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# DDT AND THEIR METABOLITES FOUND IN THE SEDIMENT OF YAMUNA RIVER, AGRA, INDIA

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## Abstract

Sediment chemistry gives a cumulative impact of pollutants on aquatic environment. The transport pathways affect physical and chemical properties including the pollutant concentration and the chemical form in which the pollutant occur. Bulk density of Yamuna sediment ranges between 1.3 – 1.7 g $cm^{-7}$.Moisture content of the sediment of Yamuna at Agra ranges 5.92 to 17.70%. Water holding capacity ranges 12.66-24.56% at studied areas. The percent organic matter was high ranging from 3.50 to 5.05%. The occurrence of DDT isomer was obtained in the following order p,p'-DDT> p,p'-DDE> o,p'-DDT. The results found in this study are not uniform over the whole part of the river. This variation in the concentration may be due to differences in the sources of pollutants and prevailing physico-chemical characteristics, and complex reactions such as adsorption, flocculation-taking place in the sediment.

**Keywords:** Sediment chemistry, Yamuna, DDT, organic matter.

## Introduction

Pesticide residues reach the aquatic environment through direct runoff, leaching, careless disposal of empty containers, equipment washing etc(Milliadis1994).Pesticide residues in sediment of streams draining agricultural land can be a useful indicator of the entry of pesticides from crop production applications, into aquatic systems.

Sediment chemistry gives a cumulative impact of pollutants on aquatic environment. This situation may become even more serious when season changes. After first playing a role in the concentration effect, may then assist in the transportation of enriched sediments to areas where they may be introduced in to biological food chain or help to chemically remobilize the elements (Rao, et al, 2001). The transport pathways affect physical and chemical properties including the pollutant concentration and the chemical form in which the pollutant occur. The results found in this study are not uniform over the whole part of the river. This variation in the concentration may be due to differences in the sources of pollutants and prevailing physico-chemical characteristics, and complex reactions such as adsorption, flocculation-taking place in the sediment. Therefore, the present study has undertaken to see the effects of pollutants in sediment on water quality and it was compared with other studies. One of the most crucial properties of these pollutants is that they are nonbiodegradable in the environment. Sedimentation of particles in a river results in the overlying water being trapped and entrained in the sediment. Chemical species present in the water are absorbed on the sediment .The sediment thus serves as a valuable sink for a large number of pollutants(sigg,1986).Depending on the physico-chemical environment the contaminants trapped in the sediment can leach out to the overlying water and therefore ,such processes have to be taken in to account in water management planning and in various sediment cleanup programs(Song and Muller,1999).The chemical composition of the sediment and its variation at different sites in a river receiving the treated and untreated waste water from domestic and industrial sources have o profound impact on the water quality of the river basin.

Sediments are the ultimate repository of aquatic particles derived from either biogenic or detrial pathways. The selected region of study is Agra, which is well renowned place worldwide as TAJ CITY, situated at a latitude of 26 45N, 2750N and a longitude OF 7735E, 7810E, is a fourth most populous city in uttar Pradesh. A total of 2, 34190 kg pesticides are used in agricultural purposes. Thus, in the present paper hydrophobic pollutants, DDT and their metabolites were studied in sediment, as these are highly persistent and bioaccumulate in nature and biomagnified from one food chain to another.

## Materials and Methods

Samples were collected from 12 different sites and stored in clean polythene bags. Around 50 samples from each site in each were taken from the uninterrupted layer of surface sediment and stored in a clean polythene bags and immediately subjected to analysis for the physico- chemical parameters like pH, electrical conductivity, bulk density, water holding capacity, alkanity, moisture content and organic matter were calculated by using the standard methods.

Different solvent systems were used for extraction of pesticide residues from sediment sample but based on recovery performance, acetonitrile and dichloromethane were selected for the extraction and multi-layered column were used to remove impurities. The average recovery ranged 88.13 – 94.2% at three spiking levels 0.05, 0.02 and 0.01. The DDT and metabolites were analysed by Trace-GC-Thermo-Finnign, Italy using ECD Detector (Electron Capture Detector).

## Results and Discussion

*Bulk Density:* - Normally the bulk density ranges from 1.2-1.5g.cm$^{-3}$ for medium to fine texture soil/sediment and from 1.2 to 1.6 g cm$^{-3}$ for coarse textured soil/sediment, but it is slightly higher alkaline soil/sediment. The soil/sediment with high bulk density are inhibitive to root penetration and have low permeability and infiltration. It is inversely proportional to pore space of soil/sediment.

Bulk density of Yamuna sediment ranges between 1.3 – 1.7 g cm$^{-7}$ (Table 1). It was higher at E.D and F.N that are situated at trans Yamuna. It may be due to coarse particles present in the sediment at these sites.

***Moisture Content: -*** Moisture content of sediment / soil is not only important as a solvent and transporting agent but it maintains texture and compactness of sediment and makes it inhabitable for plants and animal. Moisture content of the sediment of Yamuna at Agra ranges 5.92 to 17.70% (Table 1).

***Water Holding Capacity: -*** It depends on the physical and chemical nature of sediment/soil. Water holding capacity ranges 12.66-24.56% (Table 1) at studied areas.

