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Review on Research Removal of Phenol from Wastewater by Using Different Methods

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***Abstract*-** Phenolic compounds are found in wastewaters of various industries such as petroleum refining, coal conversion, plastics, textiles, iron and steel manufacturing as well as pulp and paper manufacturing. It is very important to remove phenols and aromatic compounds from contaminated water before discharge into any natural water because of their toxicity to aquatic organisms. Conventional processes for removal of phenols from industrial wastewaters including extraction, adsorption on activated carbon, bacterial and chemical oxidation, electrochemical techniques.

Various methods are used for removal of the phenol from wastewater such as adsorption, volatilization and biological and non-biological methods.

The methods such as Extraction, adsorption, Polymerization, , photodecomposition, advanced oxidation , ion exchange, membrane processes, electrocoagulation, reverse osmosis, and electrochemical methods.

Index Terms- phenol, concentration , Activated carbon, Current density, pH

I. Introduction

High concentrations of phenol and phenolic compounds typically are found in aqueous effluents of oil refineries, petrochemical, ceramic, and steel plants, coal conversion processes, phenolic resin and pharmaceutical industries. One of the most prevalent forms of organic chemical pollutants in industrial wastewaters are Phenol and phenolic compounds . Since phenol and its derivatives are toxic and harmful to living organisms even at low concentrations, they are known as noxious pollutants.

A number of effects from breathing phenol in air have been reported in humans. Short-term effects reported include respiratory irritation, headaches, and burning eyes. Chronic effects of high exposures include weakness, muscle pain, anorexia, weight loss, and fatigue. Effects of long-term low-level exposures include increases in respiratory cancer, heart disease, and effects on the immune system [1].

Repeated exposure to low levels of phenol in drinking water has been associated with diarrhea and mouth sores in humans. Ingestion of very high concentrations of phenol has resulted in death. In animals, drinking water with extremely high concentrations of phenol has caused muscle tremors and loss of coordination [2].

Phenol is not expected to bioconcentrate significantly in aquatic organisms. Reported log bioconcentraction factors (BCF) in fish for phenol include 0.28 for goldfish, 1.3 for golden orfe . The highest mean level of phenol detected in bottom fish from Commencement Bay in Tacoma, Washington, was 0.14 ppm . The levels of phenol in the water or sediments were not stated. The pKa of phenol is 10 indicating that phenol will primarily exist as the protonated acid at environmental pH values. In alkaline soils and water, phenol will partially exist as an anion, which can affect its fate and transport processes.

II. VARIOUS METHODS FOR REMOVAL OF PHENOL

A. Extraction

Batch phenol removal from methyl isobutyl ketone by liquid–liquid extraction with chemical reaction was carried by M.S.A. Palma, J.L. Paivab et.al (4) in a bench-scale mixed vessel the influence of temperature, NaOH concentration in the extracting aqueous phase and rotational speed on the batch removal of phenol from a 14.4% solution in methyl isobutyl ketone. Temperature was varied in the range 10–40◦C, the concentration of NaOH between 5.5 and 6.5% and the rotational speed from 400 to 800 rpm.

Extraction of Phenol from Industrial Water Using Different Solvents Was done by Sally N. Jabrou (5) he has been worked out . the necessary liquid-liquid equilibrium data for the extraction of phenol from water. Phase equilibrium data of the ternary systems water-phenol-organic compounds were generated including phase equilibrium diagrams, distribution coefficients of phenol, tie-lines data and selectivity of the solvent. Tie-lines of two phase conjugate layers were determined by use of cross-section method and the accuracy of experimental tie-line data for the ternary was checked for six different solvents.

V. Archana et.al (3) investigated removal of phenol using ionic liquid immobilized polymeric micro-capsules persistent emulsification and leaching of extractant in conventional extraction operations, room temperature ionic liquid (RTIL) encapsulated in microcapsules (MC) is used as extractant. The extractant loading capacity in the microcapsules was also analyzed by solvent extraction using hexane as solvent. Room temperature ionic liquid (RTIL) encapsulated polymer microcapsules (MC) prepared using styrene and divinyl benzene as adsorbent can be effectively employed for the adsorption of phenol. phenol adsorption was dependent on PH. Adsorption of phenol follows the Freundlich isotherm of multilayer adsorption and obeys a pseudo-second order model. Thermodynamic analysis of the adsorption suggests that the process is not only exothermic but also spontaneous. Desorption studies indicated regeneration of the adsorbent for three cycles of operation and also the stability of the extracant in the microcapsules. Response surface methodology and the central composite design were appropriate in determining the optimal conditions for phenol adsorption on RTIL encapsulated polymer microcapsules. The optimal conditions of adsorption has initial phenol concentration 100 ppm, pH : 6, adsorbent dosage: 1 g/100 ml. In these conditions the percentage removal of phenol and the adsorption capacity were 92.5% and 9.07 mg/g which are in good agreement with the predicted values.

B. Adsorption

M. R. Sawant et.al (6) investigated efficiency of physically activated Date Seed Carbon (DSC) for phenol removal was assessed. The effect of various parameters like initial concentration, amount of adsorbent,agitation speed, and temperature has been studied.

