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A. P. Tomilov^a; B. I. Martynov^a; V. V. Turygin^a; A. V. Hudenko^a; I. N. Chernyh^a

^a State Research Institute of Organic Chemistry & Technology, Moscow, Russia

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Electrochemical Synthesis of Organophosphorus Compounds on the Base of Elemental Phosphorus

A.P. TOMILOV, B.I. MARTYNOV, V.V. TURYGIN, A.V. HUDENKO
and I.N. CHERNYH

*State Research Institute of Organic Chemistry & Technology. 23, Shosse
Entuziastov, Moscow, 111024 Russia*

The straight synthesis of organophosphorus compounds on the base of white phosphorus may solve a lot of problems concerning with simplification technology proceeding as a whole. At present time we are investigating procedures for the electrochemical generation of organophosphorus compounds directly white phosphorus. The ability to carry out this type of procedure in single step will have considerable environmental benefits. Thus procedure affording trialkylphosphates in a yield more than 90% and purity up to 98% for row material in undivided cell has been elaborated.

In undivided cell yield and composition of the products depend on: the nature of electrolyte, electrode's materials, temperature and current density. Graphite is more appropriate as anode material. Hydrogen chloride or bromide (iodide) alkali metals salts in alcohol solutions maybe use as mediators.

At temperatures low 15°C triethylphosphate is a single product of the electrosynthesis. The electrolysis of phosphorus-ethanol solution at 45°C leads to the mixture of triethylphosphate and corresponding ethylphosphonate up to 40% of the last. Contents of diethylphosphite in the mixture arise up to 15-20% in the case of block oxidation conditions.

Preparative scale electrochemical synthesis allows to obtain the other trialkylphosphates on the base of various alcohols: iso-propanol, butanol, ethylene bromohydrin etc. Butanol's solution electrolysis can result the phosphonate too, while iso-propylphosphonate in these conditions does not generate.

The general advantage of elaborated process is the minimal amounts of the wastes and a total absence of chlorinated wastes. While in the production of 1 ton triethylphosphate by classic method about 0.6 ton of HCl forms as waste. The electrochemical method on the base of white phosphorus results ~20% of wastes only in comparison to the well known chemical technology.

The equipment needed for these procedures has been well tested and is known to be reliable. The attempt of simulation of uninterrupted mode of action procedure carried out in filterpress electrolyzer with compulsory circulation of electrolyte by rotary pump. Granulated phosphorus was in individual reactor.

We believe that the electrosynthesis on the base of elemental phosphorus maybe useful technology method not only for phosphates, phosphonates and phosphites generation. Although such procedure allows to obtain and the other organophosphorus compounds, as trialkyl (or triaryl) phosphines, amides of phosphoric acid etc.