**Table 1: Average values of physico-chemical characteristics of sediments at different sites of Agra.**

| Sampling Sites | Moisture content (%) | Bulk Density (g cm$^{-3}$) | Organic matter (%) | Water holding Capacity (%) | Alkalinity (mg kg$^{-1}$) |
|---|---|---|---|---|---|
| **Cis Yamuna (Upstream)** | | | | | |
| AG1 | 17.15 | 1.4 | 4.20 | 24.00 | 195 |
| AG2 | 17.23 | 1.4 | 4.13 | 24.38 | 231 |
| AG3 | 17.33 | 1.3 | 4.88 | 24.56 | 255 |
| Average | 17.24±0.09 | 1.35±0.01 | 4.40±0.4 | 24.31±0.28 | 227±30 |
| **(Downstream)** | | | | | |
| AG4 | 17.70 | 1.4 | 4.30 | 24.42 | 214 |
| AG5 | 17.50 | 1.3 | 4.50 | 24.70 | 219 |
| AG6 | 17.60 | 1.3 | 4.50 | 24.06 | 272 |
| Average | 17.6±0.06 | 1.34±0.07 | 4.45±0.13 | 24.39±.031 | 235±32 |
| **Trans Yamuna Upstream** | | | | | |
| AG7 | 5.92 | 1.7 | 3.50 | 12.66 | 214 |
| AG8 | 6.30 | 1.6 | 4.90 | 13.28 | 257 |
| AG9 | 17.30 | 1.3 | 5.05 | 23.88 | 243 |
| Average | 9.8±6.4 | 1.59±0.2 | 4.48±0.8 | 16.60±6.3 | 238±21 |
| **Down stream** | | | | | |
| AG10 | 16.90 | 1.3 | 4.66 | 25.11 | 229 |
| AG11 | 17.36 | 1.4 | 4.14 | 23.22 | 163 |
| AG12 | 17.50 | 1.3 | 4.16 | 25.46 | 191 |
| Average | 17.2±0.3 | 1.35±0.02 | 4.32±0.02 | 24.60±1.2 | 238±21 |

***Organic Matter: -*** The percent organic matter was high ranging from 3.50 to 5.05% (Table 1). The higher values may be attributed to the anthropogenic activities and remains of the leaves and dead plants, in this stretch of the river. The sandy sediment with coarse sand followed by fines with silty clay act as adsorbents. The organic matter is adsorbed onto the sediment with a monolayer formation due to bioflocculation processes. Organic matter is highly beneficial in the soil/ sediments for retaining the nutrients and for aggregation. It is also responsible for adsorbing various pollutants in the sediments.

***DDT and their metabolites: -*** DDT was detected in all sediment samples. The total DDT concentration ranges from 175-213 µg/kg (Table 2). T-DDT was found 192±8 µg/kg at upstream and 215±15 at downstream of cis Yamuna, While it was found 209±10 µg/kg in upstream and 194±74 µg/kg at downstream of trans Yamuna. The occurrence of DDT isomer was obtained in the following order p,p'-DDT> p,p'-DDE> o,p'-DDT. p,p'-DDT was found predominant compound among DDTs in river water. The dominance of DDTs in sediments were also found by Pandit et al, 2002 and Guzzella, et al, 2005.

**Table 2: Mean concentrations of various pesticides (in µg/gm) in the sediments of river Yamuna.**

| Sampling Sites | p,p'-DDT | o,p'-DDT | p,p'-DDE | Total |
|---|---|---|---|---|
| **Cis Yamuna (Upstream)** | | | | |
| AG1 | 105 | 30 | 59 | 195 |
| AG2 | 78 | 27 | 77 | 183 |
| AG3 | 101 | 40 | 56 | 198 |
| Average | 94±14 | 32±7 | 64±11 | 192±8 |
| **Down stream** | | | | |
| AG4 | 125 | 41 | 64 | 231 |
| AG5 | 82 | 33 | 100 | 216 |
| AG6 | 100 | 32 | 68 | 200 |
| Average | 102±22 | 35±5 | 77±19 | 215±15 |
| **Trans Yamuna Upstream** | | | | |
| AG7 | 131 | 24 | 60 | 215 |
| AG8 | 123 | 25 | 67 | 216 |
| AG9 | 93 | 36 | 67 | 197 |
| Average | 116±19 | 28±6 | 65±4 | 209±10 |
| **Down stream** | | | | |
| AG10 | 83 | 32 | 60 | 175 |
| AG11 | 100 | 33 | 67 | 200 |
| AG12 | 108 | 40 | 59 | 208 |
| Average | 97±13 | 35±4 | 62±4 | 194±17 |
| Over All Average | 103±17 | 34±5.59 | 68±11 | 202±15.4 |

This may be due to slow degradation of DDTs or recent input of DDTs in this environment (Yuan, et al, 2001). The relative concentration of the parent compounds and their metabolites/isomer are very useful in providing information on source and history of input to the environment and possible degradation pathways involved. According to Strenberg et al, 1998, the ratio of p,p' DDT/p,p'-DDE provides a useful index to know whether the DDTs at a given site is fresh or aged input. Further a value <0.33 generally indicates an aged input. In the present study, the value of >0.33 was found(Table-3) indicating recent input of DDTs. The high percentage composition of op' DDT and pp'-DDT (Table 4) with respect to total DDT clearly illustrates that the usage has not been eradicated yet in the country and there might be new input of DDT to the river.

