



بسم الله الرحمن الرحيم

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Cairo University

ARTIFICIAL NEURAL NETWORKS BASED MODELING AND OPTIMIZATION OF THERMOCHEMICAL CONVERSION OF BIOMASS

By

Ahmed Abdelgawad Aly Abdelgawad Mady

A Thesis Submitted to the
Faculty of Engineering at Cairo University
in Partial Fulfillment of the
Requirements for the Degree of

MASTER OF SCIENCE

In

Chemical Engineering

FACULTY OF ENGINEERING, CAIRO UNIVERSITY
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Key Words:

Deep learning, Machine learning, Combustion, Pyrolysis, Gasification.

Summary:

Biomass is considered one of the most promising and feasible renewable energy sources. Over time, the exploitation of biomass feedstock for various industries has been grown significantly. Most experimental techniques, however, require equipment that is extremely complex and costly. In this research, a novel approach aiming to predict the most desirable outputs of different biomass thermochemical conversion processes has been adopted.

The main goal of this study is to utilize the machine learning techniques specifically deep learning in the field of biomass energy recovery through the development of artificial neural network models that can predict the higher heating value of biomass feedstock, lower heating value of gasification product, bio-oil and bio-char weight percentages for fast and slow pyrolysis respectively. The main input parameters used are obtained using both proximate and ultimate analysis as well as operating conditions for gasification and pyrolysis. This study also introduces deep learning aside with optimization as a magic tool for identifying different biomass feedstock that have a high potentiality for further processing technology or investigation.

Disclaimer

I hereby declare that this thesis is my own original work and that no part of it has been submitted for a degree qualification at any other university or institute.

I further declare that I have appropriately acknowledged all sources used and have cited them in the references section.

Name: Ahmed Abdelgawad Aly Abdelgawad Mady **Date:** / /2022

Signature:

Dedication

I would like to dedicate this thesis with sincere gratitude to my parents for their love, support and encouragement throughout my life. I would also like to dedicate this message to my dear sisters and colleagues who have always stood by me and supported me.

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*Last but not least, I would like to say that I am completely indebted to my family whose estimation to me grows over time. Their unconditional love, continuous encouragement and unbelievable faith in me made me go up quickly every time I fall on my back. **My family** made me realize the blessing of having people in your life who share your moments of success, but more importantly your moments of depression. Honestly, I would like to say If it weren't for my family, I would have given up on the first obstacle in this long journey.*

Table of Contents

DISCLAIMER	I
DEDICATION	II
ACKNOWLEDGMENTS	III
TABLE OF CONTENTS	IV
LIST OF TABLES	VI
LIST OF FIGURES	VIII
NOMENCLATURE.....	X
ABSTRACT.....	XI
CHAPTER1 INTRODUCTION	1
CHAPTER2 LITERATURE REVIEW.....	3
2.1 CHARACTERISTICS OF BIOMASS FUELS	3
2.2 OVERVIEW OF RECENT ADVANCES IN THERMOCHEMICAL CONVERSION OF BIOMASS	4
2.2.1 Combustion.....	4
2.2.2 Pyrolysis	9
2.2.3 Gasification.....	12
2.3 OVERVIEW OF DEEP LEARNING BASIC CONCEPTS, STRUCTURE AND MATHEMATICS OF ARTIFICIAL NEURAL NETWORKS	20
2.3.1 Artificial intelligence (AI).....	20
2.4 REVIEW OF RELEVANT BIOMASS ENERGY RECOVERY MODELING.....	27
2.4.1 Combustion.....	27
2.4.2 Gasification.....	31
2.4.3 Pyrolysis	33
2.5 COMMON RESEARCH GAPS.....	34
2.6 SIGNIFICANCE TESTS FOR NEURAL NETWORKS.....	34
2.6.1 Various techniques for evaluating variable significance in ANNs	35
CHAPTER3 METHODOLOGY.....	37
3.1 PROCEDURE.....	38
3.1.1 Data preprocessing	38
3.1.2 Model Training & Optimization.....	39
3.1.3 Evaluation metrics	40
3.1.4 ANN based HHV prediction model for biomass combustion	41
3.1.5 Gasification.....	43
3.1.6 Fast pyrolysis.....	46
3.1.7 Slow Pyrolysis	50
CHAPTER4 : RESULTS AND DISCUSSIONS	53
4.1 COMBUSTION	53
4.1.1 Results	53
4.1.2 Discussion.....	58
4.2 GASIFICATION	59
4.2.1 Results	59
4.2.2 Discussion.....	60

