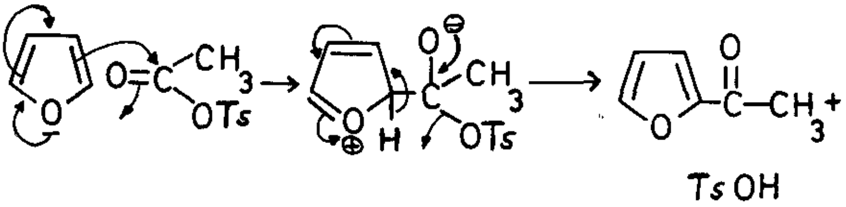
# STUDIES ON THE FURAN SERIES. PART VI.
# A FACILE METHOD OF ACYLATING FURANS AND THIOPHENES.

Seppo I. Pennanen
Department of Chemistry
Helsinki University of Technology
02150, Otaniemi, Finland

A convenient acylation of some furans and thiophenes in 75-96% yield is described. The results of the acetylation with acetyl p-toluenesulfonate are tabulated.

During our studies on furan chemistry, acetyl p-toluensulfonate(=TsOAc)[1] has been found to be a convenient and mild acetylating reagent for furan and methylfurans. The normal Lewis acid-catalysed acetylation of the acid-sensitive furan and methylfurans gives rise to a strong resinification, with reported yields between 10 and 66%.[2,3] With a 10-50% excess of TsOAc in dry MeCN the acetylation took place smoothly at room temperature, giving 2-acetylfurans in 75-96% yield (Table). The reaction can easily be performed on a large scale and the product can be separated from the excess TsOAc and TsOH formed by $NaHCO_3$ / $H_2O$ / $Et_2O$ treatment (TsOH can be regenerated). Thiophene and methylthiophene reacted with TsOAc as well, giving 2-acetylthiophenes in 84-93% yield (Table).

A plausible mechanism for this reaction is as follows:

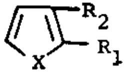


Under the above reaction conditions furfural, its derivatives (acetals and diacetate) and 2-formylthiophene were resinified. Methyl 2-furoate and anisole reacted slowly with TsOAc in the refluxing solvent,giving 5- and <u>para</u>-acetylated products, respectively, whereas ethyl thiophene-2-carboxylate, benzene and toluene were unreactive.

Other mixed anhydrides of TsOH and aliphatic acids are readily prepared by a modification of a reported[1] method by heating dry TsOH with an excess of the appropriate acid chloride at 80-100°C and evaporating the unreacted acid chloride under a high vacuum. Propionyl and n-butyryl p-toluenesulfonate reacted smoothly with furan in dry MeCN at room temperature, giving 2-acylated furans in 82% and 88% yields, respectively (81% and 93% yields produced by a more complicated method are reported in the literature[5]). Attempts to benzoylate furan with PhCOOTs failed.

It seems likely that the mild method described above for the acylation of furans and thiophenes can be extented to include other aliphatic acids from which mixed anhydrides with TsOH can be prepared.

Table. Acetylation with acetyl p-toluenesulfonate (= TsOAc).a)

|  | Product b) | Solvent c) | Temperature | Reaction time | Yield | Yield in literature |
|---|---|---|---|---|---|---|
| X=O, $R_1=R_2=H$ | 2-Ac- | MeCN | 25°C | 2hr | 96% | 10-66% [2] |
| X=O, $R_1=Me$, $R_2=H$ | 2-Ac-5-Me- | PhH d) | 25°C | 2hr | 81% | 15-30% [2] |
| X=O, $R_1=H$, $R_2=Me$ | 2-Ac-3-Me- | PhH | 25°C | 2hr | 75% | 20% [2] |
| X=O, $R_1=COOMe$, $R_2=H$ | 5-Ac-2-COOMe- | PhH | Reflux | 24hr | 63% | 46% [2] |
| X=S, $R_1=R_2=H$ | 2-Ac- | MeCN | Reflux | 2hr | 93% | 87% [3] |
| X=S, $R_1=Me$, $R_2=H$ | 2-Ac-5-Me- | PhH | 25°C | 2hr | 84% | 78% [4] |
| X=O,S, $R_1=CHO$, $R_2=H$ | Resins | MeCN | 0°C | - | - | - |
| X=S, $R_1=COOEt$, $R_2=H$ | No reaction | PhH | Reflux | 24hr | - | - |
| Benzene, Toluene | No reaction | - | Reflux | 24hr | - | - |
| Anisole | <u>para</u>-Ac- | MeCN | Reflux | 24hr | 63% | 94% |

a) A 10-50% excess of TsOAc was used in all reactions.

b) All products had identical physical and spectral data properties with those reported.

c) All solvents and reagents were dried with $CaH_2$.

d) 2-Methylfuran reacted with MeCN in the presence of TsOH giving 1,1,1-tri(5-methyl-2furyl)ethane.

REFERENCES

1. M. H.Karger and Y. Mazur, *J. Org. Chem.*, 1971, **36**, 528 and 540.

2. P. A. Finan and G. A. Fothergill, *J. Chem. Soc. (C)*, 1963, 2723.

3. H. D. Hartough and A. I. Kosak, *J. Am. Chem. Soc.*, 1947, **69**, 1012.

4. T. F. Doumani and J. F. Cuneo, *U.S. 2, 522, 752.* Ref. *Chem. Abst.*, 1951, **45**, 662h.

5. J. V. Heid and R. Levine, *J. Org. Chem.*, 1948, **13**, 409.

Received, 29th January, 1976