

Possibility of anaerobic detoxication of white phosphorus

© Anton Z. Mindubaev,^{1*+} Farida K. Alimova,² Serge C. Ahossiyenagbe,²
Chuluun Bolormaa,² Alexandra D. Voloshina,¹ Natalia V. Kulik,¹
Salima T. Minzanova,¹ Lubov G. Mironova,¹ and Dmitry G. Yahvarov^{1*}

¹Institution of RAS. A.E. Arbusov Institute of Organic and Physical Chemistry KazSC RAS.
Arbusov St., 8, Kazan, 420088. Republic of Tatarstan. Russia. E-mail: mindubaev@iopc.ru

²Department of Biochemistry. Kazan (Volga Region) Federal University. Universitetskaya St., 18.
Kazan, 420008, Republic of Tatarstan. Russia.

*Supervising author; +Corresponding author

Keywords: detoxication, white phosphorus, waste water slurges, anaerobic conditions, kinetics of gas evolution.

Abstract

Possibility of white phosphorus degradation under the effect of waste water sludge (WWS) of wastewater treatment facilities is shown for the first time. It has been established that as a result of the toxic effects of white phosphorus decomposition products the process of inhibition of methanogenic activity of microorganisms takes place, with the subsequent adaptation of microorganisms to the action of fluorine which leads to the complete biodegradation and recycling of white phosphorus into non-toxic products. White phosphorus is clearly established to suppress the microorganisms growth not immediately after application, but in the course of several days or even weeks. This means that the degradation intermediates that accumulate in the substrates possess the toxic action. Considering the change in evolved gaseous products composition one can make a conclusion about greater stability of eubacteria to white phosphorus as compared to that of methanogens. White phosphorus aggregative state and thermostating mode (mesophilic or thermophilic) do not significantly effect the vital activity of anaerobic microorganisms in the presence of white phosphorus. NMR method allowed us to establish that white phosphorus oxidizes to water-soluble compounds as a result of interaction with active sludge. White phosphorus degradation rate is demonstrated to be inversely proportional to the activity of metabolic processes in microflora that gives the evidence of biological destruction. The effect of white phosphorus on the microbe metabolites is manifested in abrupt increase of skatole and *n*-cresol content as compared to the control data, detected by GCMS method. Microorganism cultures are obtained, growing on substrate with white phosphorus content of 0.01 and even 0.1%.