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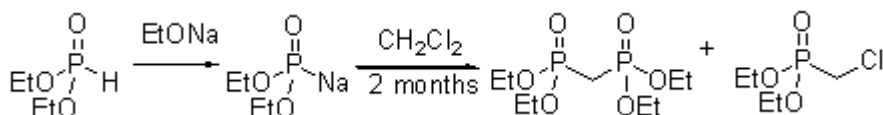
Methane-diphosphonic Acid Tetraethyl Ester

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Methanediphosphonic acid tetraethyl ester is a useful intermediate for the synthesis of phosphonoalkenes [1] or diphosphonoalkenes [2]. Methanediphosphonic acid tetraethyl ester is also a precursor of bioactive compounds [3] and hybrid organic-inorganic materials [4]. Many synthetic methods are available in the literature [5], but none of them is very convenient and commercial methanediphosphonic acid tetraethyl ester [6] remains expensive. We have improved the method described by Horni [7]. Although our method is long (a 60 day reaction at ambient temperature), the yield is excellent (89%) and the method is simple and convenient in comparison with other methods of literature.

A solution of sodium ethoxide was prepared by adding sodium metal (3 mol, 69 g) in portions to absolute ethanol (900 ml). Diethyl phosphite (3 mol, 386 ml) was added with stirring, and the mixture stirred for 1 h at ambient temperature. The excess of alcohol was evaporated using a rotary evaporator. Dichloromethane (1000 ml) was added, and the mixture was agitated for 2 months in a closed bottle. The mixture was washed with water (500 ml) and the organic phase was dried over magnesium sulfate. The solvent was evaporated, and the product was obtained as a colourless liquid (89% yield) by distillation [Bp : 128 °C(0.02)].

RN : 1660-94-2

¹H NMR (CCl₄): 1.35 (t, J = 7 Hz, 12 H, P-O-C-CH₃) 2.45 (t, J = 21 Hz, 2 H, P-CH₂-P) 4.15 (dq, J¹ = J² = 7 Hz, 8 H, P-O-CH₂).

¹³C NMR (CDCl₃): 16.4 (P-O-C-CH₃), 25.7 (t, J = 137 Hz, P-C-P) 62.55 (P-O-C).

³¹P NMR (CDCl₃): 19.05.

IR (film) : 1250 (P=O), 1020 (P-O-C), 960, 820.

References

- Cardogan, J. I. G. In *Organophosphorus reagents in Organic Synthesis*, Academic Press, London, New York, **1979**. Johnson A. In *Ylid Chemistry*, Academic Press, New York, **1966**. Wadsworth, W. S., Jr. *Organic Reaction* **1978**, *25*, 73. Villieras, J.; Rambaud, M.; Kirschleger, B. *Phosphorous and Sulfur*, **1983**, *14*, 385. Villieras, J.; Rambaud, M. *Synthesis*, **1982**, 924 and **1983**, 300. Villieras, J.; Rambaud, M.; Graff, M. *Tetrahedron Lett.*, **1985**, *26*, 53; Villemin, D.; Puciova-Sebova, M.; Toma, S.; Hachemi, M. *Phosphorus, Sulfur, Silicon* **1996**, *113*, 131.
- Lehnert, W. *Tetrahedron* **1974**, *30*, 301.
- Bijvoet, O.L.M.; Fleisch, H.A.; Canfield, R.E.; Russell, R.G.G. In *Bisphosphonate on Bones*, Eds Elsevier, Amsterdam, **1995**.

4. Alberti, G. *NATO ASI, Ser. C* **1993**, 179-90. Alberti, G.; Costantino, U.; Vivani, R.; Zappelli, P.; Rossodivita, A.; Bassignani, L. *Eur. Pat. Appl.* **1992**, EP 469, 682 (C.A., 116: 263335j).
5. Czekanski, T.; Gross, H.; Costisella, B. *J. Prakt. Chem.* **1982**, 324, 537. Chung, S.-K.; Moon, S.-H. *Carbohydr. Res.* **1994**, 260, 39. Teulade, M.-P.; Savignac, P.; Aboujaoude, E.E.; Lietge, S.; Collignon, N. *J. Organomet. Chem.* **1986**, 304, 283. Balczewski, P.; Mikolajczyk, M. *Synthesis* **1995**; 392. Ezquerra, J.; Yruretagoyena, B.; Moreno-Manas, M.; Roglans, A. *Synth. Commun.* **1995**, 25, 191.
6. Commercially available from Fluka, Lancaster Synthesis Ltd., Aldrich. External Access ID 359181
7. Hormi, O.E.O.; Pajunen, E. O.; Avall, A.K. C. Pennanen, P. *Synth. Commun.* **1990**, 12, 1865.

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