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# REACTIONS OF PHENYL ISOCYANATE WITH VINYL ETHERS

Teruaki Mukaiyama, Ryuichiro Yoda and Isao Kuwajima
Laboratory of Organic Chemistry, Tokyo Institute of Technology

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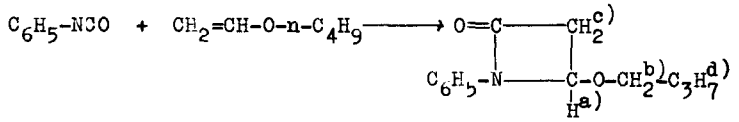
It has been reported that β-lactam can be synthesized from aryl isocyanate with diazomethane[1] or enamines[2].

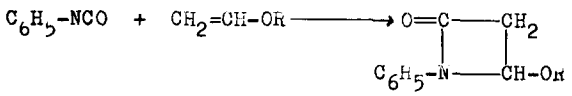
It has been also recently found that the reactions of chlorosulfonyl isocyanate with olefin affords β-lactam[3].

In the present paper, the reactions of phenyl isocyanate with vinyl ethers are described. When equimolar amounts of n-butyl vinyl ether and phenyl isocyanate were heated at 150°(bath temperature) for 20 hr., a large amount of liquid, boiling at 120-125° under 1 mmHg, was obtained.
The elemental analysis and the molecular weight measurement show that the product is a 1:1 adduct of the starting materials. Further, its infrared spectrum has an intense peak at 1760 $cm^{-1}$ attributable to carbonyl group of β-lactam. The result of n.m.r. spectrum also supports the β-lactam structure; it shows absorptions at τ a) 4.65 (triplet, 1 proton), b) 6.52 (triplet, 2 protons), c) 7.05 (doublet, 2 protons), d) 8.55-9.10 (multiplet, 7 protons) and five aromatic protons at low field.



Similarly, β-lactams were isolated by the reactions of phenyl isocyanate with ethyl, β-chloroethyl, iso-butyl, 2-ethylhexyl and dodecyl vinyl ethers under similar condition. These results are listed in Table I.

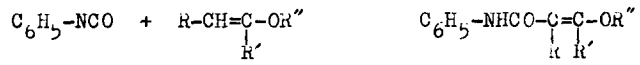
Table 1



| R | Reaction Time (hr.) | Yield (%) | B.p. (°C/mmHg) | Analysis Found (Calcd.) C | H | N |
|---|---|---|---|---|---|---|
| n-$C_4H_9$ | 10 | 44 | 120-3/1 | 71.04 (71.20 | 7.74 7.82 | 6.39 6.39) |
| iso-$C_4H_9$ | 20 | 62 | 120/0.07 | 71.29 (71.20 | 8.07 7.82 | 6.48 6.39) |
| $C_4H_9$-$CHCH_2$ (branch $C_2H_5$) | 24 | 51 | 158/0.09 | 73.89 (74.14 | 9.46 9.15 | 5.20 5.09) |
| $C_{12}H_{25}$ | 13 | 7 | * | | | |
| $C_2H_5$ | 10 | 3 | 119/5 | | | |
| Cl-$CH_2CH_2$ | 13 | 4 | * | | | |

* undistillable (Reaction Temperature; 150°)

On the other hand, when substituted vinyl ethers such as 1-cyclohexenyl ethyl ether, isopropenyl ethyl ether or α-ethoxy styrene were used in the above experiment, the corresponding β-lactams could not be obtained, but β-alkoxy α,β-unsaturated carboxylic anilides were produced.



Reference

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