*International Journal of Research in Advent Technology (IJRAT) Special Issue "*ICADMMES 2018*"*
E-ISSN: 2321-9637
Available online at www.ijrat.org

Ammonia Removal From Probiotic Industrial Wastewater Using Electro Oxidation

Boda Meenakshi[1], Kalyani.G[1], Bhagawan.D[1], Himabindu.V[1]*
[1] *Centre for Environment, IST, JNTUH Kukatpally-500085, Telangana, India*
* *Prof. Centre for Environment, IST, JNTUH Kukatpally-500085, Telangana, India*

Abstract: Ammonia pollution has become one of the most serious environmental problems. Ammonia is very undesirable in water and can be toxic to fish. The treatment of ammonia is a special concern due to their recalcitrance and persistence in the environment. Need for ammonia removal from industrial waste water is to control eutrophication and water reuse application hence it became an essential part to treat. In order to be discharge this wastewater in to water bodies a proper treatment process is required. Electrooxidation (EO) is a simple and efficient process for industrial probiotic waste water. Electrooxidation of ammonia was studied with an objective to enhance the conversion of ammonia to nitrogen from probiotic industrial waste water.In this study ammonia removal of 83.4% and COD removal of 94%, Ammonia concentration was decreased from 162.4 to 26.8ppm after 60 min electrolysis at voltage of 10V and current density of 50 mA/cm^2.

Index Terms-— Electrochemical Oxidation; Ammonia; stainless steel electrode; probiotic waste water.

1. INTRODUCTION:

Ammonia has been originating to exit in many types of agricultural, municipal, domestic and many industrial waste waters. A huge amount of ammonia on surface water is a source of contamination, due to eutrophication of ponds and streams and poisonousness to aquatic life. Eutrophication of water bodies, a major worldwide environmental problem whose main cause is disposal of nutrients (Nitrogen and Phosphorus) directly from water plants or indirectly from agricultural runoff and leaching from sludge deposited in landfills and human. The rapid growth and industrialization along with an increased awareness about the need for a clean environment have forced industrialists, environmentalists and governments to look for cheap, efficient and long-lasting solutions to waste water treatment and recycling of nitrogen and phosphorus. Ammonia contamination in water bodies is becoming a major environmental problem worldwide. [1].

Two major groups of treatment processes for ammonia removal, they are physicochemical and biological treatment approaches. (1) Nitrification (2) ion exchange and (3) Air stripping and (4) Breakpoint Chlorination are generally used. Though air stripping and ion exchange are extensively used, as no destruction of the pollutant, it requires to be further treated. Breakpoint chlorination demands a large amount of chlorine and relatively low efficiency. Biological method is effective with the addition of carbon sources, large land areas and significantly impaired by low temperature in winter. As electrochemical method has the advantage of high treatment efficiency, withno sludge creation, small area occupied by the plant and relatively low investment costs, a large number of researchers has focused on it recently. In general, ammonia can be oxidized electrochemically into nitrogen, nitrate, or nitrite by electro oxidation processes. [2] Recently, researchers havefocussed on the electrochemical reduction of ammonia with different anodes andcathodes (such as iron, stainless steel, aluminium, Cu, Ti, Rh and Cu/Zn) [3].

ELECTRO OXIDATION: In recent years, the electrochemical oxidation process hasBeen shown as a promising alternative for ammonia removal from different types of waste waters. electro oxidation consists of anode & cathode when electric power is applied from a power source. In this EO process Decomposition of the organic materials through Electro oxidation process without corrosion of electrodes.

ADVANTAGES OF ELECTROOXIDATION:

1. More efficient and inexpensive technique.
2. Low energy consumption.
3. Effective removal of contaminates.

OBJECTIVES:

To remove the ammonia from waste water by electrochemical method (electro oxidation).

To optimize the conditions of technology to prove its uniqueness for the removal of the ammonia For this an experimental work was carried out focusing the general problem of effluent discharge for the industries containing high ammonia concentration using electro oxidation method. SS electrodes were used for carrying out % reduction in ammonia as well as carrying out % reduction in COD

2. Materials and Method:

The material and methods adopted in the study were presented below.

