Journal of Bioremediation & Biodegradation

Mini Review Open Access

Biodiesel Fuels' Half-Lives of Biodegradation in Terrestrial and Aquatic Systems: A Review

Arun Kumar*

Department of Chemical Engineering, University of Portharcourt, Nigeria

Abstract

It is essential to have knowledge of the biodegradation kinetics of biodiesel fuels while choosing the best remediation tactics and doing risk and impact assessments. However, there is a lack of consistency in this information, and we still don't fully understand what causes variation in biodegradation rates. In order to determine the 142 biodegradation and 56 mineralization half-lives of diesel and biodiesel fuels in diverse experimental setups, we thoroughly analysed 32 scientific literature sources. Using sets of averaged half-life values and their statistical uncertainty, the analysis focused on the variation in half-lives among fuels and experimental settings. Biodegradation half-lives varied from 9 to 62 days across all data sites and were 2-5.5 times shorter than mineralization half-lives. In terrestrial environments, biodegradation and mineralization half-lives were 2.5–8.5 times longer for all fuels than in aquatic systems. a system of water. Although discrepancies in the quantity of data points from separate studies obscured differences in half-lives between different fuels, the half-lives were generally shorter for blends with greater biodiesel concentration. The kind of mixes and experimental system did not, in the majority of cases, have statistically significant effects on biodegradation half-lives. While more research is necessary to define the rates of biodegradation in anaerobic environments, our data can be utilised to better characterise the dangers and effects of biodiesel fuels in aerobic aquatic and terrestrial habitats. Due to its relatively high biodegradability, biodiesel fuels may benefit from remediation techniques that use monitored natural attenuation and other passive methods to degrade and disperse contaminants in their natural environments.

Keywords: Biodiesel; Biofuels; Bioremediation; FAME; Impact assessment; Risk assessment

Introduction

Depending on the nation or location, biodiesel, a form of fuel made primarily from plants, is blended with petroleum diesel oil in amounts ranging from 2 to 20%. Cadillo Benalcazar Gupta, DeMello, and Schleicher. The Renewable Energy Directive for the time period in the European Union sought to replace 10% of fossil fuels with biofuel The European Parliament. The production of biofuels has been increasing significantly, with the annual global production of biodiesel increasing more than ten times between 2000 and 2020, reaching 45 billion litres. This increase was accompanied by a rise in understanding of the possible drawbacks of producing biofuels from agricultural plants, which are mostly brought on by the conversion of natural land to cultivated land, which releases carbon stored in the soil and natural biomass as CO2 In addition to social effects, competition with food and feed may indirectly result in the loss of natural land somewhere else. Regulations limiting the production of biofuel from first-generation feedstock to 7% in 2015 and ultimately 3.8% in 2030 were created as a result of these worries. Biodiesel is typically thought to be easily biodegradable in the environment, with blends containing more biodiesel reporting much greater biodegradation rates. According to the dictionary, "biodegradation" is the process by which microorganisms break down organic materials into more basic ones [1,2]. The term "mineralization" refers to the degree of deterioration attained when microbes completely consume the test chemical, producing carbon dioxide, water, mineral salts, and new microbial cellular components. Several factors, such as the environment and exposure conditions (aerobic or anaerobic), or the species of degrading microorganisms, might affect the biodegradation and mineralization kinetics of biodiesel fuels. Knowledge of these factors, as well as information on the biodegradation and mineralization kinetics in various conditions and types of environments, is necessary for the selection of an appropriate remediation strategy for biodiesel fuels and the assessment of environmental risks and impacts of biodiesel emissions to the environment. One review on the environmental fate of biodiesel has been written, although it concentrates on subsurface biodiesel transport mechanisms rather than issues with biodegradation and mineralization. Although there are individual studies available that give experimental results on its biodegradation and/or mineralization, this data has not yet been systematically gathered, examined, and compared. In this review, we assemble information on the biodegradation kinetics and explain the variables that affect the half-lives of biodegradation and mineralization. We take into account different media, aeration settings, and types of biodiesel blends [3,4]. Diesel fuel derived from petroleum is used as the comparison standard. Two steps were taken in conducting the review. In the first phase, we compiled a list of all research that touch on any aspect of the biodegradation of biodiesel fuels and may therefore include information on the kinetics of biodegradation and/or mineralization [5,6]. The following keyword combinations were used to locate those studies in the Scopus database: biodiesel, diesel, blend, biodegradation, mineralization, bacteria, degradation, and microbial degradation. As a result, we discovered 145 peer-reviewed papers [7,8].

