

## **Chlorinated Pesticide Residues in Sediments from the Arabian Sea Along the Central West Coast of India**

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The problem of environmental contamination by persistent chlorinated pesticides still evokes major concern due to the presence of their residues in the environment and in human tissues. In developing countries like India organochlorine insecticides, especially DDT are extensively being used in agriculture and vector control programmes. High concentration of DDT found in the marine environment has led to a total ban on its use in USA, Europe and Japan and restricted the use of other chlorinated pesticides (Harvey 1974). A very few data is available on their levels of concentration from the seas around India (Jenson et al, 1972; Tanabe et al, 1980; Kureishy et al, 1978; Kannan and Sen Gupta, 1987). On an average 55000 tons of pesticides and insecticides are used every year in India for agricultural purposes (Sen Gupta and Qasim, 1985). The cumulative effects of these chlorinated pesticides on our coastal environment can be expected to be considerable. Organochlorine pesticides are in general, fat soluble and hence can be concentrated by various marine organisms, like zooplankton (Kureishy et al, 1978; William and Holden, 1978; Patel et al, 1977). Persistent pesticides residues can be expected to accumulate in marine sediments. However, very little data on this are available along the Indian coast. An attempt has been made in the present communication to identify and quantify some of the chlorinated pesticides residues in the marine sediments collected from different region along the central west coast of India. This is a part of our ongoing project to monitor and map pollutants within the exclusive economic zone of India.

### **MATERIALS AND METHODS**

Sediment samples were collected from different region along the central west coast of India during the cruise

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(no.172) of R.V.Gaveshani with the help of Peterson grab and hydrographic winch on board. Immediately after collection the sediment samples were wrapped in aluminium foils and stored in deep freeze on board to avoid any further bio-degradation of the pesticides. The positions of the sample collection sites was reproduced in fig.1. Organochlorine pesticides were extracted from these collected sediments following a somewhat modified method of extraction of pesticides developed by Sarkar (1987, unpublished). The method was little bit different from that had been used for lake and river sediments (El-Dib and Badway 1985). The most important part of the modification of the extraction was the use of different electrolytes such as ammonium chloride, sodium chloride, potassium chloride etc. with the sediment samples. The electrolytes were used to facilitate the desorption of the pesticides already adsorbed on the sedimentary particles leading to a maximum possible extraction of the pesticides from the sediments. Three different solvents such as dichloromethane, acetone and n-hexane were used for the extraction. All the solvents were perfectly purified and double distilled in order to avoid any contamination. The solvent extracts were dehydrated with anhydrous sodium sulphate and purified according to Wheeler and Thompson (1980) using conc. sulphuric acid, flourisil column and activated copper powder. The purified extracts were evaporated almost to dryness and redissolved in just 5 ml dehydrated double distilled n-hexane to make it ready for analysis. Gas chromatography was applied for the identification and quantification of the pesticides with reference to the EPA standard samples (Moye, 1980; El-Dib and Badway 1981; Trim et al, 1983). A Perkin Elmer (3920 B) GC equipped with Ni<sup>63</sup> electron capture detector and a glass column (1/8 inch i.d. and 16 ft length) was used. The column was packed with OV-17 and QF-1, on 80/100 chromosorb W. The column, injector and detector temp. were 200°C, 225°C and 250°C respectively. Argon (5% methane) was used as a carrier gas at a flow of 75 ml/min.

## RESULTS AND DISCUSSION

Results presented in Table.1 show the residue levels of organochlorines found in the sediments from the Arabian sea along the central west coast of India during September 11-30, 1986. Residues of BHC, Aldrine, Dieldrine, PP'-DDT, OP'-DDT, PP'-DDE, OP'-DDE and PP'-DDD were identified and quantified in the sediments. But OP'-DDD was not at all detected in any of the sediment samples collected so far. This may be attributed to the fact that the conversion of this particular metabolite from OP'-DDT is very unlikely in the marine

