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RESEARCH ARTICLE

A study of Interaction of soil with Endosulphan as an Insecticide by using FBR

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Abstract

The main objective of this work is the interaction of two different soils with endosulfan as a insecticide by using Fixed Bed column reactor. In this work, soil sample was collected from agriculture field at Papanasam, near Kumbakonam. The present study discussed that the influent and effluent samples were collected periodically were analyzed for endosulphan residues. For each soil, transport-cum-sorption curves were obtained for three different initial concentration of endosulphan 50, 30, and 10 mg/l. The transport, sorption, partitioning with in soil matrix, microbial biodegradation, and other phenomena pertaining to pesticides can be best simulated by column type continuous flow operations through FBR system. On the other hand, few CMBR experiments are also essential to substantiate the results obtained in FBR studies. Hence, both the studies were undertaken to completely understand the transport-cum-sorption of endosulphan in soil medium.

INTRODUCTION

Agriculture is the back bone of India and its long-term sustainability chiefly depends on crop growth and food grain production. Post harvest and grain storage sectors are the two integral components of overall food grain and oil seeds production.

Pest menace is not new but, as old as the agriculture practice in the then World. In China, for instance, “brimstone” (sulphur) was being burnt to control pests (in 2000 B.C). Endosulfan (6, 7, 8, 9, 10, 10-hexachloro-1, 5, 5a, 6, 9, 9a-hexahydro-6, 9-metano-2, 4, 3-benzodioxathiepin-3- oxyde) is a mixture of two stereo isomers, α- and ß-endosulfan, in a ratio of 7:3 (Tomlin, 2000).

Endosulfan is used extensively throughout the world to control the insect pests of a wide range of crops and most importantly, it has been used for the control of Helicoverpa sp. in cotton cropping. However, endosulfan presents risk for water (Tapsoba and Bonzi-Coulibaly, 2006) and soil (Savadogo et al., 2006) pollution. Endosulfan is extremely toxic to fish and aquatic invertebrates and has been implicated increasingly in mammalian gonadal toxicity, genotoxicity, and neurotoxicity (Sutherland et al., 2000). It can bind to soil particles and persist for a relatively long period with half- life of 60-800 days depending on the type of soil (Siddique et al., 2003). Accordingly, the manufacturing and use of these chlorinated pesticides has either been banned or severely restricted in most developed and developing countries.

These attributes lead to bioconcentration, biomagnification in certain food chains, and persistence in the environment (Rose et al., 1999).In Cameroon, in the group of chlorinated insecticides, only the use of endosulfan is now permitted. In this country, the major use of pesticides is on the coffee, cocoa and cotton crops. Endosulfan and its isomers are designated to be biologically active and their microbial breakdown for carbon or sulphur sources (Siddique et al., 2003) is an important means of biodegradation and bioremediation. However, continuous input of these chemicals into the soil ecosystem could potentially affect the soil microorganisms and their activities.

This may lead to the stimulation, decrease, or modification of soil biological processes (Domsch et al., 1995) that are essential for soil fertility and crop productivity.

As the literature on transport-cum-degradation of endosulphan is only moderate; and based on regional and/or local soil types, the interaction of endosulphan with soil from Kumbakonam, Tamilnadu state, was considered in this investigation.

Material and Methods

The two different soils (red soil and black cotton soil) (about 10 kg each in a plastic bag) were procured from the agricultural fields in Papanasam, Kumbakonam, at a depth of 20 cm below the top soil. The samples were thoroughly cleaned manually in order to eliminate the higher size particles (10 to 20 mm), debris of leaves, fiber materials, and others. Later, they were oven-died at temperature of 90^0 C overnight, and properly stored until their further use.

For each soil, sieve analysis was carried out using a set of B.S sieves ranging between 4.78 to 0.075 mm (4.78, 2.38, 1.41, 0.71, 0.5, 0.211, and 0.075 mm). However, in FBR studies, soil Particles passing through 4.78mm and retaining on 2.38mm

Endosulphan-soil Interaction in FBR

Fixed studies were performed for two different soils, using endosulphan (EC grade) concocted with tap water. A Perspex glass column of interval diameter of 3.3 cm was appropriately packed with the soil for a required depth necessary for the experiments, by dry packing method. Also, the bed was sandwiched between two layers (2 cm on top and bottom) of ordinary cotton, to prevent entrance and exit flow disturbances.

The detailed experimental fixed-bed setup is shown in Fig 1. The influent and effluent samples were collected periodically were analyzed for endosulphan residues. For each soil, transport-cum-sorption curves were obtained for three different initial concentration of endosulphan 50, 30, and 10 mg/l.

Result and Discussion

Assessment of Flow-rate through Soil in FBR

In order to appropriately select the flow rate in different FBR studies, effluent uncontrolled flow measurements were undertaken, for both the soil of depth 20 cm. Figure 4.7 shows effluent flow rates for two different soil. From Fig 2, the trends in flow rates variation appeared to be similar for both the soils, because of the similar texture they possess. Also, at 5 and 60 cm depth of water above the bed, the flows varied between 4.5 and 12 ml/min (for both red soil and black cotton soil). Similarly, for a depth of 10 cm of soil (black cotton or red soil) with 60 cm of depth of water above the soil, the effluent flow rate was significantly reduced from 12 ml/min at the beginning to 8 ml/min (for black cotton soil) or 9 ml/min (for red soil) after 10 h.