4.3 FAST PYROLYSIS	61
4.3.1 Results	61
4.3.2 Discussion.....	67
4.4 SLOW PYROLYSIS	68
4.4.1 Results	68
4.4.2 Discussion.....	70
CHAPTER5 CONCLUSIONS AND RECOMMENDATIONS	71
5.1 CONCLUSIONS	71
5.2 RECOMMENDATIONS	72
REFERENCES.....	73
APPENDIX.....	78
EXAMPLES OF THE CODE USED FOR DATA ANALYSIS, MODEL DEVELOPMENT AND THEIR CORRESPONDING RESULTS	101
5.2.1 Importing relevant packages and loading data	101
5.2.2 Exploratory data analysis	102
5.2.3 Encoding categorical variables.....	107
5.2.4 Scaling features	107
5.2.5 Data shuffling	108
5.2.6 Dividing data into train/validation/test.....	108
5.2.7 Saving data for modeling.....	109
5.2.8 Importing data for building the model.....	109
5.2.9 Fitting neural network model	110
5.2.10 Evaluating the model on test data.....	111
5.2.11 Plotting R-squared	111
5.2.12 Saving and loading the model	111
5.2.13 Creating model function	112
5.2.14 Model Demo for end user.....	113

List of Tables

TABLE 2.1. COMPARISON BETWEEN GASIFICATION, COMBUSTION AND PYROLYSIS	11
TABLE 2.2. COMPARISON BETWEEN FOUR DIFFERENT TYPES OF SYNTHETIC GAS [28].....	13
TABLE 2.3. THE MOST RECENT MODELS BASED ON ELEMENTAL AND PROXIMATE ANALYSIS.....	29
TABLE 2.4. THE PREDICTION OF HEATING VALUE USING ANN MODELS	30
TABLE 2.5. PUBLISHED GASIFICATION MODELING USING ANN	32
TABLE 2.6. PUBLISHED PYROLYSIS MODELING USING ANN	33
TABLE 3.1. THE STATISTICS OF DATA USED FOR HHV PREDICTION.....	41
TABLE 3.2. STRUCTURE OF HHV FIRST PREDICTION MODEL	42
TABLE 3.3. STRUCTURE OF HHV SECOND PREDICTION MODEL	43
TABLE 3.4. STRUCTURE OF HHV SECOND PREDICTION MODEL	43
TABLE 3.5. THE STATISTICS OF DATA USED FOR GASIFICATION MODELING	45
TABLE 3.6. STRUCTURE OF GASIFICATION PREDICTION MODEL	45
TABLE 3.7. OPTIMUM INPUT PARAMETERS AND CORRESPONDING PREDICTED RESPONSE FOR GASIFICATION ANN MODEL	46
TABLE 3.8. THE STATISTICS OF DATA USED FOR FAST PYROLYSIS MODELING	47
TABLE 3.9. STRUCTURE OF FAST PYROLYSIS PREDICTION MODEL.....	47
TABLE 3.10. STRUCTURE OF FAST PYROLYSIS PREDICTION MODEL.....	48
TABLE 3.11. STRUCTURE OF FAST PYROLYSIS PREDICTION MODEL.....	48
TABLE 3.12. OPTIMUM INPUT PARAMETERS AND CORRESPONDING PREDICTED RESPONSE FOR FAST PYROLYSIS ANN MODEL.....	50
TABLE 3.13. OPTIMIZATION RESULTS IN TERMS OF YIELDS OF EACH COMPONENT ..	50
TABLE 3.14. THE STATISTICS OF DATA USED FOR SLOW PYROLYSIS MODELING	51
TABLE 3.15. STRUCTURE OF SLOW PYROLYSIS PREDICTION MODEL	51
TABLE 3.16. OPTIMUM INPUT PARAMETERS AND CORRESPONDING PREDICTED RESPONSE FOR SLOW PYROLYSIS ANN MODEL	52
TABLE 4.1. REGRESSION STATISTICS FOR HHV FIRST ANN MODEL	54
TABLE 4.2. REGRESSION STATISTICS FOR HHV SECOND ANN MODEL	56
TABLE 4.3. REGRESSION STATISTICS FOR HHV ANN MODEL	58
TABLE 4.4. REGRESSION STATISTICS FOR GASIFICATION ANN MODEL	60
TABLE 4.5. REGRESSION STATISTICS FOR FAST PYROLYSIS BIO-OIL ANN MODEL.....	62

TABLE 4.6. REGRESSION STATISTICS FOR FAST PYROLYSIS BIO-GAS ANN MODEL ...	64
TABLE 4.7. REGRESSION STATISTICS FOR FAST PYROLYSIS BIO-CHAR ANN MODEL	66
TABLE 4.8. REGRESSION STATISTICS FOR SLOW PYROLYSIS ANN MODEL	69

