

THE INFLUENCE OF DIFFERENT TEMPERATURES ON THE ADSORPTION OF ENDOSULPHAN ON TARAI SANDY LOAM SOIL

Dhirendra Singh*

Department of Soil Science, Faculty of Agriculture, S.C.R.S. Government College, Sawaimadhapur, Rajasthan, India.

*Corresponding Author: Dhirendra Singh

Department of Soil Science, Faculty of Agriculture, S.C.R.S. Government College, Sawaimadhapur, Rajasthan, India.

Article Received on 21/12/2016

Article Revised on 11/01/2017

Article Accepted on 01/02/2017

ABSTRACT

The important adsorbed isothermals, dispersion coefficient (Kd), had been used to don't forget the adsorption thermodynamics of endosulphan on Tarai sandy loam at 10 °C, 20 °C, and 40 °C, respectively. The statistics were well fitted by way of the Freundlich situation and yielded L-framed isotherms at all the temperatures tested. Thermodynamic limits just like the thermodynamic concordance regular (Ko).

KEYWORDS: Adsorption, thermodynamics, endosulphan, Freundlich condition, scattering coefficient, entropy, enthalpy, free energy.

INTRODUCTION

Pesticides have been used for decades to combat irritation. Pesticides may be the most significant factor in further developing food production, particularly in developing nations, in order to support the more significant sources of food necessary to feed the growing population. The extensive and unpredictable use of synthetic pesticides results in severe natural degradation and serious medical issues. Among creatures that live. This has increased the interest of agricultural and ecological researchers in determining the fate of pesticides. This kind of testing for pesticides used in crop production has received a lot of attention over the past few years.

A non-ionic foundational, contact, and stomach insect poison with a place in the cyclodiene group, endosulphan (6, 7, 8, 9, 10, 10-hexachloro-1, 5, 5a.6, 9, 9a hexahydro 6, 9-methano - 2, 4, 3-benzodioxathiopin-3-oxide) can be found in the environment. It is fruitful against a couple of bugs and vermin on various yields and is by and large used because of its optimal toxicological movement and low tirelessness conversely, with other chlorinated pesticides. Its feasibility, being a soil - applied pesticide, however depends on physi-cochemical properties of the soils, regular conditions and its ability to show up at the objective organ-isms in a palatable obsession for a particular pe-riod of time. The majority of research on the thermodynamics of organophosphorus and carbamate pesticide adsorption was conducted on fluid-arrangement soils and fly debris.^[1-5] This study was started to focus on the impact of various temperatures on the adsorption of endosulphan and to relate the Freundlich constants and

conveyance coefficient. The purpose of this study was to understand the fundamental science of endosulphan in soil and to assess the thermodynamic boundaries of endosulphan with soil. However, writing relating to adsorption thermodynamics of endosulphan on Tarai sand soil is not available.

MATERIALS AND METHODS

The surface soil tests of tarai sandy loam, ranging in depth from 0 to 30 centimeters, were taken from the Pilibhit regions of Uttar Pradesh.

A 2 mm sifter was used to dry, squash, and sieve the dirt, and the physicochemical tests were not standard. Results got are according to the accompanying : PH 9.0, organic carbon 2.0 g/kg, calcium carbonate 4.5 g/kg, surface area 34.8 m²/g, sand 54.37 percent, silt 32.13 percent, clay 13.50%, and texture sandy loam.

Endosulphan was gotten from M/s Indo-Inlet Fertilizers and Artificial materials Organization Confined. Sultanpur (U.P.). By dissolving a significant amount of the endosulphan in methanol, a stock arrangement of 200 mg L⁻¹ endosulphan was prepared.

Adsorption studies

The adsorption of endosulphan on ordinary soils at 10°C, 20°C and 40°C temperature changed into completed in replica by means of p.C. Balance strategy at constant (zero.25 fs) volume part of methanol. Sensible aliquots of 0.0, 0.50, 1.0, 1.5, 2.0, 2.5, 3.0, 4.0 and 5.0 mL of endosulphan route of motion (200 mg/L) had been taken in unique 50 mL glass-stoppered tightened carafes. Each

jar's final suspension contained 20 milliliters of subtle water, vital extent of methanol, and 1 gram of everyday soil to obtain the desired fs (0.25). The suspension obtained changed into kept at 20°C in an incubator for twenty-four hours. Critical examination showed that there was no quantifiable development in endosulphan adsorption latest hours. The suspensions were then centrifuged at 10,000 rpm for 10 minutes using (Beckman version L3-50) extremely-rotator and inside the supernatants endosulphan was evaluated spectrophotometrically at 520 nm.^[6]

The above-referred to suspensions were shaken at 10°C, 20°C, and 40°C with ordinary soils acting as adsorbents to recognition on the effect of temperature. The ice water helped keep the temperature at 10 ranges Celsius.

RESULTS AND DISCUSSION

Adsorption isotherms of endosulphan on tarai sandy loam soil at 10°C, 20 °C and 40°C were constructed connecting the amount of endosulphan adsorbed (ug/g) and the amount of endosulphan remaining in suspension (ug/ml) at equilibrium (Fig.1).

