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Biodegradation Modeling Of Phenol Using Light Crude Petroleum Oil in Seawater

Mousa Wang*

Department of Pharmaceutical Chemistry, University Teknologi PETRONAS, Malaysia

Abstract

As a byproduct of industrialised production and chemical reactions, phenol is significant worry pollution. Using the recently discovered plant growth-stimulating bacteria C. flaccumfaciens, the kinetics of phenol's growth and biodegradation were first studied. Haldane's growth kinetics inhibition coefficient, half-saturation coefficient, and maximum specific growth rate for phenol-dependent growth kinetics were each determined using the Haldane inhibition model. The Haldane equation is ideally suited to empirical data with a sum of squared error [1]. Trends in phenol biodegradation are also correctly predicted by the enhanced Gombertz model [2]. As the initial phenol concentrations were raised, so did the rate of phenol biodegradation and the lag time [3]. At an incubation temperature of 28 C, C. flaccumfaciens growth and phenol biodegradation were most successful [4].

Keywords: Biodegradation; Oil Spill Modelling

Introduction

A biodegradation process for phenol most organic hydrocarbons are pollutants, and they contain a wide variety of elements that can be harmful to human health. Phenol and its derivatives, which are referred to as secondary byproducts, are frequently used as raw materials in industrial and agricultural production [5]. Phenol causes olfactory and gustatory problems in water and is toxic to a number of aquatic creatures at lower mg/L concentrations. An excessive amount of phenol exposure can lead to cancer, morbidity, weight loss, liver failure, central nervous system issues, rashes, paralysis, and difficulties speaking. Due to its rapid cutaneous imbibition, inhalation, and consumption, it has a fatal effect [6]. It may result in significant eye and respiratory pain. It is categorised as human. The US Environmental Protection Agency identified phenol as a contaminant of primary concern due to its toxicity [7]. Economic burdens or more toxic byproducts pose new threats to the environmental disposal of phenol. Successful ways to get rid of phenol compounds include solvent extraction, absorption, ion exchange, incineration, chemical activated carbon absorption, oxidation, and liquid extraction. However, both physical and chemical processes are typically expensive, and the majority of these processes don't successfully breakdown phenol; instead, they only change its phase, which causes pollution and consequently dangerous byproducts. Contrarily, phenol biodegradation is a more economical and advantageous solution for the environment [8]. Because of this, the importance of biological phenol therapy has increased. microorganisms in a number of ways, such as improving nutrient bioavailability and biosorption, decreasing soil-plant pathogens by controlling pathogenic factors, building materials that support plant growth, and removing harmful constituent parts from the soil, like harmful compounds that may hinder plant growth. Plant growth-promoting bacteria (PGPB) are a type of microbe that can be utilised in place of synthetic fertilisers, pesticides, and genetically modified plants [9]. Additionally, PGPB can mitigate the detrimental effects of environmental stresses on soils. Stress can be brought on by high salt concentrations, pollution from heavy metals and other non-living pollutants, or various organic toxins [10].

Discussion

Therefore, PGPB intends to serve as a potential means of re-establishing agricultural fields that were previously inappropriate [11]. Scientists have been enthralled by the biodegradation of aromatic compounds like phenol for many years [12]. Bacterial cells are ubiquitous and have adapted to utilise the unprocessed organic substances that humans create. Bioremediation or biodegradation is generally the best solution because to its complete biodegradation and inexpensive cost. This work investigated the ability of isolated growth-promoting C. flaccumfaciens, which was confirmed by GC-MS and HPLC studies, to biodegrade phenol. This required simulating the growth dynamics of C. flaccumfaciens using phenol as a carbon and energy source [13]. As a result, the bottle was filled to the mark with distilled water and vigorously agitated before being filter sterilised [14]. The mineral broth media containing phenol was finished by filling It is still difficult for microbes to remove trace organic micro pollutants from drinking water sources. In fast sand filters, nitrifying and heterotrophic bacteria can biodegrade OMPs while feeding on dissolved organic matter and ammonia (DOM) [15]. This means that both microbial activity and OMP biodegradation may be impacted by the loading patterns of ammonia and DOM. The impact of substrate loading on OMP biodegradation at environmentally relevant concentrations in RSFs is currently poorly understood. At varying substrate loading rates and/or empty bed contact periods, we examined the biodegradation rates of 16 OMPs. By acting as an additional carbon source for the heterotrophic degrader, DOM enhanced the biodegradation of paracetamol while impeding the biodegradation of 2, 4-D, mecoprop, and benzotriazole due to substrate competition. Reduced loading the type of OMP, which can be selected based on the priority compounds in practise, will therefore depend on the best substrate loading pattern. The overall results provide a step toward improving microbial removal of OMPs from drinking water by properly utilising RSFs and contribute to understanding OMP biodegradation pathways at trace concentrations.

