UNIVERSITI TEKNOLOGI MARA

JIIICaS 2024
JOHOR INTERNATIONAL INNOVATION, INVENTION COMPETITION AND SYMPOSIUM

PROCEEDINGS OF JOHOR INTERNATIONAL INNOVATION INVENTION COMPETITION AND SYMPOSIUM 2024 (JIIICaS 2024)

"Flourish and Nurturing Sustainable Innovation for a Prosperous Nation"

JIICOS 2024
JOHOR INTERNATIONAL INNOVATION, INVENTION COMPETITION AND SYMPOSIUM

Editorial Board

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Preface

In the name of Allah, the Almighty who gives us the enlightenment, the truth, the knowledge and with regards to Prophet Muhammad (peace be upon him) for guiding us to the straight path. We thank to Allah for giving us guidance and strength to write this e-book.

This e-book compiles the extended abstracts that submitted to Johor International Innovation Invention Competition and Symposium 2024 (JIIICaS2024), where JIIICaS2024 is a virtual platform for all creative minds to share and present their invention and innovation. Each abstract gives a brief background on the innovation or project.

We hope that this e-book will help the readers to get to know the innovation done by the students and get some ideas to develop future innovation products.

Foreword Rector

Assalamualaikum warahmatullahi Wabarakatuh, Salam Sejahtera, Salam Malaysia MADANI and Salam UiTM Dihatiku.

In the name of Allah, the Most Gracious, the Most Merciful.

It is a great honor to welcome you to the Johor International Innovation, Invention, Competition, and Symposium 2024 (JIIICaS 2024). This event connects various disciplines, focusing on education and engaging educators, students, researchers, and innovators from all walks of life.

Innovation is not just about ideas; it demands perseverance, creativity, and determination to turn those ideas into reality. The remarkable projects showcased today highlight the dedication and spirit of all participants. Initiatives like this not only explore new technologies but also cultivate skills and leadership among our youth. At Universiti Teknologi MARA (UiTM) Johor Branch, we are fully committed to fostering a dynamic culture of innovation, promoting the commercialization of new products, and encouraging meaningful collaborations with industry and society.

As we celebrate this event, I would like to extend my heartfelt gratitude to all sponsors, judges, the College of Computing, Informatics and Mathematics, UiTM Pasir Gudang Campus as the event organizer, as well as to the researchers and participants for their hard work in making this event a success. Let us continue striving for innovation and excellence. May the ideas presented today inspire us and lay the groundwork for future achievements.

Thank you.

Associate Professor Dr. Saunah Zainon
Rector
Universiti Teknologi MARA (UiTM)
Johor Branch

(A-PP031) SOLVING MIXTURE PROBLEMS IN APPLIED MATHEMATICS: A DIFFERENTIAL EQUATION APPROACH

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ABSTRACT
This study explores the dynamic behavior of solute concentration in a tank system subjected to continuous inflow and outflow of a salt solution. By applying first-order linear differential equations. It reveals how the solute concentration evolves over time, transitioning from an initial state of pure water to a steady-state equilibrium. The findings highlight the critical role of parameters such as inflow rate and concentration in determining the system's long-term behavior. This analysis provides valuable insights into the mechanisms governing mixture processes, offering practical implications for fields like chemical engineering and environmental science, where precise control of concentration dynamics is essential for optimizing operational efficiency and safety.

Keywords: Mixture Problem, Linear Solution, Differential equations

1.0 INTRODUCTION
Mixture problems are central to applied mathematics and have significant implications in fields like chemical engineering, environmental science, and pharmaceutical development. These problems involve understanding how the concentration of substances in a mixture changes over time, which is crucial for optimizing processes, ensuring safety, and making informed decisions. In many cases, the behavior of mixtures can be effectively modeled using first-order linear differential equations, which describe the relationship between the rates of substance inflow and outflow. This study focuses on developing and solving these differential equations to predict solute concentration dynamics in a tank-based system.

1.1 PROBLEM STATEMENT
Accurately predicting solute concentration in a mixture over time is vital for optimizing processes in various fields. This study addresses the challenge of modelling a tank system with constant solute inflow and outflow, developing a first-order linear differential equation to predict concentration dynamics under varying conditions.

2.0 OBJECTIVE

The primary objectives of this study are:

a) To develop a mathematical model using first-order linear differential equations to describe the behavior of solute concentration in a mixture.
b) To solve the differential equation analytically and predict the concentration of the solute over time.
c) To validate the model with practical data and explore the impact of varying initial conditions and rates on the solution.

