

Persistence of Organic Pollutants in Ground Water Around Kurkumbh Industrial Area (Daund) from Pune District, (MS) INDIA

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ABSTRACT

The global distribution of persistence of organic pollutants (POPs) has become one of the main environmental problems in the last decade. The environmental exposure to persistent of organic pollutants (POPs) become emerging risk factor for contribution of the knowledge of atmospheric transport and persistent organic pollutants (POPs) in remote area. Such persistent of organic pollutants (POPs) which includes chlorinated pesticides were determined in water sample collected around Kurkumbh industrial area during Pre-monsoon and post monsoon 2014. Concentration of total pesticides ranges from 0.02 to 0.07 ng/L and 6.39 to 149.4 ng/L. The rate of percolation of pesticides and polycyclic aromatic hydrocarbons (PAHs) were high at site second as compare to site first from study area because of high slope of area. The organic pesticides like Hexachlorocyclohexane (HCH) as a-HCH, b-HCH, γ-HCH, Heptachlor, Dieldrin, Aldrin Total pesticides (TP), Total cyclodiene (TC), Heptachloroepoxide (HCP) Dichlorodiphenyl Trichloro ethane (DDT) and organic pollutants like Naphthalene, Phenanthrene, Pyrene, Toluene were studied. The concentration of organic pesticides and (PAHs) were below the detection limit in the study area.

Keywords: Chlorinated pesticides, (PAHs) and organic pollutant water around Kurkumbh industrial area.

I. INTRODUCTION

Persistence is the ability of substance to remain without change in the environment for a long period of time. It is the potential of this substance to travel hundreds to thousands kilometers away from its original sources. It causes damage or death to living organism. Some of them may cause cancer immunological and reproduction defects. They also disturb the nervous and respiratory system, affects the level of liver enzymes¹. The POPs are bioaccumulation in living organism by capture it either directly from the environment and are indirectly from their food supply. The PCBs, DDT, PAHs may be responsible for occurrence of the breast cancer. Kurkumbh is considered as semi closed water body affected mainly from loading unloading operation². POPs have a wide range of industrial anthropogenic and agriculture applications. They include pesticides such as DDT (dichlorodiphenyl / trichloroethane) and lindane (γ-HCH) in addition to petroleum hydrocarbons which are organic chemicals composed of fused benzene rings formed during incomplete combustion of coal, oil, petrol and wood. The soil is polluted by these substances

primarily as use of pesticides application in agriculture. Another soil pollution sources may be also the over irrigation. Some pesticide is soluble in water which causes pollution of soil as well as ground water. Number of industrial sources such as power stations heating station as well as household furnaces transport and use of agricultural spray³. Evaporation of water or soil surfaces causes air pollution. Hence POPs concentration in atmosphere is increases gradually which are harmful to human being and any other living organism. To overcome these analytical problems, pesticides should be pre-concentrated as large possible to enable detection by the instruments⁴.

POPs are synthetic organic compounds which are widely spread on land and in aquatic environment. There are commonly considered the most persistent anthropogenic organic compounds introduced in to the environment. Some of these are highly toxic and have a wide range of chronic effects including endocrine disruption, mutagenicity and carcinogenicity. Furthermore POPs are chemically stable and therefore not easily degraded in the environment or in organism. They are lipophilic and

accumulate in the food chain⁵. Organo-chlorine pesticides are synthetic compounds that are chemically stable and hydrophobic. They include Dichlorodiphenyl Trichloro ethane (DDT). The Pesticides used in agriculture as an insecticide. This pesticide such as BHC (Hexachlorocyclohexane), chlordane and aldrin are other chlorinated pesticides use in agricultural. It is generally agreed that, the pollution around Kurkumbh industrial area has reached a critical level⁶. River runoff (Bhima) has the direct effect of reducing the salinity of the water. Untreated domestic waste water with agricultural and industrial wastes is still release through a number of drainages along the coastal area of study. The organochlorines pesticides act as never poisons and are highly toxic to fish because of their chemical structure and their persistence. The health hazard posed by these compounds has been studied extensively by several authors. The Kurkumbh are big industrial area which discharge industrial waste water in ground as well as on the surface (Fig. 5). The Bhima River is longest river nearby the area. Peoples are used river water for irrigation. The over irrigation used of insecticides, pesticides, fertilizers polluted the ground water⁷⁻⁸. There were various organic pollutants are percolated in ground water which causes harmful effects on living organism⁹.