***Corresponding author:** Mousa Wang, Department of Pharmaceutical Chemistry, University Teknologi PETRONAS, Malaysia, E-mail: MousaWang87@gmail.com

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Reported that rather than ammonia concentration or volumetric flow velocity separately, the nitrification activity of RSFs was controlled by the ammonia loading rate. Ammonia and DOM loading rates affect the activities of nitrifying and heterotrophic bacteria in RSFs, which may affect how quickly OMPs degrade. However, nothing is known about how primary substrate loading rates affect the rate of OMP biodegradation. Here, we put up two theories increased nitrification activity is caused by higher ammonia loading rates, which may improve the autotrophic co-metabolism of OMPs. By raising the activity of the heterotrophic community, increasing the DOM loading rate both increases OMP biodegradation and decreases it owing to substrate competition. Changing the volumetric flow velocity causes variable empty bed contact periods with a constant sand bed height. EBCT has a significant impact on OMP biodegradation. Because increasing substrate loading rates promote microbial activity and might make up for decreased contact time between OMPs and biofilms, shorter EBCT might be advantageous for the biodegradation of readily biodegradable chemicals. As a result, a prolonged EBCT may be beneficial for the biodegradation of slowly biodegradable OMPs but has little to no effect on, or perhaps has a detrimental impact on, their removal. Three columns were run concurrently using three distinct feeding plans: control no ammonia and DOM, DOM only, and ammonia only.

Conclusion

Dynamic loading rates of ammonia, DOM, and OMPs as well as EBCTs were used in various operating phases by altering either the starting substrate concentrations or volumetric flow velocity. Pseudo-first-order kinetic models were used to calculate the OMP biodegradation kinetics of each phase. The findings deepen our understanding of OMP biodegradation mechanisms and provide light on how tough it is to employ RSFs to biodegrade OMPs, despite growing interest in this area due to the complexity of OMP biodegradation patterns under various operational settings. This is the first work that, to the best of our knowledge, examines OMP biodegradation behaviours in relation to substrate and contaminant loading patterns. Non-hazardous microorganisms are used in microbial biodegradation to detoxify or remove harmful substances. Water supplies are contaminated by Direct Red81, a hazardous and cancer-causing dye released into wastewater from the textile industry. Sampling and sample preparation are necessary for the offline spectrophotometric techniques frequently employed to track biodegradation. They fail to take into account how created products and changes in the composition of the medium might affect the method's selectivity. Potentiometric sensors provide a straightforward, portable, inline, and real-time analysis tool. No potentiometric sensor for online monitoring of an ongoing microbial-biodegradation process has, to our knowledge, been published. A recent study used Candida albinos to study the biodegradation of DR81. The researchers routinely removed samples to track changes in the UV-visible spectrum of DR81. A portable and selective solid-state device is optimised and validated in this work. Azo dyes are synthetic colours used in the textile, printing, and leather, cosmetic, culinary, and pharmaceutical sectors. They include one or more azo bonds. During processing, water is used extensively in the textile and dyeing industries. When discharged into the environment, such effluent contains significant volumes of wasted dyestuff, which poses a substantial pollution hazard. If dye-rich effluents are not adequately handled, they can impair both the aquatic environment and human health. Textile wastewater can result in bleeding, gaseousness, skin rashes, dermatitis, and skin ulcers. Many azo-dyes have breakdown products that are mutagenic and carcinogenic to aquatic life. Untreated discharge of textile dyes has the potential to cause bioaccumulation, which might affect human health by entering the food chain. Therefore, it is essential to get rid of harmful substances. Industries are required to treat sewage containing dyes separately due to environmental rules limiting the appearance of colour in discharged wastewater. Furthermore, dyeing wastewater treatment and reuse have become essential to prevent environmental dangers and lower production costs due to a lack of supply and rising water prices in the industrial sector. Textile wastewater has been treated using a variety of physicochemical techniques, such as electrokinetic coagulation, advanced oxidation processes, coagulation-flocculation, adsorption, membrane filtration, ion exchange, and radiation. These techniques, however, have a number of drawbacks because of their high cost, poor efficacy, significant sludge production, and problems with secondary contamination. As alternative, biological processes involving bacteria, fungus, yeast, actinomycetes, algae, and plants convert, degrade, or mineralize azo dyes. Some hazardous materials are reduced through biodegradation.

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None

Conflict of Interest

None

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