3.0 METHODOLOGY

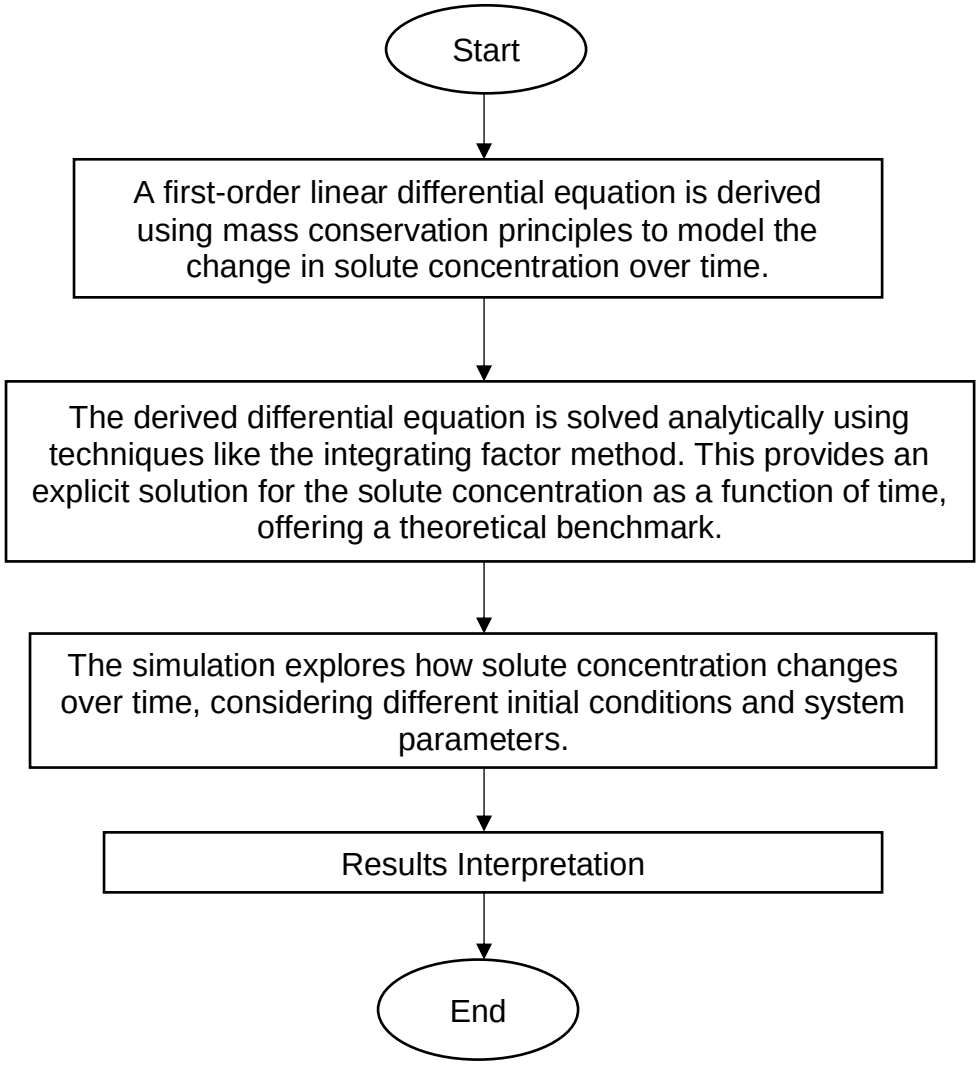

Figure 1: The methodology framework of study.

Figure 1 shows this study involves defining a problem scenario where a tank system with an inflow of a salt solution and simultaneous outflow is modeled using a first-order linear differential equation based on mass conservation principles. The differential equation is solved analytically to provide an understanding of the system's behavior over time, with particular attention to the solute concentration dynamics. Numerical methods are then employed to simulate the system under various initial conditions and parameter settings, allowing for a detailed analysis of how these factors influence the concentration. Validation of the numerical results against the analytical solution

ensures accuracy, and the insights gained are used to interpret the system's behavior, emphasizing the practical applications of this approach in real-world scenarios.

4.0 RESULTS

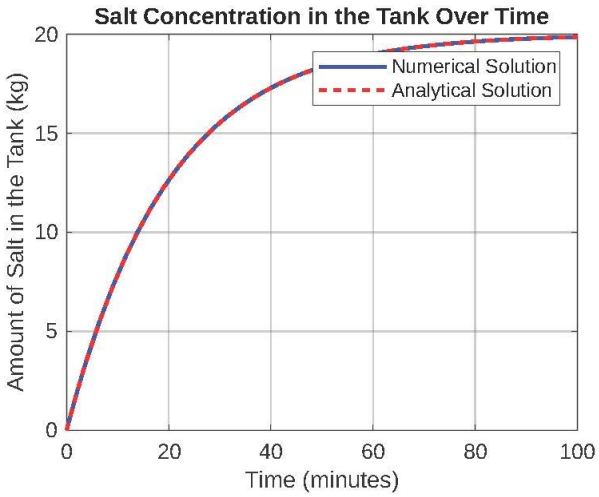

Figure 2: Graph of salt concentration in the tank over time.

The results in figure 2 demonstrate that the salt concentration in the tank, modeled by the differential equation $\frac{dQ(t)}{dt} = r_{in} \cdot c_{in} - \frac{r_{out}}{V_0} \cdot Q(t)$, increases over time, starting from zero and eventually reaching a steady state where the inflow and outflow rates of salt are balanced. The analytical solution, $Q(t) = \frac{r_{in} \cdot c_{in} \cdot V_0}{r_{out}} (1 - e^{-\frac{r_{out}}{V_0} t})$, closely matches the numerical results obtained from MATLAB, confirming the model's accuracy. The simulation reveals that the concentration rises rapidly at first but slows as it approaches the steady state, influenced by parameters like inflow rate, inflow concentration, and outflow rate. These findings highlight the effectiveness of the differential equation in predicting the dynamic behavior of the mixture system.

5.0 CONCLUSION

This study successfully demonstrates the application of first-order linear differential equations in modeling and solving mixture problems. The developed model accurately predicts the solute concentration in a tank over time, with results validated through both analytical and numerical methods. The study reveals how the system approaches a steady state, where the inflow and outflow of the solute are balanced, and how varying initial conditions and rates affect the concentration dynamics. This approach is particularly useful in fields like chemical engineering and environmental science, where precise modeling of mixture behavior is critical for process optimization and decision-making.

6.0 BENEFIT OF STUDY

a) It provides a reliable model for predicting solute concentration in mixture problems, crucial for optimizing industrial processes.
b) Helps in optimize mixing processes, reducing waste and ensuring efficient resource use in industries.

7.0 REFERENCES

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