

UTILIZING NEURO FUZZY LOGIC FOR THE AUTOMATION OF
COAGULANT DOSING IN WATER TREATMENT SYSTEMS

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22352007

MASTER'S DEGREE
in

MASTER OF MECHANICAL ENGINEERING

ENGINEERING AND INFORMATION TECHNOLOGY



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July 2024

STATEMENT BY THE AUTHOR

I hereby declare that this submission is my own work and to the best of my knowledge, it contains no material previously published or written by another person, nor material which to a substantial extent has been accepted for the award of any other degree or diploma at any educational institution, except where due acknowledgement is made in the thesis.

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ABSTRACT

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This thesis explores the application of Adaptive Neuro-Fuzzy Inference System (ANFIS) for optimizing coagulant dosing in water treatment systems. Utilizing a dataset with variables including temperature, pH, Total Dissolved Solids (TDS), and turbidity, the study compares different ANFIS models to identify the most effective configuration. The four-variable model, incorporating all the mentioned parameters, demonstrated the best performance with a Root Mean Square Error (RMSE) of 0.320207 for training data and 0.272577 for testing data. Results showed that models with multiple input variables enhance prediction accuracy, with R^2 values improving from 0.047 for temperature alone to 0.43 for the comprehensive model. The findings highlight the model's capability to predict coagulant dosage, thereby enhancing the automation and efficiency of water treatment processes. Continuous monitoring and regular updates of the model are recommended to adapt to changing water quality. Further research is suggested to explore additional water quality parameters and integrate the ANFIS model with advanced control systems for improved real-time monitoring and management. This study concludes that ANFIS is a reliable tool for optimizing coagulant dosing, contributing to more efficient and consistent water treatment operations.

Keywords: *Adaptive Neuro-Fuzzy Inference System (ANFIS), Coagulant, Water Treatment, Root Mean Square Error (RMSE), Total Dissolve Solid (TDS), pH, Turbidity.*

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DEDICATION

I dedicate this works for my best half, Widyanova.

ACKNOWLEDGEMENTS

I would like to express my heartfelt gratitude to everyone who supported me throughout my master degree's journey. First and foremost, I thank God for guiding me and enabling me to complete this thesis on time. To my loving wife, Widyanova Suryaningsih, your sacrifices, understanding, and encouragement meant the world to me during this journey.

I extend my sincere appreciation to my Advisor, Edi Sofyan, B.Eng., M.Eng., Ph.D, and my Co-Advisor Dr. Ir. Gembong Baskoro, M.Sc, for his dedicated guidance, insightful advice, and encouragement that motivated me to achieve my best. I am truly privileged to have had such a supportive mentor. Also, I am also thankful to the lecturers and staff at Swiss German University for their assistance and support throughout my studies. Surely not to forget, I extend my thanks to my classmates for all our collaborative efforts over the past years.

TABLE OF CONTENTS

	Page
STATEMENT BY THE AUTHOR.....	2
ABSTRACT.....	3
DEDICATION.....	5
ACKNOWLEDGEMENTS.....	6
TABLE OF CONTENTS.....	7
LIST OF FIGURES	9
LIST OF TABLES.....	10
ABBREVIATIONS	11
CHAPTER 1. INTRODUCTION	12
1.1 Background	12
1.2. Research Problems.....	14
1.3 Research Objectives.....	14
1.4. Significance of Study	14
1.5. Research Questions.....	14
1.6. Hypothesis.....	15
CHAPTER 2. LITERATURE REVIEW	16
2.4 Water Quality Analysis.....	23
2.5 Chemical Dosing System.....	28
2.6 Automation chemical dosing system	30
2.7 The application of intelligent algorithms	32
2.8 Fuzzy Logic	34
2.9 ANFIS	35
2.10 Model Evaluation Method	39
CHAPTER 3. RESEARCH METHODS	42
3.1 Root Cause Analysis	42
3.2 Research Design.....	44
3.3 Time line	46
3.4 Block diagram design process	46
3.5 Mechanical Electronic & Interface Design.....	48
3.6 Software Design.....	49
3.6 Software Design.....	50
3.7 Software Flowchart.....	57