Discussion

The second phase was searching each of these publications for information on the kinetics of biodegradation or mineralization, such as half-lives or rate constants. Results were included in the analysis if the following requirements were satisfied: the half-life values were

***Corresponding author:** Arun Kumar, Department of Chemical Engineering, University of Portharcourt, Nigeria, E-mail: Arunkumar43@gmail.com

Received: 01-Mar-2023, Manuscript No. jbrbd-23-91334; **Editor assigned:** 07-Mar-2023, PreQC No. jbrbd-23-91334 (PQ); **Reviewed:** 21-Mar-2023, QC No. Jbrbd-23-91334; **Revised:** 24-Mar-2023, Manuscript No. Jbrbd-23-91334 (R); **Published:** 30-Mar-2023, DOI: 10.4172/2155-6199.1000558

Citation: Kumar A (2023) Biodiesel Fuels' Half-Lives of Biodegradation in Terrestrial and Aquatic Systems: A Review. J Bioremediat Biodegrad, 14: 558.

either provided by the authors or could be calculated from other data presented in the article typically, rate constants; the type of fuel; the type of system aquatic, terrestrial; and the aeration conditions [9,10]. Only if measured in the same experiment as for biodiesel fuels were the data on the mineralization or biodegradation kinetics of diesel fuels included. Studies measuring the biodegradation of particular fuel components were excluded because they could not be compared to data on overall biodegradation, such as chromatograms or mass fractions for components of biodiesel or composition assessments of FAMEs. Data for blends that reflect degradation as a drop in purity or as a change in indicator colour were also excluded. Which burned crude oil, jet fuel, pure petroleum hydrocarbons, or other fuels besides petroleum As a result; data on mineralization and/or biodegradation kinetics were discovered in 32 papers, all of which passed the requirements for inclusion in the second stage of the review process. If available, non-mandatory information regarding other factors that may have an impact on the biodegradation process, such as the type of fuel used, the origin of the microorganisms autochthonic microorganisms present in the sample or prepared inoculum), soil moisture, and temperature, was also reported to support the interpretation of the results. It is essential to have knowledge of the biodegradation kinetics of biodiesel fuels while choosing the best remediation tactics and doing risk and impact assessments. However, there is a lack of consistency in this information, and we still don't fully understand what causes variation in biodegradation rates. In order to determine the biodegradation and mineralization half-lives of diesel and biodiesel fuels in various experimental setups, we thoroughly analysed 32 scientific literature sources. Using sets of averaged half-life values and their statistical uncertainty, the analysis focused on the variation in half-lives among fuels and experimental settings. Biodegradation half-lives varied from 9 to 62 days across all data sites and were much shorter than mineralization half-lives. In comparison to aquatic systems, the half-lives of biodegradation and mineralization were twice longer in terrestrial systems for all fuels. The halving times were generally shorter for blends with higher biodiesel percentage, while variations in the amount of data points from separate studies obscured variations in fuel half-lives. The kind of mixes and experimental system did not, in the majority of cases, have statistically significant effects on biodegradation half-lives. While more research is necessary to define the rates of biodegradation in anaerobic environments, our data can be utilised to better characterise the dangers and effects of biodiesel fuels in aerobic aquatic and terrestrial habitats. Due to its relatively high biodegradability, biodiesel fuels may benefit from remediation techniques that use monitored natural attenuation and other passive methods to degrade and disperse contaminants in their natural environments.

