Brazilian Journal of Microbiology (2008) 39:311-313
ISSN 1517-8382

FATE OF ORGANOCHLORINE ^{14}C-DICOFOL IN A LAB-SCALE WASTEWATER TREATMENT

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Submitted: September 11, 2007; Returned to authors for corrections: January 11, 2008; Approved: February 19, 2008.

ABSTRACT

The fate of organochlorine ^{14}C-dicofol in activated sludge process was investigated. Results showed that the major part of radioactivity remained adsorbed on biological sludge. Consequently, its final disposal deserves special attention. The small amounts of dicofol, biotransformed or not, which remained in the treated effluent could contaminate receiving bodies.

Key-words: sewage, activated sludge, organic micropollutants, dicofol

Recently, environmental researches have found organic micropollutants in wastewater treatment plants (WTP) (2,4,8). The possible sources of these micropollutants in WTP are domestic households, industrial wastewaters, residues from research laboratories and dissolved and suspended substances in precipitation (4,8). Wastewater treatment is usually performed by the activated sludge process, which mainly allows the removal of dissolved organic matter. Organic micropollutants may be degraded, adsorbed on sludge flocs, or discharged in the treated effluent (2,6) during the biological process. Katsoyiannis and Samara (4) suggested that the adsorption on the sludge is the main process responsible for the removal of some persistent organic pollutants (POP) in WTP. Byrns (2) developed a model to foresee the fate of POP (in different parts of the effluent treatment process) based on their physical-chemical properties.

In this work the fate of the micropollutant dicofol was investigated. Dicofol (1,1-bis-(4-chlorophenyl)-2,2,2-trichloroethanol) is a toxic organochlorine acaricide used in many countries and can generate persistent and toxic metabolites during its biodegradation, like DDE (2,2-bis-(4-chlorphenyl)-1,1-dichloroethylene) (7). The fate of ^{14}C-dicofol in the different phases of primary treatment (primary sludge and settled effluent) and biological process (biological sludge, treated effluent and air) was measured on lab-scale experiments (batch process).

Primary treatment process was performed by settling raw wastewater (500 mL) for 1 h. Secondary treatment was conducted in a 2.5 L reactor, which was connected to a sequential three-trap system. The reactor was fed with synthetic wastewater prepared according to Holler and Trösch (3) and biological sludge was colleted from WTP of Ilha do Governador/RJ. The biological process was carried out for 24 h. In all experiments, a mixture of 1.0×10^5 Bc of radiolabeled molecules of dicofol and 10 mg of dicofol (non radiolabeled) were added to sewage. After both treatments, the radioactivity of all phases was measured using a Scintillation Counter model Tri-carb 2100 TR Packard. In the traps, 30 mL of the solution of diethylene glycol monobutyl ether with ethanolamine (1:1 ratio) was added to track $^{14}C\text{-}CO_2$ (mineralization product). The treated effluent was filtered in a 0.45 mm membrane to remove non-settled particles and radioactivity of the filtrate effluent was measured. Analyses of chemical oxygen demand (COD) and total suspended solids (TSS) were made according to APHA (1).

After primary treatment, 53% of COD and 40% of TSS remained in the settled material. Fig. 1(A) shows that the major part of radioactivity was measured in settled material. This result is different from those foresee by the model of Byrns (2), which expected about 55% of dicofol in the primary sludge. The model of Byrns is based on physical-chemical properties of the pollutant, but does not consider the characteristics of the