Yun-Hwei Shen (7) has been performed feasibility of removing phenol from water using a novel adsorption–flocculation process. The treatment involves dispersing bentonite to the phenol contaminated water and subsequently adding BTMA ion to create flocs, which are an agglomerate of BTMA-bentonite and phenol molecules. Under the appropriate operating conditions, 90% phenol removal and nearly 100% bentonite recovery may be achieved.

Binoy SarkarA et.al (8) were carried out Adsorption of Phenol by HDTMA-modified Organoclay modification of bentonite by HDTMA hugely improved the adsorption of phenol as compared to the unmodified bentonite.

C. Electro coagulation

Edris Bazrafshan1 et.al (9) has investigated that coagulation process using M. peregrina seed extract as a natural coagulant in the removal of phenol from aqueous environments. The results obtained with synthetic reveal that the most effective removal capacities of phenol were achieved with coagulant dose 0.1 and 0.3 ml/L at pH 5 and the highest removal was found to be 95.16, 95.84 at initial phenol concentration of 5, 10 and 100 mg/L.

Treatment of Petrochemical Wastewater Containing Phenolic Compounds by Electrocoagulation Using a Fixed Bed Electrochemical Reactor.

El-Ashtoukhy et.al (10) were carried out parameter pH, time, current density, electrolyte concentration, initial phenolic compound. concentration and temperature were investigated for phenolic compounds removal in batch reactor. Maximum removal of phenolic compounds was attained at pH = 7, NaCl concentration = 1 g/L, current density = 8.59 mA/cm2 , temperature = 25°C. Increase in the current density and NaCl concentration resulted in an increase in the phenolic compound removal and decrease in COD of the treated solution.

M. T. Jafarzadeh et.al (11) have been investigated that the removal of phenol from an actual wastewater using a batch electro coagulation reactor at different operational conditions such as electrode type, initial pH, current density and electrolysis time were investigated for their effects on the removal efficiency.

D. Membrane Separation Technique

Membranary techniques used at the separation of some phenolic compound from aqueous media was carried out by Ioana DIACONU1 et.al (12).they investigated separation of some phenolic compounds

m-nitrophenol, p-nitrophenol, m-cresol, p-cresol, using the bulk liquid membranes technique. Using chloroform as the organic solvent for the membrane, the operational parameters of the transport were studied and the optimum separation condition feed phase pH, the receiving phase pH, the time period of the transport have been carried out.

Application of modified maxwell-stefan equation for separation of aqueous phenol by pervaporation was tried by Ujjal K Ghosh et.al (13). They investigate simulation of the phenol-water separation by pervaporation using polyurethane (PU) membranes. The modified Maxwell-Stefan model takes into account the non-ideal multi-component solubility effect, nonideal diffusivity of all permeating components, concentration dependent density of the membrane. In this study ,They also found phenol in the feed increases, the partial fluxes of the phenol and water also increases but with the former having a more drastic increment. The effect of membrane thickness on the fluxes is inversely proportional diffusion of the components to the permeate side.

Tarakranjan Gupta et.al (14) investigated the synthesis and pervaporation characteristics of a novel Hydroxyterminated polybutadiene based polyiminourethaneurea film for separation of phenol from phenol water mixture.

E. Biological Method

Monitoring the Ozonation of Phenol Solutions at Constant pH by Different Methods investigated by Edgardo M. Contreras et.al (15).they have been investigated Oxidation_reduction potential and proton production profiles can be used as alternative indicators to monitor the ozonation of phenol solutions at constant pH.

Effect of Phenol Loading on Wastewater Treatment by Activated Sludge Process carried out by H. Pasdar et.al (16). They investigated effects of Phenol concentration, retention time and aerating time on the performance of the activated sludge process are given in terms of COD, TOC, TSS parameters. The optimum hydraulic retention time was noted. The results showed that increasing concentrations of Phenol , the efficiency of COD increased , reduction of COD was observed.

***F.** Electro-Fenton Process*

Yang, C. et.al (18) investigated that degradation of phenol in an aqueous solution with bipolar graphite electrodes and activated carbon. Reaction parameters including the pH value of the solution, the dosage of ferrous ion, and the current density within the solution on the removal of phenol and COD at various reaction times were evaluated for the treatment of wastewater containing phenol of 100 mg/L and granular activated carbon. electro catalytic oxidation and radical oxidation contributed to the degradation of phenol

Marcio Pimentel.et.al (17) has been investigated oxidative degradation of aqueous phenols solutions in acidic medium by electro-Fenton process using a carbon felt cathode and a platinum anode.

They has been carried out Ferrous ironions were the most effective catalysts with optimum concentration Fixing constant currents and pH , smaller volumes and greater cathode surfaces allowed faster degradation. optimum catalytic conditions were obtained phenol degradation. During electroFenton degradation of some other compounds, using iron as catalyst may lead to formation of complexes, changing iron concentration in the media. metal cations may present better results as catalyst. Phenol oxidation by hydroxyl radicals follows a pseudo-first order.

III. CONCLUSION

Extraction, adsorption, electrocoagulation, membrane separation techniques, biological method, electron fenton methods were used for phenol removal. We also use for removal of phenol by using natural and synthetic adsorbents.

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