2.1 Chemicals: The chemicals required for efficient removal of ammonia from industrial waste water by electrochemical methods are listed below

S.NO:	NAME OF THE CHEMICAL	NAME OF THE CHEMICAL
1	Sulphuric Acid	H_2SO_4
2	Sodium Hydroxide	NaOH
3	Boric Acid	H_3BO_3
4	Mercuric Sulphate	$HgSO_4$
5	Silver Sulphate	$AgSO_4$
6	Ethyl Alcohol (95%)	$C_2H_5O_H$
7	Stock Mixed Indicator	Methylene Blue, Methyl Red and ethyl alcohol.
8	Borate Buffer	$Na_2B_4O_7{\cdot}10H_2O$ and NaOH
9	Potassium Dichromate	$K_2Cr_2O_7$
10	Ferrous ammonium Sulphate	$(FeNH_4)_2\ (SO_4)_2$
11	Barium chloride	Bacl2
12	Stannous chloride	Sncl2
13	Potassium chromate	K2CrO4
14	Ammonium molybdate	(***NH4***)2MoO4)
15	Ferrous sulphate	Feso4

2.2 Analytical Methods:

The physicochemical analysis of the samples was done using the following methods given in table.2

S.No	Parameter	Methods	Instrument/Equipment
1	pH	Electrometric method	pH meter
2	Electrical Conductivity	Electro metric method	Conductivity meter
3	Dissolved oxygen	-	Dissolved Oxygen meter
4	Chemical oxygen demond	Digestion followed by titration using FAS method	-
5	Ammonia	Kjeldahl method	Kjeldahl Unit
6	Nitrates	UV Spectrophotometric	UV-Visible
7	Sulphates	Turbid metric method	UV-Visible
8	Chlorides	Argentometric method	-

2.3 Probiotic Wastewater:

The probiotic wastewater used in this experiment was collected from the outlet of a unique biotechindustry located Hyderabad. Its initial characterization are as shown below in Table 1.

2.4. Experimental Setup and Methodology

The initial characterization of the sample was carriedout according to "standard methods for examination of water and wastewater 21th addition-2005, APHA" [27] . In electro oxidation method, the operational parameters like reaction time (10–60 min) and current voltage (10 V) are investigated. The above EC experiments were carried in a 250 mL glass beaker having a working capacity of 200 mL as shown in Fig. 1(A). stainless steel Electrodes are connected to the respective anode and cathode leading to the DC rectifier (AP lab, L 6403(1–84 V, 0–3 A)). The active surface area of each electrode is 20cm2 and the inter-electrode distance between the anode and cathode rods is 1 cm. Before each run, stain less electrodes

are washed with tap water and then again rinsed with distilled water. To increase the organic removal from Probiotic waste water.

Reactor setup:

Removal of the pollutant (%) = (Ci-Cf)∗100 / Ci
Where, Ci is the initial pollutant concentration(mg /L) and
Cf is the final pollutant concentration(mg/ L).

3. Results and Discussion:

3. 1 Initial Characterization:

Initial characterization was done for industrial probiotic waste water wastewater effluent and which was given in Table

Table**:** Initial characteristics of the industrial probiotic wastewater Sample

S.No:	**Parameters**	**Initial Concentration (mg/L)**	**CPCB Limits (mg/L)**
1	pH	9.02	6.5 TO 8.5
2	Electrical Conductivity [EC]	13.68(ms/cm)	
3	ammonia	162.4	40
4	Chemical Oxygen Demand	20000	250
5	Nitrates	53	
6	Sulphates	276	400
7	Total solids [TS]	8800	
8	Total dissolved solids	6150	2100
9	Dissolved solids	0.21	
10	Chlorides	538.8	

All parameters expressed in mg/l except pH, EC. EC expressed in Milli Siemens.
NOTE: NA-Not Applicable; CPCB limits (2012)

3.2 Electro oxidation technique for industrial probiotic wastewater treatment

The experiment were conducted to find out the optimum reaction time and studied from 10min to 60min reaction time. It was found that both ammonia and COD removal was increased with reaction time.