The organic pollutants cause harmful effects on human being, plant and living organism. The building blocks of living organisms are organic compounds which contain carbons and hydrogen¹⁰. However human have learnt to manufacture organic compounds that are extremely difficult to breakdown and as a result have become widely dispersed throughout the environment. These chemicals re-termed persistent organic pollutants (POPs) and are extremely resistant to nature break down processes and therefore are stable and long-lived. Most do not occurred in nature built are created through artificial process¹¹.

Once released (POPs) in to the environment many persist few years even decades therefore even if production of all (POPs) ceased today. They would contain to pollute the environment for many years to come. Many POPs are also highly toxic and built up in the fatty tissues of animals and humans. In order to understand more clearly the behavior of these pollutants on a global scale and to prepare the future environmental policies; a baseline study is aimed to determine the

occurrence of POPs in water of around Kurkumbh industrial area¹².

II. Material and Methods

Ten ground water samples were collected 5 km away from (site 1) Kurkumbh industrial area during (May, 2014). However another ten water samples are collected 10 km away from (site 2), during January 2014 (Fig. 2, 3a3b, 4a and 4b). According to slope and grading pattern (Fig. 1, 6a and 6b). The studied areas were represented by four sector, western sector, southern sector and northern sector. Water samples were extracted in the field and stored at 4⁰c and transported to the laboratory for PAHs analysis using well established techniques¹³. The result measured in water samples using UV, Spectrophotometer (Sequoia-Tummer model 450) at 360 mm recitation and 415 mm emission. A calibration wave was determined by analyzing five separate concentration (0.5, 1, 2, 1 and 6 mg/L) of chrysene using h-hexane as the solvent. Clamp up and fractionation was performed prior to gas chromatograph / flame ionization detector and electron capture detector (GC/FID/ECD)¹⁴.

The 1st ml of the extracted volume was passed through the silica column prepared by slurry packing 20 ml (10 gm) of silica followed by 10 ml (10 ml) of alumina and finally 1 gm of anhydrous sodium sulphate. Elution was performed using 40 ml of hexane/dichloromethane (90:10) followed by 20 ml of hexane/dichloromethane (50:50) which combined contain PAHs. Finally eluted samples were concentrated under a gentle stream of purified nitrogen to about 0.2 ml prior to be injected into GC/FID for pesticides analysis¹⁵. All samples were analyzed by a Hewlett Packard 5890 series II GC gas chromatography equipped with a flame ionization detector (FID) and electron capture detector. For hydrocarbon analysis the instrument was operated in split less mode (3ml split less injection) with the injection Dieldrin, DDT, to control the analytical reliability and assure recovery efficiency and accuracy of the results. Four analysis were conducted on organo-chlorine compounds¹⁶.

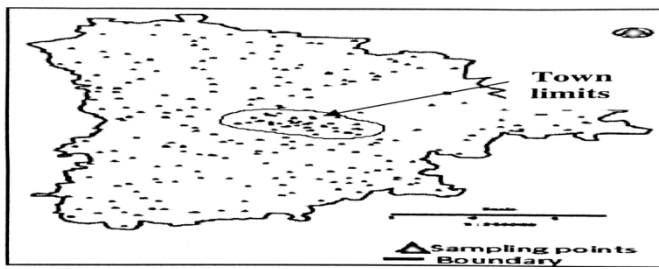


Figure 1. Location map of the study area.



Figure 2. Agricultural field and irrigation type around study area.



Figure 3(a). Source of irrigation around study area.