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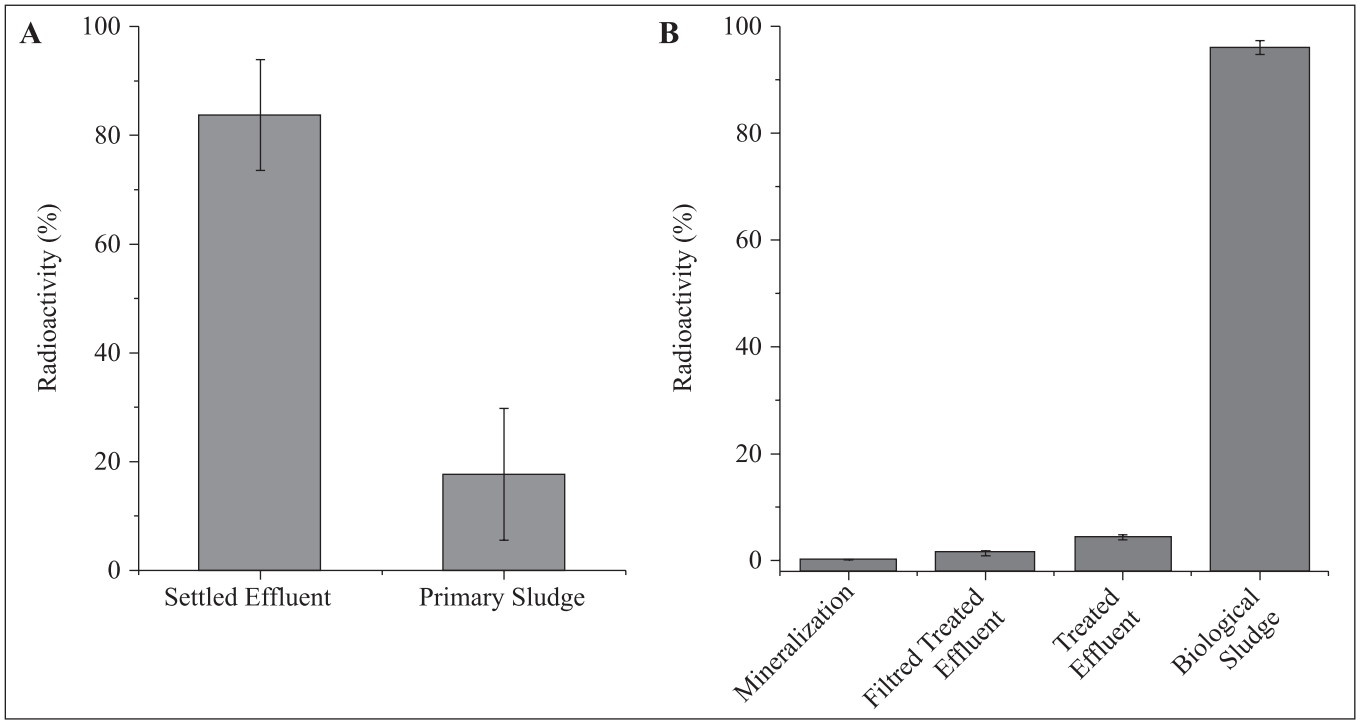

Figure 1. Distribution of radioactivity: primary treatment (A) and secondary treatment (B). Both containing 5.0 mg dicofol.L^{-1}.

wastewater contaminants like, surfactants, oils and grease and others non-settling substances as mentioned by Morris and Lester (6). Our results suggest that the composition of domestic effluent should be considered.

In the secondary treatment, 97% removal of COD in the control and 94% in the experiments containing dicofol were obtained after 24 h of treatment. Fig. 1(B) shows that biodegradation of dicofol generating ^{14}C-CO_2 (mineralization) was very small (0.1%) and the major part of the radioactivity was found in the biological sludge (93.9%). After filtration of the treated effluent, 4.5% of radioactivity remained in the filtred solids, probably absorbed to suspended solids. These results showed that dicofol is not mineralized under aerobic conditions. Probably dicofol was partially transformed into DBP (dichlorobenzophenone), as previously described by other authors (5). According to the model of Byrns, 95% of dicofol should be adsorbed on biological sludge and 5% would remain in the treated effluent. Morris and Lester obtained 90% of PCB (Aroclor) removal by sorption on biological sludge in a pilot-scale activated sludge process (6). In our study, the results were similar to those obtained by Morris and Lester and foreseen by Byrns model.

These results showed that despite dicofol being removed from sewage by sorption on biological sludge; small amounts of these substances, biotransformed or not, remain in treated effluent and can contaminate natural waters and, consequently, affect wild life. Normally, the final sludge is treated by anaerobic process and after is used as soil amendments or disposed in a landfill. Therefore, the solid and aqueous final residues should be safely managed to avoid environmental contamination.

ACKNOWLEDGEMENTS

The authors wish to thank CNPq and FAPERJ for their financial support and to the Wastewater and Water State Company (Cedae/RJ) for the cooperation.

RESUMO

Destino do Organoclorado ^{14}C-dicofol no Tratamento de Efluentes

A dinâmica do organoclorado ^{14}C-dicofol no processo de lodos ativados foi investigada. Os resultados mostraram que a maior parte da radioatividade ficou adsorvida no lodo biológico. Consequentemente, o seu descarte final merece atenção especial. Pequenas quantidades de dicofol, biotransformadas ou não, permanecem no efluente tratado podendo contaminar os corpos receptores.

Palavras-chave: esgoto doméstico, lodos ativados, micropoluentes orgânicos, dicofol

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