

International Conference on Emerging Trends in Engineering, Science and Technology (ICETEST - 2015)

## Study on removal of Acetamiprid from wastewater by electrocoagulation

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### Abstract

Pesticides pose a serious threat to living organisms owing to its non-biodegradability and toxicity. In most countries, there are strict regulations as to how much pesticide load is allowed in the effluent from an industry. But, due to the inadequacy of the methods already in practice, these norms may not be followed. In this study, electrocoagulation using aluminum electrodes was applied to artificially simulated wastewater containing Acetamiprid, which is a third generation pesticide belonging to the neonicotinoid class. The electrocoagulation process was chosen for the study taking into consideration, its several advantages which include ease of operation and the scope for automation. The effect of four factors, viz. current density, pH, time and salt concentration on the removal percentage were studied. A model of the process based on these factors was developed using Response Surface Methodology in Minitab 14.

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Peer-review under responsibility of the organizing committee of ICETEST – 2015

*Keywords:* Acetamiprid; electrocoagulation; electrode dissolution; pesticide; Response Surface Methodology; wastewater;

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### 1. Introduction

Pesticides, especially herbicides and insecticides, are being increasingly used in agriculture, forestry, and domestic activities with the intention of preventing, destroying, repelling or mitigating pests. Despite their advantages, pesticides may pose threats to human and animals due to their non-biodegradability. Water contamination by pesticides is mainly due to the run-off from agricultural lands and also due to effluents from pesticide- manufacturing industries. As per Stockholm Convention on Persistent Organic Pollutants, nine out of twelve most powerful organic pollutants are pesticides [1].

'Acetamiprid' is the International Organization for Standardization (ISO)–approved name for (E)-N1-[(6-chloro-3-pyridyl) methyl]-N2-cyano-N1-methyl acetamidine. (Fig.1.).

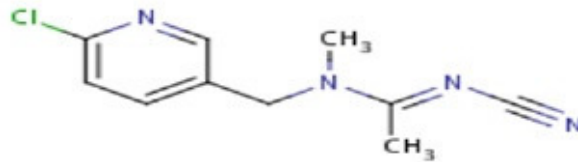


Fig 1. Structure of Acetamiprid

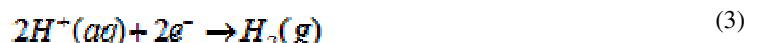
It is one of the most widely used third generation pesticide belonging to the neonicotinoid group, which is one of the fastest growing classes of pesticides today. Acetamiprid is used in controlling sucking insect pests such as aphids, whiteflies, leaf and plant hoppers, thrips, some micro-Lepidoptera, and a number of coleopteran pests. It is applied to crops of leafy vegetables, citrus fruits, pome fruits, grapes, cotton, and ornamental plants and also in commercial cherry farming [2]. The Panel on Plant Protection Products (PPR) of Europe studied the developmental neurotoxicity (DNT) of the compound and found that it may affect the neuronal development and function in mammals, similar to nicotine [3]. The estimate of acceptable daily intake for humans is 0–0.07 mg/kg bw and the acute reference dose is 0.1 mg/kg bw. The lowest one-tenth of LC50 to protect the most sensitive freshwater aquatic life for Acetamiprid is 6.6 µg/L (U.S. EPA Office of Pesticides)[4].

Several processes like Fenton, photo-Fenton and Fenton-like processes have already been used for studying the degradation of Acetamiprid. Cao et.al (2008) studied the photocatalytic degradation of Acetamiprid using Ag doped TiO<sub>2</sub> nanoparticles [5]. The kinetics of Fenton and Fenton-like reaction of Acetamiprid were studied by E.E. Mitsika et.al (2013) [6]. Fasnabi et.al studied the removal of Acetamiprid from wastewater by both Fenton and photo-Fenton processes [7]. The ozonation process for the removal of Acetamiprid from aqueous solutions was also investigated by Fasnabi et al [8]. Khan et al. (2009) studied the photocatalytic degradation Acetamiprid in aqueous suspensions of titanium dioxide (TiO<sub>2</sub>) as a function of irradiation time [9]. The removal of several other pollutants using electrocoagulation have also been studied [10-24].

Electrocoagulation involves the use of electricity to generate metal ions that form coagulants in the solution, using sacrificial anodes followed by coagulation-flocculation of pollutants. The active metal cation (produced at the anode) reacts with hydroxide ions (produced at the cathode) to form a metal hydroxide which then acts as a coagulant, with the pollutant particles and metal hydroxides forming larger aggregates which may either settle out or be carried to the surface as flocs, by hydrogen bubbles produced at the cathode[6]. In the case of aluminum reaction taking place at the anode is:



The side reactions are:



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