Conclusion

Knowledge of these factors, as well as information on the biodegradation and mineralization kinetics in various conditions and types of environments, is necessary for the selection of an appropriate remediation strategy for biodiesel fuels and the assessment of environmental risks and impacts of biodiesel emissions to the environment. One review on the environmental fate of biodiesel has been written, although it concentrates on subsurface biodiesel transport mechanisms rather than issues with biodegradation and mineralization. Although there are individual studies available that give experimental results on its biodegradation and/or mineralization, this data has not yet been systematically gathered, examined, and compared. In this review, we assemble information on the biodegradation kinetics and explain the variables that affect the half-lives of biodegradation and mineralization. We take into account different media, aeration settings, and types of biodiesel blends. Diesel fuel derived from petroleum is used as the comparison standard. Two steps were taken in conducting the review. In the first phase, we compiled a list of all research that touch on any aspect of the biodegradation of biodiesel fuels and may therefore include information on the kinetics of biodegradation and or mineralization. The following keyword combinations were used to locate those studies in the Scopus database: biodiesel, diesel, blend, biodegradation, mineralization, bacteria, degradation, and microbial degradation. As a result, we discovered 145 peer-reviewed papers. The second phase was searching each of these publications for information on the kinetics of biodegradation or mineralization, such as half-lives or rate constants. Results were if the following requirements were satisfied: half-life numbers were either provided by authors or could be computed from other information in the paper. In most cases, rate constants Aeration conditions, system type aquatic or terrestrial, fuel type, and system were all stated. Only if measured in the same experiment as for biodiesel fuels were the data on the mineralization or biodegradation kinetics of diesel fuels included. Studies measuring the biodegradation of particular fuel components were excluded because they could not be compared to data on overall biodegradation, such as chromatograms or mass fractions for components of biodiesel or composition assessments of FAMEs. Data for blends as well as methods to express degradation as a drop in purity or a change in the indicator colour were excluded. Which utilised fuels other than petroleum-based diesel? As a result, data on mineralization and/or biodegradation kinetics were discovered in 32 papers, all of which passed the requirements for inclusion in the second stage of the review process. Where available, non-mandatory information regarding other aspects that may have an impact on the biodegradation process, such as the fuel specification, the source of the microorganisms, soil moisture, and temperature, was also supplied in order to support the interpretation of the results.

Acknowledgement

None

Conflict of Interest

None

References

1. Fischbach MA, Walsh CT (2009) Antibiotics for emerging pathogens. Science 325: 1089-1093.
2. Linares JF, Gustafsson I, Baquero F, Martinez JL (2006) Antibiotics as intermicrobial signaling agents instead of weapons. Proc Natl Acad Sci 103: 19484-19489.
3. Peschel A, Sahl HG (2006) The co-evolution of host cationic antimicrobial peptides and microbial resistance. Nat Rev Microbiol 4: 529-536.
4. Willyard C (2017) The drug-resistant bacteria that pose the greatest health threats. Nat News 543: 15.
5. Prestinaci F, Pezzotti P, Pantosti A (2015) Antimicrobial resistance: a global multifaceted phenomenon. Pathogens Glob Health 109: 309-318.
6. Laxminarayan R, Duse A, Wattal C (2013) Antibiotic resistance—the need for global solutions. Lancet Infect Dis 13: 1057-1098.
7. Chambers HF (2001) The changing epidemiology of Staphylococcus aureus? Emerg Infect Dis 7: 178.
8. Lister PD, Wolter DJ, Hanson ND (2009) Antibacterial-resistant pseudomonas aeruginosa: clinical impact and complex regulation of chromosomally encoded resistance mechanisms. Clin Microbiol Rev 22: 582-610.
9. Perez F, Hujer AM, Hujer KM, Decker BK, Rather PN, et al. (2007) Global challenge of multidrug-resistant acinetobacter baumannii. Antimicrob Agents Chemother 51: 3471-3484.
10. Wright GD (2003) Mechanisms of resistance to antibiotics. Curr Opin Chem Biol 7: 563-569.