuality of the substances were checked by the TLC method.

## EXPERIMENTAL

Anabasinium Salt of Phosgene. The salt was obtained by mixing anhydrous toluene solutions of phosgene (0.05 mole) and anabasine (0.05 mole), previously cooled to −15°C. A colorless solid was formed. The solvent was decanted off, and the residue was subjected to vacuum and stored in an atmosphere of nitrogen over $P_2O_5$ at −10°C (Table 1). The salt I is hygroscopic and deliquesces in air, gradually becoming yellow, then orange, and, finally, bright red. It is readily soluble in $CHCl_3$.

A solution of 10 g of the salt I in 30 ml of anhydrous chloroform was treated with 7.1 g of aniline in 150 ml of benzene. The resulting oily anabasine hydrochloride crystallized, mp 194°C (ethanol); and the benzene solution yielded carbanilide (VI), with mp 238-239°C (from ethanol). By the comparison method in TLC on $Al_2O_3$ (activity grade II) with a layer of sorbent 0.5 mm thick on a 20 × 9 cm plate (with iodine vapor as the developer) only anabasine and carbanilide were identified, with $R_f$ 0.36 and 0.49, respectively (see Table 1).

Preparation of Compounds II, III, and IV. A mixture of 12 g of anabasine and 150 ml of chloroform was gradually added to 200 ml of anhydrous chloroform containing 30 g of phosgene. The reaction was carried on for 1.5 h in a current of dry nitrogen with vigorous stirring at 0-2°C with an excess of phosgene always present; the solution became bright red. The chloroform was distilled off, and the individual products were isolated on alumina (activity grade II). A solution of 1 g of the mixture in 5 ml of $CHCl_3$ was deposited on a plate (35 × 35 cm) with a 5-mm layer of sorbent. After the volatilization of the solvent, the plate was placed in a chamber with a benzene−acetone (160 : 80) system. Substance IV was revealed in UV light, and the others were shown up by iodine vapor on a control plate with dimensions of 3 × 35 cm. The sections of alumina with the individual substances were removed, and substance IV was eluted with ether, and II and III with chloroform. The properties of the isolated substances are given in Table 1.

Ethyl anabasine-N-carboxylate (VII) was obtained by allowing a mixture consisting of 2 g of substance II, 30 ml of ether, and 15 ml of ethanol to stand for a day. The solvent was distilled off, the hydrochloride was decomposed with a 30% solution of alkali, and the base was extracted with ether. Bp 146-147°C/2 mm, $n_D^{20}$ 1.5241. Hydrochloride, mp 196-197°C (acetone).

## CONCLUSIONS

The reaction of anabasine with phosgene has given the anabasinium salt of phosgene, anabasine-N-carbonyl chloride, and the urea derivative N,N'-carbonyldianabasine. In addition to the formation of these substances, the pyridine ring of anabasine is cleaved, giving the red substance 1-chloro-5-chloroformylamino-2-piperidin-2-yl)penta-1,3-diene.

## LITERATURE CITED

1. C. Scholtissek, Ber., 89, 2562 (1956).
2. German Patent No. 109,933 (1898); C. 1900, II, 460.
3. A. Sekera, I. Gruby, and I. Yakubets, in: Czech. Chem. Commun., 18, 870 (1953).
4. V. Nemets and I. Kurlina, Tr. Leningradsk. khim.-tekhn. in-ta, No.10, 3 (1941).
5. O. Wallach and F. Lehmann, Lieb Ann., 5, 237, 239 (1887).
6. Yu. N. Forostyan and G. V. Lazur'evskii, USSR Patent No. 122,634; Byull. izobr., No. 18, 43 (1959).
7. G. V. Lazur'evskii and Yu. N. Forostyan, ZhOKh, 29, 3498 (1959).