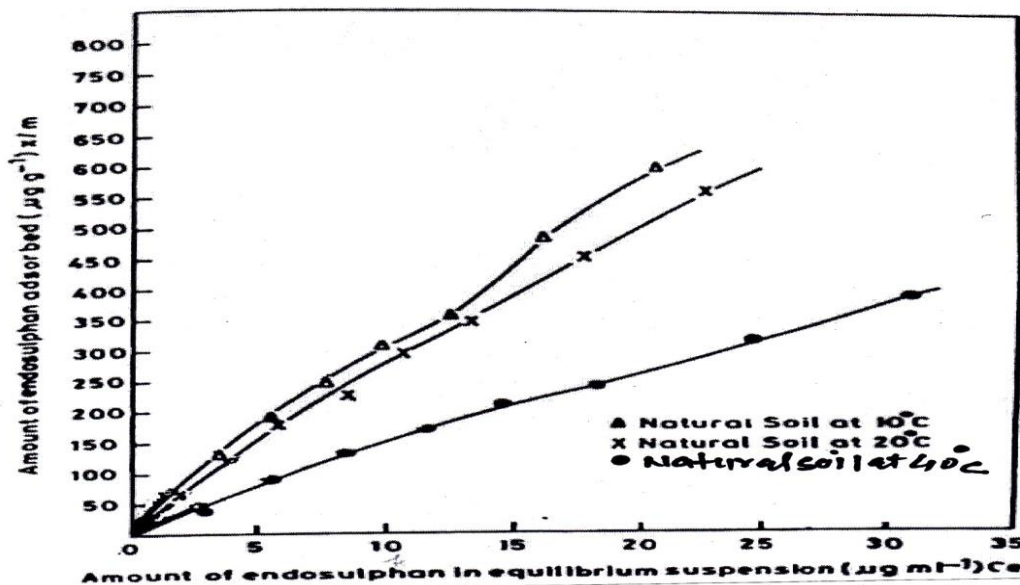


Fig.1 Adsorption Isotherms of Endosulphan at 10°C, 20°C & 40°C temperatures for Tarai Soil.

The isotherms portrayed in the figure are like the L-shaped isotherms characterized by Giles et al^[7] and recommend that the dirt had typical partiality for adsorption of endosulphan. Comparative outcomes were gotten by numerous specialists.^[8,9] The isotherms additionally show that endosulphan adsorption diminished with expanding temperature, true to form from the exothermic idea of the adsorption peculiarities. The lower adsorption at higher temperature is halfway because of the debilitating of appealing powers among endosulphan and soil destinations and partly because of upgrade of the warm energies of the adsorbate accordingly making the alluring powers among endosulphan and soil locales adequate to hold endosulfan. But, the idea of the response continues as before in the dirt.

The dispersion coefficient (K_d) still up in the air by utilizing the recipe,
 $x/m = K_d \cdot C_e$ (1)

The measurable normal of the relative multitude of K qualities was determined by straight relapse condition constrained through the origin.

$$K_d = \frac{\sum \left(\frac{x}{m} \cdot C_e \right)}{\sum C_e^2} \quad (2)$$

Where \sum represents the summation of the qualities.

The upsides of K_d recorded are 28.21, 25.63 and 13.13 and K qualities 42.66, 33.88 and 19.95 at each of the three 10°C, 20°C and 40°C. temperatures. The more prominent adsorption at 10°C was additionally affirmed when K_d and K qualities was taken in to thought.

Expansion in temperature gives more prominent potential effect on the grounds that the height in temperature causes loss of water from particular adsorption locales there by making these destinations accessible to the pesticide. So here decline in adsorption was presumably because of debilitating of van der Waal's powers of fascination among endosulphan and Soil.^[10]

This adsorption conduct of endosulphan on tarai sandy loam at each of the three temperatures was in close concurrence with the Freundlich condition. The Freundlich constants K and N were acquired from the direct relapse investigation
 $\log x/m = \log K + N \log C_e$ (3)

where x/m is how much endosulphan adsorbed per gram soil (ug/g) and C_e is the fixation (ug/ml) of endosulphan in balance suspension. K and still up in the air from the block and slant of the bend, separately. The upsides of K as given above and N values were 0.85, 0.83 and 0.86 at 10°C; 20°C and 50°C.

The thermodynamic balance consistent K_o , for the adsorption response was determined by the strategy for Biggar and Cheung^[12] as applied by Singh et al.^[11] and.^[13]

$$K_o = \frac{C_s}{C_e} \cdot \frac{v_s}{v_e} \quad (4)$$

where C_e (ug/g) is how much endosulphan adsorbed per gram of the dissolvable in touch with soil, C_e (ug/ml) is the convergence of endosulphan in harmony suspension, Y_s is the movement coefficient of the adsorbed solute and Y_e , is the action coefficient of the solute in balance suspension. The proportion of movement coefficients was thought to be solidarity (14) in the weaken scope of the examinations.

