

Characterization of hazardous waste landfill leachate and its treatment through electrocoagulation.

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Introduction

Management of leachate has always been a concern for environmentalists because of its huge potential to contaminate underlying soil and ground water. Situation becomes crucial when the leachate is produced from hazardous waste landfills, as it contains all the toxicity from parent wastes and possess high concentration of recalcitrant compounds, heavy metals and low BOD/COD ratio etc. As characteristics of “parent material” is the prime factor to define the characteristic of leachate, its detailed characterization is very much necessary before deciding the treatment trail. Many characterization studies have been carried out by researchers in past but almost all are oriented towards municipal waste landfills (Aziz et al., 2010; Naveen et al., 2016), specific studies focusing on hazardous waste landfill are seldomly available for reference. Therefore in this study detailed characterization of leachate from different hazardous waste landfills (of different age) has been done for a duration of one year so that an extensive dataset can be prepared for the same. Results of the study helped in analysing the impact of landfill age and seasonal variation on leachate characteristics and selection of appropriate treatment processes.

For treatment of leachate, advanced oxidation processes (AOPs) have gained sincere popularity during last decade as they can efficiently deal with the toxic and recalcitrant compound present in the leachate unlike the conventional treatment processes. Many AOPs including fenton process, photo assisted fenton, ozonation, and electrochemical oxidation have been studied and tested for leachate treatment. Other AOPs like electrocoagulation is also emerging as an efficient technology for treating complex waste water including leachate (Gautam et al., 2019). In present study, along with detailed characterization, treatability of hazardous waste landfill leachate has been checked through electrocoagulation (EC). Effect of different operating parameters on treatment efficiency was also studied. COD was selected as a parameter of concern to analyse the performance of EC. Overall this study was carried out with following objectives:

- To prepare a reference document with extensively detailed characterization
- To study the variation in leachate characteristics with variation in age of landfill
- To study the variation in leachate characteristics with variation in season of the year
- To select an appropriate technology (AOP) for treating leachate
- To check leachate treatability through selected AOP: Electrocoagulation
- Study the effect of various operating parameters on treatment efficiency

Material and Methods:

For fulfilment of initial three objectives, three hazardous waste landfills of different age (2years, 11years and 20 years respectively) were selected in Bharuch district of Gujarat state of India and monthly sampling was carried out for all the landfills for a duration of 12 months so that all the seasons can be covered and effect of age and seasonal variation on leachate characteristics can be analysed. Along with characterization, based on literature review (Gautam et al., 2019) electrocoagulation was selected as the major treatment technology and COD was selected as the major parameter to assess the efficiency of the process. Figure 1 shows the detailed methodology followed during study.

Results and Discussion

Results of the study gives a detailed dataset to analyse the characteristics of leachate produced from hazardous waste landfill, this dataset can be used as a readymade reference by other researchers working in the field of leachate treatment. Statistical analysis (ANOVA and Post Hoc analysis) shows that landfill age significantly affects the leachate characteristic whereas no specific pattern or significant impact of seasonal variation could be observed during study.

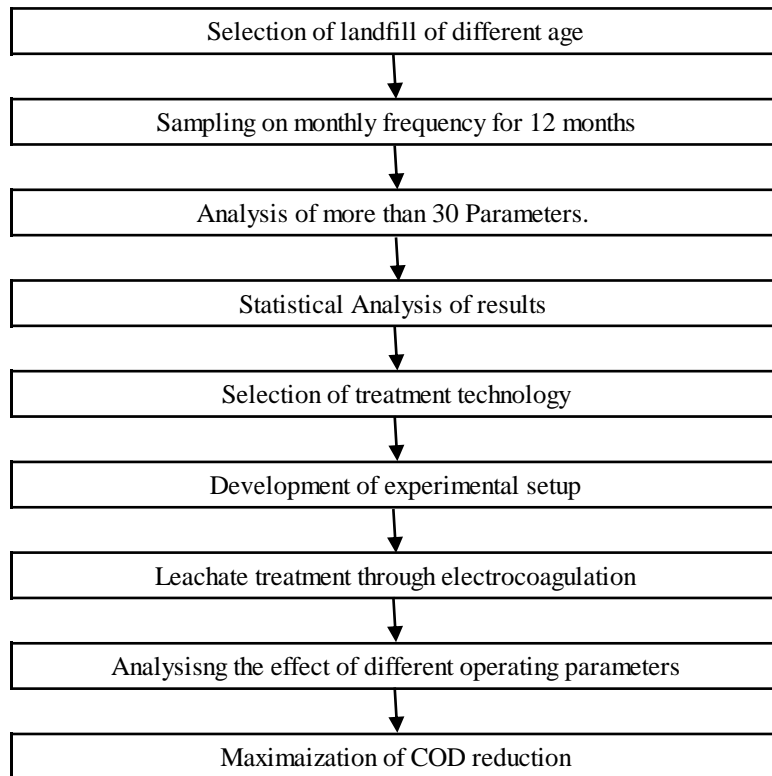


Figure 1: Methodology adopted during study

Results of leachate treatment through electrocoagulation shows high efficiency in cod reduction and it was observed that under favourable conditions, EC may result in more than 80% of removal efficiency. Effect of different operating parameters like current and interelectrode distance and electrolysis time was also studied to get maximum COD reduction.

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