Figure 3(b). Source of irrigation around study area.



Figure 4(a). Dug well for around study area.



Figure 4(b). Dug well for around study area.



Figure 5. Chemical industry around study area.

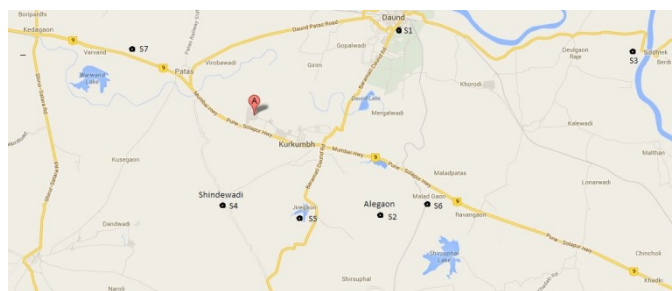


Figure 6(a). First sampling site around study area.

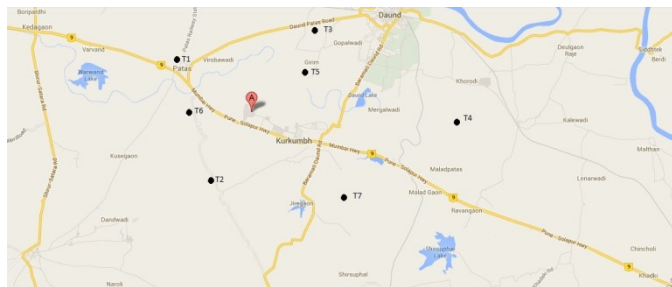


Figure 6(b). Second sampling site around study area.

III. Result and discussion

Table (1 and 2) shows the residual concentration of organochlorine compounds determined in water samples collected from study areas. The data of Table (1 and 2) indicates that PP-DDT [2, 2, bis (P-Chloropheny)-1, 1, 1 trichlorothane] is the most dominant organochlorine compound during summer reason. The maximum concentration was 147.4 ng/L recorded DDT is generally used against a wide variety of agricultural and forest pests and pests including, vectors such as mosquito and test –test fly in the environment. DDT can be degraded by solar radiation or metabolized in organism Heptachlor is the common name for 1,4, 5, 6, 7, 8, 8- heptachloro 3a, 4, 7, 7a tetrahydro -4, 7-methane – 1H – indane. It is generally use as insecticides and also occurs technically as chlorodane. In the environment, degraded or metabolized and is more commonly found as its epoxide compared with a mean concentration of 0.151ng/L for all locations during summer from study area second¹⁷.

Aldrin is an alicyclic chlorinated hydrocarbon and is rapidly converted to the epoxide form. Dieldrin. The presence of an average of 0.097 ng/L of aldrin with mean clue of 0.071 ng/L of dieldrin. Recorded at site second during summer season, part maintained at 29⁰C and the detector maintained at 3⁰C samples were analyzed on a fused silica capillary column HP-1 100% dimethyl polysilolane (30 m. length 0.32 mm i.d., 0.17 mm film thickness). The oven temperature was programmed from 60-29⁰C changing at a rate of 3⁰C min and maintained at 29⁰C for 25 min. The carrier gas was nitrogen flowing at 1.2 ml /min. However HP-5 capillary

column film thickness with Ni63 – electron capture detector (ECD) was used for pesticides analysis. The oven temperature was programmed from 9⁰C – 14⁰C at rate of 5⁰C / min maintained at 14⁰C for 1 min then from 14⁰C – 25⁰C at rate of 3⁰C /min maintained at 25⁰C for 1 min then from 25⁰C – 35⁰C at rate of 2⁰C /min and maintained at 30⁰C for 1min the carrier gas was nitrogen flowing at 1.5 ml/min¹⁸⁻¹⁹. A stock solution containing the following PAHs was used for quantification of hydrocarbons naphthalene phenanthrene, pyrene, Toluene by dilution to create a series of calibration standards of PAHs at 0.1, 0.25, 0.5, 0.75, 1.0, 2.0, 5.0 and 10 ng ml/L. The detection limit was approximately 0.01 ng /L for each PAH for analytical reliability and recovery efficiency of the results, six analyses were conducted on PAH reference material²⁰.

