Identification and Treatment Methodologies for Pesticides in Waste Water

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Abstract

Paper focuses on various methods or techniques adopted in Pesticide Waste water Treatment and identification. A review of certain such processes and methods are elaborated in detail. As pesticide manufacturing is done with wide range of raw materials, each and every industry has different effluent characteristics. And thus each of following techniques and processes has its positives and negatives.
Keywords: Pesticides, Treatment, Photochemical Processes, Adsorption, Water oxidation

I. INTRODUCTION

Pesticide is general term described as a chemical agent to destroy or control pests and can apply to wide range of spectrum of chemicals, including insecticides, rodenticides, herbicides, fungicides, biocids, etc. For treatment or identification of any specific type of pesticides, any one of following methods as reviewed can be implemented.

II. METHODOLOGY

A. Photochemically Induced Fluorescence and Second Order Multivariate Calibration:

In this technique, most widely used neonicotinoid pesticide in farming induatry, named as 'imidacloprid' can be determined in water samples. Imidacloprid [1-(6-chloro-3-pyridylmethyl)-N-nitroimidazoli-din-2-ylideneamine] belongs to a new group of active ingredients and was first introduced to the market by Bayer in 1991. In multivariate calibration, figures of merit are related to the concept of multivariate net analyte signal (NAS). This concept involves the decomposition of the total spectrum of a given sample (x) into two orthogonal parts: one part that can be uniquely assigned to the analyte of interest (the net analyte signal, designated x*) and the remaining part that contains the contributions from the other components, which may be different than expected or unexpected sample components (xother), as indicated in Eq. (1):

$$x = xn^* + xother = cn \cdot sn^* + xother \qquad (1)$$

Where xn*and sn* are the net analyte signals (vector signal) corresponding to a given sample and to a sample having the nth analyte at unit concentration, respectively, and cn is the analyte concentration. If matrix-like net analyte signals are implied, Eq. (2) is applied

$$Xn^* = cn \cdot sn^* \qquad (2)$$

The expressions for the sensitivity (Sn) are obtained from the norm of the net analyte signal at unit concentration sn=‖ sn*‖ or Sn=‖ sn*‖. Conversely, for an inverse model the sensitivity is defined as Sn=‖ sn*‖-1 or Sn=‖ Sn* ‖-1 .

B. Low Cost and Locally Available Organic Substances:

In this method, sorption and desorption of chlorfenvinphos, chlorpyrifos, simazine, etc various pesticides wastes on sunflower seed shells, rice husk, composted sewage sludge, agricultural soil, etc can be done.

Raquel Rojas et.al. Studied that:

- Trifluralin and Chlorpyrifos showed fastest sorption kinetics and best sorption capacities when sorbed on all organic wastes.
- Rice Husk was found to be best adsorbent for simazine.
- Not only organic matter content but nature, physicochemical characteristics of surface play a significant role in pesticide adsorption.

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C. Photochemical Methods:

Utilization of light radiation as source of energy is basic principle in this method. Natural solar light or an external UV light (like Xenon or mercury lamps) can be source of photon. Both photo physical and photochemical changes can be brought about by absorption of radient energy ie. Photons by reactant molecules.

"In the photochemical processes, the transformation of the reactant molecules is achieved mainly by two methods. If the reactant molecules absorb the radiant light and transforms, the process is called photolysis. In this process, the reactant molecules (or sensitizers) absorb the light energy and are transformed into other chemical forms through activation. This process, thus, involves the homolytic cleavage of activated molecules to form the degradation products.

1) *Photolysis:*

In this absorption of radiation in both direct and indirect routes tends to induce chemical change for degradation of pesticides.

2) *Photolysis combined with oxidants (H2O2 / O3)*

By combination of chemical oxidants such as hydrogen peroxide or ozone the efficiency of photolysis can be improved.

3) *Photo Fenton Methods.*

In this the irradiation of fenton reaction systems with UV–vis light takes place,when absorption of the light is done the photochemical reduction of Fe(III)–Fe(II) takes palace followed by reaction with hydrogen peroxide.This lead to the formation of a powerful oxidizing agent like the hydroxyl radical.

4) *Semiconductor based Photocatalysis*

Principle of photocatalysis is the photo-excitation of a semiconductor due to the absorption of electromagnetic radiation in either UV or visible spectrum.

5) *Photosensitized induced process*

In this some specific chemical compounds called sensitizers absorb the light radiation and are excited to a higher energy state to transfer the excess energy to the target compound This principle is very useful in the degradation of pesticides, which have low absorption efficiency.

6) *Photoelectrocatalysis*

This is an advanced oxidation technology that relies on ultraviolet (UV) light to activate a proprietary, high surface area semi-conductor photoactive electrode.

D. Supercritical Water Oxidation (SCWO):

In this, organic matters are rapidly, thoroughly oxidized and composed into small molecular matters such as H2O, N2, CO2 and heterocyclic atoms are converted into corresponding acids or organic salts with help of supercritical water (T>374.15,C,P>22.12MPa) used as reagent, acid-base catalyst or unique environmentally safe solvent. Supercritical water has different properties from ambient water on density, dielectric constant, etc. due to decrease of hydrogen bonding content. Removal efficiency of organic matters can be boosted within less than several minutes to more than 99% as reaction occurs in single-phase environment. Both organic matters and oxidant are dissolvable in supercritical water. Also no SOx and NOx pollutants.

E. Sonodegradation of Organophosphorus Pesticides:

Ultrasound has been used for many applications, including cell disruption, nanotechnology, water and wastewater treatment, chemical reactions, food preservation, and so forth. Ultrasound has been extensively used as an advanced oxidation process for water and wastewater treatment. This is owing to the production of hydroxyl radicals in aqueous solutions and subsequent oxidation of pollutants in the presence of ultrasound. The ultrasound technique was successfully used to degrade two organophosphorus pesticides, i.e. diazinon and malathion, from aqueous solutions.

The study done by Mohammad Hadi et.al showed that there was no significant relationship between initial pesticides concentrations and their degradation percentages. Similar result have also been observed in the sonochemical degradation of diazinon Ultrasonic irradiation was a slow process and the complete degradation may require combination with other advanced oxidation processes (AOPs) to thoroughly dissipate the pesticides.

F. Degradation with salt tolerant Streptomyces venezuelae:

Balakrishnan Navin et.al studied the degradation of organophosphorus pesticicide with Streptomyces venezuelae and concluded that it is very effective towards pesticide degradation.

III. CONCLUSION

Besides various compounds found in Pesticides and its treatment and degradation is tedious job, all above described methodologies are adopted to treat wastes. Selection of Method depends upon its ease to use, economy, and compounds in the waste.

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