List of Figures

FIGURE 2.1. FIXED BED CO-CURRENT REACTOR.....	5
FIGURE 2.2. FLUIDIZED BED REACTOR	6
FIGURE 2.3. ENTRAINED FLOW REACTOR.....	7
FIGURE 2.4. CONFIGURATION OF THE UPDRAFT (COUNTER-CURRENT) GASIFIER..	15
FIGURE 2.5. DOWNDRAFT CO-CURRENT GASIFIER.....	16
FIGURE 2.6. CROSS FLOW GASIFIER.....	16
FIGURE 2.7. OPEN CORE GASIFIER	17
FIGURE 2.8. FLUIDIZED BED GASIFIER.....	18
FIGURE 2.9. THE ENTRAINED FLOW GASIFIER CONFIGURATION	18
FIGURE 2.10. TWO-STAGE BIOMASS GASIFIER OPTIMIZED FOR TAR ELIMINATION	20
FIGURE 2.11. MACHINE LEARNING: A NEW PROGRAMMING PARADIGM	21
FIGURE 2.12. A SIMPLE NEURAL NETWORK (MINIMAL EXAMPLE)	23
FIGURE 2.13. NEURAL NETWORKS	23
FIGURE 2.14. ARCHITECTURE OF NEURAL NETWORKS	24
FIGURE 2.15. MODEL PARAMETER STRUCTURE	25
FIGURE 2.16. COMMON ACTIVATION FUNCTIONS	25
FIGURE 2.17. FORWARD PROPAGATION	26
FIGURE 2.18. BACKPROPAGATION	26
FIGURE 2.19. WEIGHT UPDATING MECHANISM	27
FIGURE 3.1. MACHINE LEARNING ALGORITHM COMPONENTS	37
FIGURE 3.2. OPTIMIZATION USING DIFFERENT GRADIENT-BASED OPTIMIZERS	40
FIGURE 3.3. ILLUSTRATION OF FLUIDIZED BED GASIFIER.....	44
FIGURE 4.1. ANN ARCHITECTURE OF HHV FIRST MODEL	53
FIGURE 4.2. THE REGRESSION PLOT OF TRAINING AND TESTING FOR HHV ANN MODEL	54
FIGURE 4.3. RELATIVE SIGNIFICANCE OF INPUT VARIABLES FOR THE HHV	55
FIGURE 4.4. ANN ARCHITECTURE OF HHV SECOND MODEL.....	55
FIGURE 4.5. THE REGRESSION PLOT OF TRAINING AND TESTING FOR HHV SECOND ANN MODEL	56
FIGURE 4.6. ANN ARCHITECTURE OF HHV THIRD MODEL.....	57
FIGURE 4.7. THE REGRESSION PLOT OF TRAINING AND TESTING FOR HHV THIRD ANN MODEL	57

FIGURE 4.8. ANN ARCHITECTURE OF GASIFICATION MODEL.....	59
FIGURE 4.9. THE REGRESSION PLOT OF TRAINING AND TESTING FOR GASIFICATION ANN MODEL.....	59
FIGURE 4.10. RELATIVE SIGNIFICANCE OF INPUT VARIABLES FOR THE LHV	60
FIGURE 4.11. ANN ARCHITECTURE OF FAST PYROLYSIS BIO-OIL MODEL	61
FIGURE 4.12. THE REGRESSION PLOT OF TRAINING AND TESTING FOR FAST PYROLYSIS BIO-OIL ANN MODEL	62
FIGURE 4.13. RELATIVE SIGNIFICANCE OF INPUT VARIABLES FOR THE BIO-OIL YIELD	63
FIGURE 4.14. ANN ARCHITECTURE OF FAST PYROLYSIS BIO-GAS MODEL.....	63
FIGURE 4.15. THE REGRESSION PLOT OF TRAINING AND TESTING FOR FAST PYROLYSIS BIO-GAS ANN MODEL.....	64
FIGURE 4.16. RELATIVE SIGNIFICANCE OF INPUT VARIABLES FOR THE BIO-GAS YIELD	65
FIGURE 4.17. ANN ARCHITECTURE OF FAST PYROLYSIS BIO-CHAR MODEL.....	65
FIGURE 4.18. THE REGRESSION PLOT OF TRAINING AND TESTING FOR FAST PYROLYSIS BIO-CHAR ANN MODEL.....	66
FIGURE 4.19. RELATIVE SIGNIFICANCE OF INPUT VARIABLES FOR THE BIO-CHAR YIELD	67
FIGURE 4.20. ANN ARCHITECTURE OF SLOW PYROLYSIS MODEL	68
FIGURE 4.21. THE REGRESSION PLOT OF TRAINING AND TESTING FOR SLOW PYROLYSIS ANN MODEL.....	69
FIGURE 4.22. RELATIVE SIGNIFICANCE OF INPUT VARIABLES FOR THE BIO-CHAR YIELD	70

Nomenclature

AI	Artificial Intelligence
ANN	Artificial neural network
C	Carbon
ER	Equivalence ratio
FC	Fixed carbon
H	Hydrogen
HHV	Higher heating value
HR	Heating rate
MSW	Municipal solid waste
N	Nitrogen
O	Oxygen
PS	Particle size
S	Sulfur
T	Temperature
VM	Volatile matter