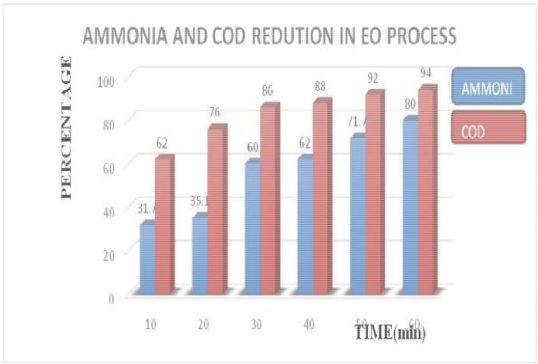
Table:electro oxidation effect of contact time (min)

Time (Min)/ Parameters	**10**	**20**	**30**	**40**	**50**	**60**
pH	9.71	9.56	9.82	9.09	9.13	9.02
Electrical Conductivity (ms/cm)	13.68	13.24	13.59	13.64	13.53	13.72
Ammonia (mg/l)	110.88	105.28	64.96	61.60	45.92	26.88
Chemical Oxygen Demand (mg/l)	7600	4800	2800	2400	1600	1200
Nitrates (mg/l)	49.55	35.60	26.20	25.05	23.10	19.15
Sulphates (mg/l)	205.5	158.5	120.0	96.05	60.55	46.55
Chlorides (mg/l)	475.03	475.03	173.70	148.89	99.26	74.40
Dissolved Oxygen(mg/l)	0.21	0.27	0.26	0.23	0.22	0.23

All parameters expressed in mg/l except pH, EC. EC expressed in Milli Siemens.

Graph was plotted time versus COD reduction and Ammonia reduction, which was shown in Figure, it was observed that, both COD and ammonia reduction was increased with increasing time.

Fig: Ammonia and COD removal



OPERATIONAL COST:

Power consumption of the electro oxidation process was studied.

a=UItEC/V

Where

a= electricity consumed (kWh/m3, U = Cell voltage (V), I = Current (A), tEC = Operating time(h), V = Volume of the sample (m3).

Table: power consumption for electro oxidation for probiotic waste water.

:

S.NO:	**Treatment Method**	**Power consumption/ L**	**Price/litre**
1	Electro oxidation	0.1kwh/hr	0.695rs

Conclusion:

The following conclusions were drawn from the experimental work done inthe laboratory batch study,

- Experimental results showed that ammonia Removal efficiency leading to treated industrial probiotic waste water with a NH_3concentration below the disposal limit (40 mg /l).
- From the experiments carried out to reduce ammonia, it was observed that the amount of NH_3reduces up to 26.8ppm and, COD reduces up to 1200ppm by using stainless steel electrodes at 2A and applied voltage at 10 V.
- Electro oxidation process was found to be more effective for the ammonia and COD reduction.
- SS-SS (stainless steel) electrodes were found to be most efficient for the degradation of ammonia industrial probiotic waste water.

References:

[1] 1.Rajn Desai, "Removal Ammoniacal Nitrogen by Electro Coagulation Methods". Research Scholar, Environmental Engineering, BVM Engineering College, Gujarat, India, year-2016.

[2] Yaning wang, "Efficient electrochemical removal of ammonia with various cathodes and Ti/Ruo2-pt anode". Graduate School of Life and Environmental Sciences, University of

Tsukuba, Tsukuba, Japan, accepted October 12, 2012.

[3] Mnirch Majlesi,"Improvement of nitrate removal by using continuous electrocoagulation /electro floatation unit with vertical monopolar electrode". Department of Environmental and Occupational Hazards Control Research Centre, Shahid Beheshti University of Medical Sciences, Tehran City 11369, Iran, year-2016.

[4] Amir Hossein Mahavi, "Performance evaluation of a continuous bipolar EC EO-EF reactor designed for simultaneous removal of ammonia and phosphate from waste water effluent". Department of Environmental Health Engineering, School of Public Health, Tehran University of Medical Sciences, Enghelab Street, Tehran, Iran, year-2015.

[5] K. Govindan, "Removal of nitrate ions from water by electrochemical processes". Water Research Laboratory, Water Institute, Karunya University, Coimbatore 641 114, Tamil Nadu, India, year-2015.

[6] Miao Li, "Treatment of nitrate contaminated water using an electrochemical method". School of Water Resources and Environment, China University of Geosciences (Beijing), Beijing 100083, China, year-2012.

[7] Liang Li, "Ammonia removal in electrochemical oxidation: Mechanism and pseudo-kinetics". Department of Environmental Science and Engineering,Fudan University, 220 Handan Road, Shanghai 200433, China,year-2008.

[8] Agnieszka Kapeika, "Electrochemical oxidation of ammonia (NH4+/NH3) on thermally and electrochemically prepared IrO2 electrodes". Instit ute of Chemical Sciences and Engineering, Ecole Polytechnique Federal de Lausanne (EPFL), CH-1015 Lausanne, Switzerland