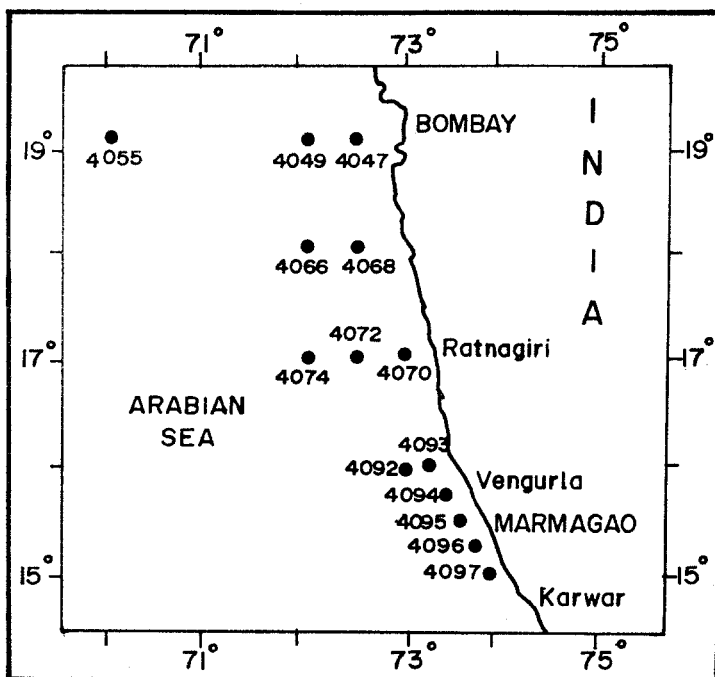


Figure 1. Locations of the sample collections sites along the central west coast of India.

environment.

Among the organochlorine pesticides detected so far in the coastal sediments, BHC was found to be detected in almost all the sediment samples and its concentration ranged between 0.44 and 17.9 ng/g. Aldrine was detected in a few of the sediment samples and its level of concentration was found to be within the range, 0.95 to 35.7 ng/g. Dieldrine was detected in only one sample. This may be attributed to the limited use of this particular pesticide. As far as the presence of DDT and its metabolites are concerned it was observed that PP'-DDT was detected only in four out of fourteen samples collected so far, whereas OP'-DDT was detected only in two samples. Among the metabolites of DDT, PP'-DDE and OP'-DDE were found to be much more significant than DDD in the marine environment. The highest concentration of PP'-DDE (44.6 ng/g) was estimated from the sediment sample collected from the Ratnagiri coast whereas that of OP'-DDE (159 ng/g) was detected from the sediment near the Marmagao coast. This may be expected due to the considerable degradation of DDT to DDE in the coastal sediments. Unlike DDE, PP'-DDD was found to be detected in one sediment sample only. The results clearly indicated that the conversion of

Table 1. Concentration of different organochlorine pesticides in sediments from the Arabian sea along the central west coast of India (ng/g wet wt.)

St.no.	BHC	Aldrine	Dieldrine	PP'-DDT	OP'-DDT	PP'-DDE	OP'-DDE	PP'-DDD	PP'-DDE + OP'-DDE + PP'-DDD	t-DDT
4047	1.30	0.95	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
4049	0.44	0.95	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
4055	7.79	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
4066	17.90	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
4068	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
4070	3.88	2.27	N.D	N.D	47.60	N.D	N.D	N.D	47.60	47.60
4072	0.48	N.D	N.D	4.63	N.D	2.38	N.D	N.D	N.D	7.01
4074	3.53	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
4092	2.18	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D	N.D
4093	N.D	35.70	0.88	N.D	N.D	N.D	N.D	N.D	N.D	N.D
4094	2.91	N.D	N.D	0.83	2.38	4.29	3.33	N.D	10.83	10.83
4095	15.20	N.D	N.D	0.28	2.23	N.D	159.0	17.6	179.10	179.10
4096	3.48	9.66	N.D	N.D	N.D	N.D	7.95	N.D	7.95	7.95
4097	1.31	2.84	N.D	1.67	N.D	5.71	N.D	N.D	7.38	7.38

N.D indicated not detectable. t-DDT (PP'-DDT+ OP'-DDT + PP'-DDE + OP'-DDE + PP'-DDD)

PP'-DDT to PP'-DDD is very insignificant in the marine sediments. On the other hand, the conversion of DDT to DDE is fairly considerable in the marine sediments. Such a significant level of concentration of DDE in the coastal sediments may be attributed to the various kinds of degradation of DDT to DDE in the marine environment. First of all the presence of different kinds of marine organisms (e.g. benthic) are expected to be highly responsible to the bio-degradation of DDT to DDE. Secondly the physico-chemical characteristics of the marine sediments are considered to be of great importance towards the degradation of DDT to DDE. The marine sediments were found to be highly rich in some of the chemical characteristics such as pH, salinity, clay mineral concentrations (bentonite, kaolinite, illite etc.), organic matter (humic substances), major elemental concentrations (e.g. Fe, Co, Ni, Mn, Zn, Cu etc.), which are likely to play important role towards the degradation of DDT to DDE. Thirdly, from thermodynamic point of view, it could be attributed to the fact that the ocean thermal energy evolved due to the continuous turbulence of seawater, resulting into considerable amount of entropy change in the system, could be sufficient to accelerate the degradation process in the marine environment even at a lower temperature (10-15°C). It was observed that the residue levels of all the organochlorine pesticides detected so far are in the following order: Dieldrine < PP'-DDD < OP'-DDE < PP'-DDT < PP'-DDE < Aldrine < BHC.

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