3.8 Control Loop Diagram.....	60
3.9 Hardware Calibration.....	61
CHAPTER 4. RESULTS AND DISCUSSIONS.....	63
4.1 Preprocessing Data.....	63
4.2 Design Neuro-Fuzzy System	65
4.3 Result Comparison.....	67
4.4 Validation.....	71
CHAPTER 5 – CONCLUSIONS AND RECOMMENDATIONS	72
5.1 Conclusion	72
5.2 Recommendations.....	72
REFERENCES	74
CURRICULUM VITAE	78

LIST OF FIGURES

	Page
Figure 1. Resident Complains About Muddy and Cloudy PDAM Water	12
Figure 2. Water Treatment Plant.....	16
Figure 3. Basic Process Water Treatment Plant.....	17
Figure 4. Process Coagulation	20
Figure 5. Jar Test.....	22
Figure 6. Chemical Dosing System	29
Figure 7. Root Cuase Analysis.....	42
Figure 8. Research Design	45
Figure 9. Block Diagram Design Process for the Automation of Coagulant Dosing in Water Treatment Systems	46
Figure 10. Mechanical, Electronic, and Interface Design for Automated Coagulant Dosing System	48
Figure 11. Mechanical, Electronic, and Interface Design for Automated Coagulant Dosing System	49
Figure 12. Schematic Diagram for Prototype, Electronic Circuit.....	51
Figure 13. ESP32	51
Figure 14. Sensor pH	53
Figure 15. Sensor TDS Meter	54
Figure 16. Sensor Temperature	55
Figure 17. Turbidity Sensor	56
Figure 18. Software Flowchart	58
Figure 19. Control Loop Diagram	60
Figure 20. Data Analysis Output Vs Turbidity, TDS, Temperature & pH.....	63
Figure 21. ANFIS with 2 Variables Input.....	65
Figure 22. ANFIS with 3 Variables Input.....	66
Figure 23. ANFIS with 4 Variables Input.....	67
Figure 24. Comparison of Predicted vs Actual Chemical Dosage for Temperature as single Input.....	68
Figure 25. Comparison of Predicted vs Actual Chemical Dosage for Temperature & pH as Variables Input.....	68
Figure 26. Comparison of Predicted vs Actual Chemical Dosage for Temperature, pH & TDS as Variables Input.....	69
Figure 27. Comparison of Predicted vs Actual Chemical Dosage for Temperature, pH, TDS & Turbidity as Variables Input.....	70

LIST OF TABLES

	Page
Table 1. Summary of Research on Coagulant Dosage Prediction Using Various AI Techniques	38
Table 2. Thesis Project Work Sequence Schedule.....	46
Table 3. Performance of different models using various input variables	70
Table 4. Validation Data	71

ABBREVIATIONS

ANN: Artificial Neural Networks
AI: Artificial Intelligence
DCS: Distributed Control Systems
DOC: Dissolved Organic Carbon
EC: Electro-Coagulation
HMI: Human Machine Interface
IDE: Integrated Development Environment
IoT: Internet of Things
ML: Machine Learning
PLC: Programmable Logic Controllers
RMSE: Root Mean Square Error
TDS: Total Dissolved Solids
TSS: Total Suspended Solids
UV: Ultraviolet
ANFIS: Adaptive Neuro-Fuzzy Inference System
PID: Proportional-Integral-Derivative (controller)
SCADA: Supervisory Control and Data Acquisition
SVM: Support Vector Machine
BOD: Biological Oxygen Demand
COD: Chemical Oxygen Demand
EPA: Environmental Protection Agency
GIS: Geographic Information System
MPC: Model Predictive Control
NLP: Natural Language Processing
PCA: Principal Component Analysis
RF: Random Forest
RNN: Recurrent Neural Networks
SVR: Support Vector Regression
WWTP: Wastewater Treatment Plant