Organochlorine pesticides were quantified from individually resolved peak areas with corresponding peak areas of the external standards. They includes a, B and u. Hexachlorocyclohexanes, Heptachlor, Aldrin, heptachloroe epoxide It is declare that there is a renewal of Aldrin in water²¹. HCH (hexachlorocyclohexane) is a fully chlorinated alicyclic compound .The most common isomers are, a, B and u HCH they u isomer known as Lindane is one normally used as an agricultural pesticides. HCH is a responsibly stable compounds and only under alkaline condition decomposes to yield trichloro-benzene. It is considered as one of the less persistence organochlorine pesticides. A maximum of 0.25 ng/L of HCH was declared at the location second²².

The data of tables I&II declared also that pesticides concentration were higher in study area second (10 km away) than study area first (10 km away). Total HCHs were the major pollutant followed by total DDTs, total cyclodienes (TC) with an average value of 0.063, 0.022 and 0.014ng/ L respectively in study area first²³. The average concentration of Nephthalene is 0.072 ng/L in side second than that of side first 0.298 ng/L. The order of concentration of phenanthrene pyrene and toluene from study area second is high than concentration of phenanthrene, pyrene and toluene from study area first because atmospheric fallorct (rain water) is the major source of pollution. Agricultural runoff river and discharge of industrial waste²⁴. Form above observation it is that POPs construction recorded is more at site

second than site first in the study area. The residual polynuclear aromatic hydrocarbons Naphthalene, Phenanthrene, pyrene and toluene were investigated in water of study area.

Table 1. Description sampling locations during May 2014

Sam pling stati on	Sampling locations	Water Source	Soil Type	Crop
T1	10 Km. South from Industrial area Tal. Daund, Dist. Pune	Dug well	Black cotton	Sugar cane
T2	07 Km. West of Aalegaon Sugar factory Tal. Daund, Dist. Pune	Lift Irrigation from Bhima river	Black cotton	Paddy
T3	20 Km. West from Bank of Bhima river near Siddhatek.	Lift Irrigation from Bhima river	Alluvial	Cowpea
T4	05 Km. North from Industrial area Shindewadi Tal. Daund, Dist. Pune	Lift Irrigation from Bhima river	Black cotton	Pumpkin
T5	10Km. North from Industrial area jiregaon, Tal. Daund, Dist. Pune	Dug well	Black cotton	Ground nut
T6	15 Km. West from Industrial area, Malad, Tal. Daund, Dist. Pune	Dug well	Black cotton	Fenugreek
T7	02 Km. South from Industrial area, Pune Solapur highway	Lift Irrigation from Canal	Black cotton	Paddy

Table 2. Description sampling locations during January 2014

Sam pling statio n	Sampling locations	Water Source	Soil Type	Crop
T1	10 Km. North from Industrial area Tal. Daund, Dist. Pune	Dug well	Black cotton	Sugar cane
T2	07 Km. East of Aalegaon Sugar factory Tal. Daund, Dist. Pune	Lift Irrigation from Bhima river	Black cotton	Sugar cane
T3	20 Km. East from Bank of Bhima river near Siddhatek.	Lift Irrigation from Bhima river	Alluvial	Sugar cane
T4	05 Km. South from Industrial area Shindewadi Tal. Daund, Dist. Pune	Dug well	Black cotton	Spinach
T5	10Km. South from Industrial area jiregaon, Tal. Daund, Dist. Pune	Dug well	Dark grey	Tomato
T6	15 Km. East from Industrial area, Malad, Tal. Daund, Dist. Pune	Dug well	Black cotton	Vegetables
T7	02 Km. North from Industrial area, Pune Solapur highway	Lift Irrigation from Canal	Black cotton	Sugar cane

Table 3. Concentration of (POPs) in ground water around Kurkumbh industrial area in May, 2014.