The worth of C_s , was determined utilizing the condition proposed by Fu et al.^[15]

$$C_s = \frac{(\rho/M)A}{S/N(x/m)} \quad (5)$$

where ρ is the density of the solvent (g/ml), M the molecular weight of the solvent, A the cross-sectional area (cm² molecule⁻¹) of the solvent molecule, N is Avogadro's number, S the surface area of the adsorbent (m²/g) and x/m the specific adsorption (m.mol/g). The cross-sectional area (A) of the solvent molecules was estimated by using the following equation.^[16]

$$A = 1.091 \cdot 10^{-16} \left[\frac{10^{24}M}{N} \right]^{2/3} \quad (6)$$

As the grouping of solute in the arrangement moved toward nothing, the action coefficient, Versus, moved toward solidarity. Condition (5) may then be composed as

$$\lim_{C_s \rightarrow 0} \frac{C_s}{C_e} = K_o \quad (7)$$

The upsides of K_o , were gotten by plotting $\ln(C_s/C_e)$ versus C_s and extrapolating to zero $C_s=0$. The worth of K_o 2.89, 2.54 and 1.37 at 10 °C, 20°C and 40 °C separately. The higher upsides of thermodynamic balance steady K_o at lower temperature for all the Dirt - endosulphan collaborations show the higher inclination of endosulphan for soil at lower temperature.

The standard free energy changes (ΔG°) for the connection of soil with endosulphan were determined from the relationship.^[17]

$$\Delta G^\circ = RT \ln K_o \quad (8)$$

The standard enthalpy change (ΔH°) was determined from the Van't Hoff isochore.

$$\ln \left(\frac{K_{T_2}}{K_{T_1}} \right) = \frac{-\Delta H^\circ}{R} \left[\frac{1}{T_2} - \frac{1}{T_1} \right] \quad (9)$$

also, the standard entropy change, ΔS° , from the situation

$$\Delta G^\circ = \Delta H^\circ - T\Delta S^\circ \quad (10)$$

The outcomes hence got are given as follows: at 10 °C, ΔG° (kJ/mol) - 40.40, at 20°C-40.15, and 40 °C - 42.73. The potential gains of ΔH° (kJ/mol) is - 16.91 for all of the three temperature. The potential gains of ΔS° (KJ/mol/degree) is 0.083 for every one of the three temperatures.

At all three temperatures, these results show ΔG° values that are negative. Hence it shows that the response is unconstrained with high proclivity of endosulphan at all temperatures. The conformation of isothermal nature is provided at various degrees and suggests that endosulphan is highly resistant to degradation in soil and also confirms the nature of the isotherms obtained at different temperatures (Fig. 1).

The negative upsides of standard enthalpy (ΔH°) changes demonstrate that the endosulphan response was temperature-reliant and exothermic. It also suggested that energetically stable products had a high degree of endosulphan binding to soil sites, indicating that endosulphan was more strongly bound to soil. During the adsorption of endosulphan onto soil at various temperatures, a greater disorder of reaction was indicated by a positive entropy change (ΔS°).

REFERENCES

1. Singh, R. P, Varshney, K. G, Rani, S. (1985). Ecotoxicol. Environ. Saf, 10: 309.
2. Singh, R. P and Singh, D (1996). Toxicol. Environ. Chem, 1996; 57: 171-185.
3. Singh, D(1998). Adsorption Sci & Technol, 1998; 16(8): 583-594.
4. Singh, D. (2000). Pest manag. Sci, 2000; 56: 195-201.
5. Kumari, K and Singh, R. P(1994). Pestic. Res. Journ, 6: 131-138.
6. Maitlen, J. C., Walker, K. C. and Westlake, W. E. (1963). J. Agric. Food. Chem, 11: 416.
7. Giles, C. H. MacEwan, T. H, Nakhawa, S. N. and Smith, D. (1960) J. Chem. Soc, 3973.
8. Ganesan, T. & Lalithakumari. D (1992) Adv. Pl. Sci.
9. Balasubramanian, G. & Mathan, K. K. (1996) J. Indian Soc, Soil Sei, 44: 321.
10. Van Bladel, R. and Moreale, A. (1974) Soil Sci. Soc. Am., Proc, 38: 244.
11. R. P. Singh, KG. Varshney and S. Rani, Ecotoxicol. Environ. Saf, 1985; 10: 309.

12. Biggar, J. W. and Cheung, M. W. (1973) *Soil Sci. Soc. Am., Proc.*, 37: 863.
13. K. G. Varshney, R. P. Singh and S. Rani, *Ecotoxicol. Environ. Saf.*, 1986; 11: 189.
14. Robinson, R. A. and Stokes, R. H. (1959) *Electrolyte Solutions*, Butterworths, London.
15. Y. Fu, R. S. Hanson and F. E. Bartell, *J. Phys. Chem.*, 1948; 52: 374.
16. K. Koda and Y. Onishi, *Bull. Chem. Soc. Jpn.*, 1959; 32: 356.
17. Glasstone, S. (1960) *Textbook of Physical Chemistry*, 2nd Edn, Van Nostrand, New York, 815.