This was due to the slow release of fine clay and silt particles from top to bottom and further accumulation at the bottom. This was illustrated in Fig. 3. From Fig. 3, it is understood that the effluent turbidity was drastically increased in both the soil media but, it was slightly higher in the black cotton soil medium. However, beyond 1.5 h, the trends in effluent turbidity were almost same. At the end of 10 h, the turbidity could not leach from the columns, due to the partial clogging at the bottom. Therefore, based on above, it was not possible to study the effect of flow rate on endosulphan interaction with the soil. But, an uncontrolled flow rate of 12 ml/min was used in further studies.

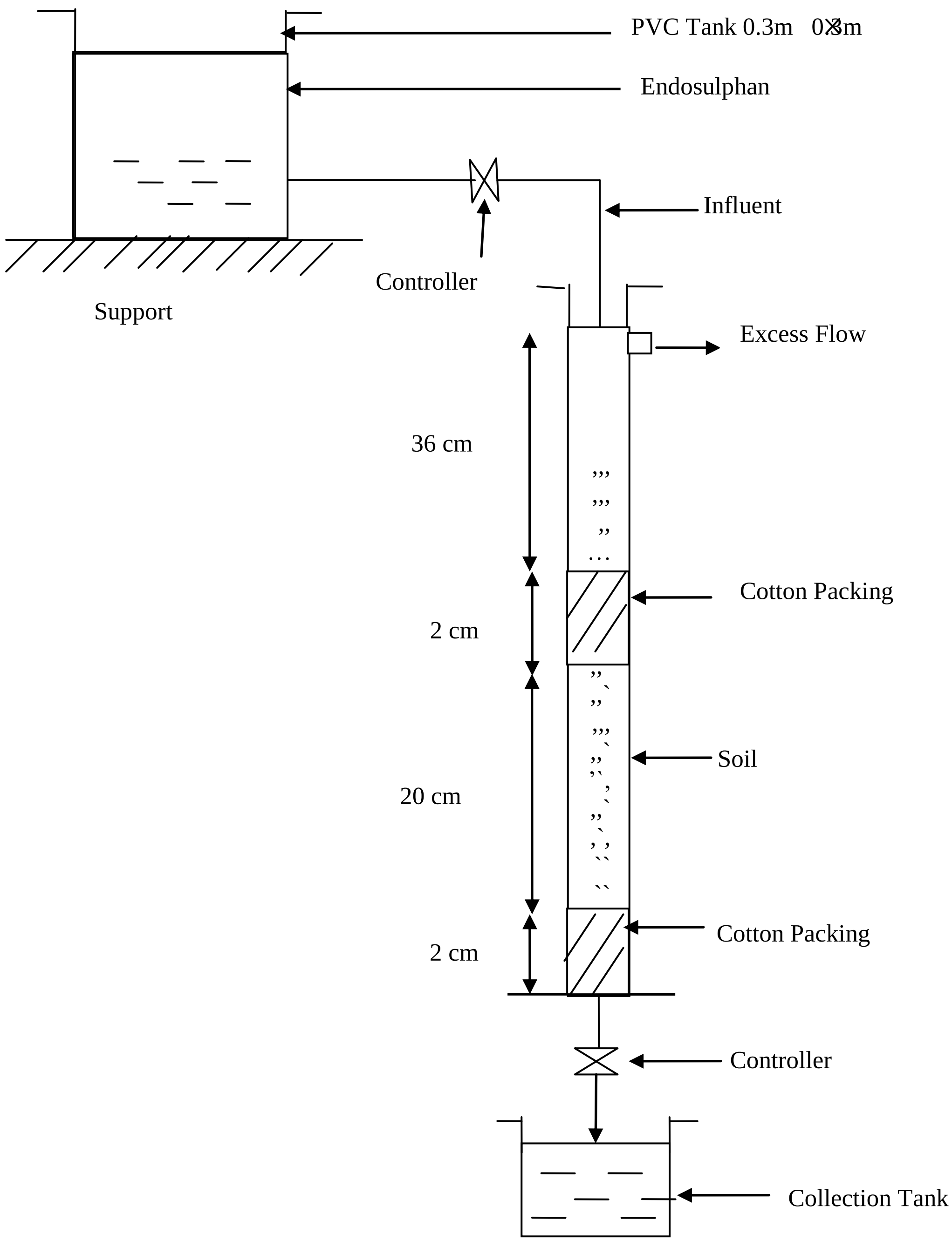

Fig. 1 – Schematic Sketch showing the Fixed-bed Setup for Endosulphan-soil Interaction.