Organic pollutants	S1	S2	S3	S4	S5	S6	S7
Alpha-HCH	0.031	0.0012	0.0031	0.0099	0.0017	0.0011	0.0023
Beta-HCH	0.0068	0.0022	0.0068	0.0032	0.0019	0.0021	0.0012
Gamma-HCH	0.0166	0.0013	0.0017	0.0011	0.0039	0.0012	0.0011
Naphthalene	0.0544	0.0048	0.0116	0.0139	0.0075	0.0044	0.0046
Heptachlor	0.0027	ND	0.0027	0.0063	0.0097	ND	0.0018
Aldrin	0.0024	0.022	0.0024	ND	0.0018	ND	0.0014
HCP	0.0003	0.0003	0.0028	ND	0.0027	ND	ND
Dieldrin	0.0003	ND	0.0026	ND	0.0035	0.0009	0.00229
TC	0.0057	0.0223	0.0105	0.0063	0.0177	0.0009	0.0061
Phenathrene	0.0013	0.0002	0.0013	ND	0.0084	0.0018	0.0079
Pyrene	0.0052	0.0083	0.0052	ND	0.0055	0.0003	ND
PP-DDT	0.0019	ND	0.0019	0.0022	0.0025	0.0085	ND
Toluene	0.0083	0.0085	0.0083	0.0022	0.0164	0.0127	0.0099
Tp	0.0684	0.0156	0.0304	0.0224	0.0415	0.018	0.0207

TP: Total pesticides, **TC:** Total cyclodienes, **HCP:** Heptachlorepoxyde, **ND:** Not detected

Table 4. Concentration of (POPs) in ground water around Kurkumbh industrial area January 2014.

Organic pollutants	S1	S2	S3	S4	S5	S6	S7
Alpha-HCH	0.17	0.097	0.02	0.35	0.24	0.09	0.27
Beta-HCH	0.04	0.19	0.02	0.04	0.03	0.01	0.02
Gamma-HCH	0.01	0.25	0.01	0.0	0.02	0.01	0.01
Naphthalene	0.023	0.023	0.023	46	029	0.11	0.29
Heptachlor	0.13	0.44	0.08	0.2	0.07	0.03	0.12
Aldrin	0.07	0.32	0.04	0.16	0.05	0.04	0.05
HCP	0.17	0.49	0.04	0.22	0.05	0.06	0.04
Dieldrin	0.04	0.23	0.03	0.11	0.03	0.03	0.02
TC	0.42	0.42	0.2	0.69	0.2	0.15	0.23
Phenathrene	0.09	0.71	0.07	0.31	0.06	0.05	0.07
Pyrene	0.16	0.64	0.14	0.31	0.08	0.04	0.16
PP-DDT	69.79	147.4	58.83	14.97	54.5	6.0	78.99
Toluene	70.0	148.7	59.0	15.59	54.64	6.13	79.22
Tp	70.69	149.4	59.46	16.75	55.17	6.39	79.73

TP: Total pesticides, **TC:** Total cyclodienes, **HCP:** Heptachlorepoxyde, **ND:** Not detected

IV. Conclusion

The present study declared that the concentration of POPs from side second is more than concentrations of POPs from side first. Since rate of persistence of organic pollutants is high from higher slope area to lower slope area. The total average concentration of some POPs, a-HCH, B-HCH, u-HCS Nephthalene, Aldrin, Dieldrin TC, phenathrene pyrene HCP is bellow the admissible environment level but the POPs, P.P-DDT, toluene and total pesticides were above the permissible limit. The maximum levels of toxic substances, recommended for the protection of aquatic biota has been published. The environmental quality objectives set by European community is 10ng/l. of P-P DDT and for HCH isomers at 20ng/L. for Heptachlor. 10-100ng/L. Thus land based activities mainly agricultural and industrial wastes are the major sources of POPs pollution around study area.

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