Hence, the frequency of spraying of DDT is always high in Agra, an urban city with high population, to control mosquito menaces, which could be the reason for greater levels encounters in sediment of Yamuna river.

The carcinogenicity of DDT and its metabolites has been studied in a number of laboratories in animals. DDT causes lung tumors and lymphomas. The main metabolites of DDT, p,p'-DDE and p,p'-DDD [1,1-dichloro-2,2-bis (p,p-chlorophenylethane], are both carcinogenic. Exposure to DDE resulted in a high incidence of liver tumors in both male and female rat. It induced chromosomal aberrations in mouse but not in rat bone-marrow cells *vivo*. (IARC, 19 91).As there are no guidelines for sediment quality in india ,It must be defined as soon as possible

**Table – 3. Ratio (p, p'-DDT/ p, p'-DDE)**

| S.S. | Ratio (p, p'-DDT / p, p'-DDE) |
|---|---|
| AG1 | 1.77 |
| AG2 | 1.01 |
| AG3 | 1.78 |
| AG4 | 1.95 |
| AG5 | 0.81 |
| AG6 | 1.45 |
| AG7 | 2.18 |
| AG8 | 1.81 |
| AG9 | 1.38 |
| AG10 | 1.38 |
| AG11 | 1.48 |
| AG | 1.80 |

**Table- 4 Yamuna river sediment pollution is compared with different guidelines for Pesticides [Effects levels (µg/kg).**

| Compound | ISGQ | PEL | NEL | LEL | SEL | ERL | ERM | MPC | Present study |
|---|---|---|---|---|---|---|---|---|---|
| **p,p'-DDE** | | | - | 5 | 60 | 2.2 | 27 | 58 | 68 |
| **p,p'-DDT** | 90 | 427 | - | 3 | 190 | | | | 102.7 |
| **o,p'+p,p'-DDT** | 51.17 | 205.11 | - | 8 | 710 | | | | 136.44 |
| **Total** | 75 | 302 | - | - | - | 1.58 | 350 | 98 | 328 |

## References


1.Susan ,V P Organochloropesticides in the sediment of yamuna river,Agra, India *Int.J.Adv. Res. Chem. Sci. 2, 10, 2015,17- 21.*

*2.Rao A S and Pilla ,R,2001.The concentration of pesticides in sediments from Kolleru Lake in India.Pest.Manage.Sci.,57;620-624*

[2] Rand, G.M., Well, P.G., Mclarty, L.S., 1995. In: Rand, G.M. editor. Introduction to aquatic toxicology. Washinhton: Taylor and Francis: 3-66.

[3] Angerer, J., Maass, R., 1983. Occupational exposure to hexachlorocyclohexane. Metabolism of gamma-hexachlorocyclohexane in man. Int Arch Occup Environ Health, 52,59-67.

[4] Van Gunter, H.R., Starn, M. and Maser, H.N.1997.200 years record of metals in lake sediments and natural background concentrations, Env. Sci. Tec., 311811:2193-2197.

[5] Liu, C, Wang, Z-Y and He, Y. 2003. Water pollution in the river mouths. Around Bohai way. Int. J. of sediment research, Vol.18 (4) pp.326-332.

[6] Iwata,H, Tanabe, S., Aramoto, M., Sakai, Tatsukawa, R., 1994. Persistent organochlorine residues I sediments from the Chukechi Sea, Bearing Sea and gulf of Alaska. Mar. Pollut.Bull; 28: 746-53.

[7] Zhau, J.L., Maskaoui, K., Qiu, Y.W., Hong, H.S. and Wang, Z.D., 2001. Polychlorinated biphenyl congeners and organochlorine insecticides in the water column and sediments of Daya Bay, China. Environ. Pollut; 113:373-84.

[8] Pandit , C.G.., Rao, M.M.M., Jha S.K., Krishnamoorty, T.M., Kale, S.P., and Raghu, K., 2001.Monitoring of organochlorine pesticide residue in the Indian marine environment. Chemosphere; 44: 302-305.

[9] Susan, V P Nisha ,S and Anjali, S Comparative Study of Heavy Metal Contamination in Sediments of Yamuna River, Agra, JOAC, 2013, 2- 3 9

[10] Susan V P Nisha, S and Anjali S Physicochemical Characteristics of Sediment of Yamuna River at Agra Region, India. Journal of Holistic Environment 2011, 57-62

[11] Susan V Pand Anjali S "An assessment of water quality of river Yamuna during monsoon at Agra city", Indian J. Environ. Prot., 2005; 25(10): 893-

[12] Susan V and Meenal G Investigation of Toxic Heavy Metals in Drinking Water of Agra City, India OJCHEG 2015, 31, (3): 1835-1839.


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