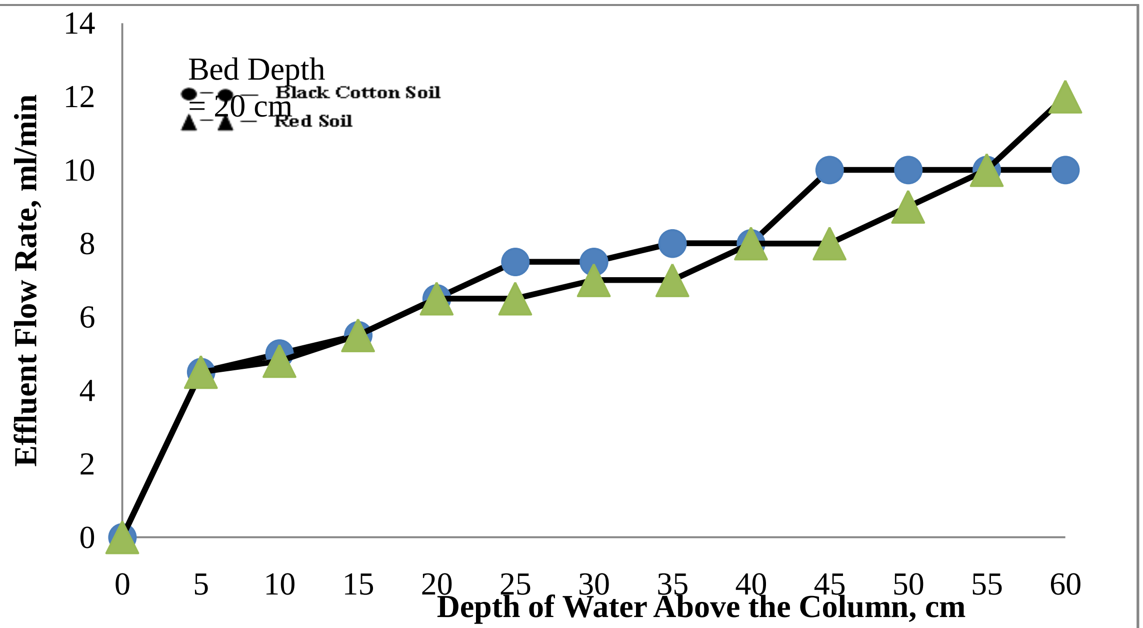

Fig. 2 - Variations in Flow Rates for Red Soil and Black Cotton

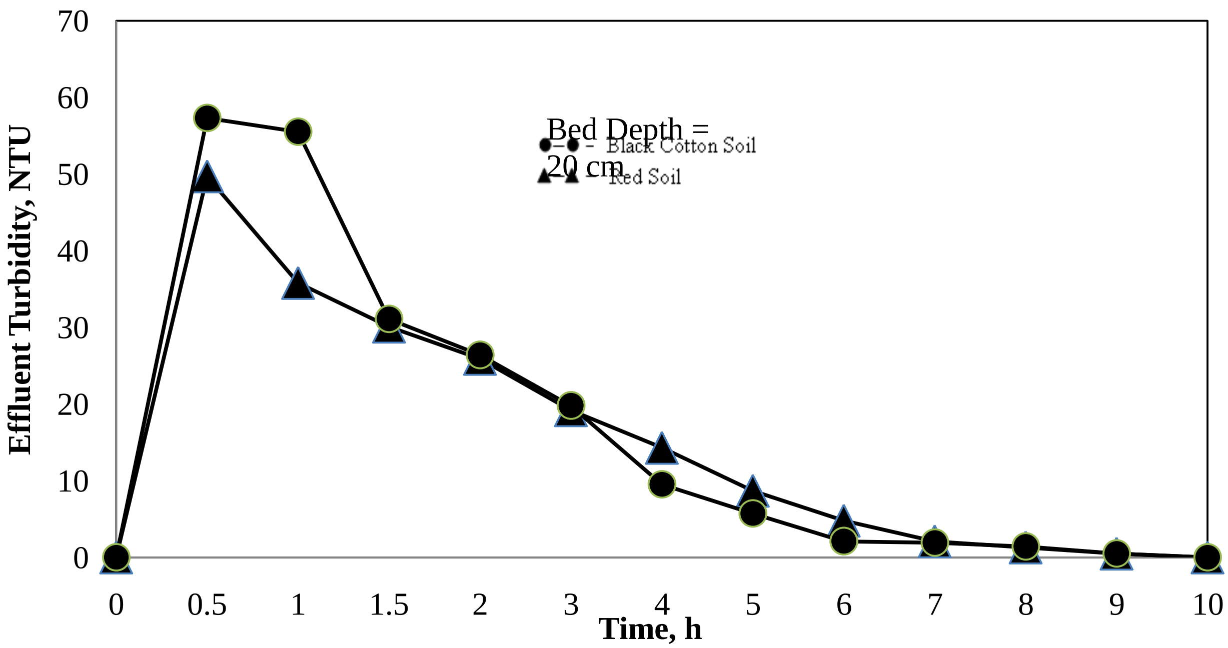

Fig. 3 - Plot of Contact Time versus Effluent Turbidity.

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