SUDAN UNIVERSITY OF SCIENCE & TECHNOLOGY

COLLEGE OF GRADUATE STUDIES

A GUIDE TO THESIS WRITING

APRIL 2021

HTTP://GRADUATE.SUSTECH.EDU.SD/

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TO THE STUDENT

This guide will help you in the process of writing and formatting your Master or Doctoral thesis/dissertation and to ensure that your research conforms to the regulations set by the College of Graduate Studies at Sudan University of Science and Technology. The guide is divided into three sections that detail the steps you should follow to accomplish your task. Every step will help in building your capacity as a researcher and guarantee the quality and originality of your work.

TO THE SUPERVISOR AND CO-SUPERVISOR

The purpose of this guide is to provide support to supervisors and co supervisors to work with students under the predefined guidelines for thesis writing and formatting to produce a work that meets the requirements of the College of Graduate Studies at Sudan University of Science and Technology. The responsibility of supervisors and co supervisors lies in assisting the students and build their capacity as researchers to understand and meet the basic requirements, through supporting, training, advising and monitoring. There are certain parameters students must follow while working on the thesis or dissertation to ensure the quality of their work. Supervisors should continuously monitor the progress of their students' works.

1. GENERAL REQUIREMENTS

This section investigates the main five chapters of the thesis or dissertation. Each chapter should describe its own content and should be started in a separate page. All chapters must be divided into further sections and sub-sections as per the requirement of the research study. The sections and sub-sections should comprise the text with paragraphs in its logical reasoning. The student must ensure that each section and sub-section has a strong connection and logic or provide base to the concepts.

1.1 Preliminary pages

Subject	Status	Example
Title page	Compulsory	Appendix A
Examiners' approval letter	Compulsory	Appendix B
Declaration of Thesis Status by the student and the main supervisor	Compulsory	Appendix C
Assigning the copyright to CGS	Compulsory	Appendix D
Introductory page	Optional	Appendix E
Dedication	Optional	Appendix F
Acknowledgements	Compulsory	Appendix G
Abstract (English/ Arabic/ Other language)	Compulsory	Appendix H
Table of Contents	Compulsory	Appendix I
List of Tables	Compulsory	Appendix J
List of Figures	Compulsory	Appendix K
List of Symbols /Abbreviations	Compulsory(if any)	Appendix L
List of Appendices	Compulsory(if any)	Appendix M

1.2 Text Body

Subject	Status	Contents
Chapter 1 Introduction	Compulsory	Background, problem statement, research questions, research objectives, hypothesis (if any), scope of study, significance of study, motivation for research and related information
Chapter 2 Literature Review	Compulsory	Theories, describing variables, theoretical framework, research gaps, and previous studies
Chapter 3 Materials and Methods	Compulsory	Research design, methods, tools, techniques to gather insights, data collection and analysis steps, procedures and material and methods
Chapter 4 Results and Discussion	Compulsory	Qualitative and quantitative information based on the analysis, Descriptive analysis, validation of tools, statistical and graphical presentation of results, hypothesis testing (if any),and results interpretation
Chapter 5 Conclusion and Recommendations	Compulsory	Conclusion and recommendations for further studies
References	Compulsory	Harvard Style

1.3 Typing and Printing

A thesis or dissertation should be typed using MS word latest version, and printed out using a high-quality printing machine. All the typing should be done with "Times New Roman" font point 12 for English writing and "Simplified Arabic" point14 for Arabic writing. The printed version of thesis or dissertation should be on single side.

1.4 Type and Size of Paper

A simple white 80 grams high quality A4 size papers (210 × 297 mm) should be used for printing the thesis or dissertation.

1.5 Margins

The page margin and size should be standardized as shown in appendix A. The left margin should be 3.5 cm (for binding purposes) and 2.5 cm from the top, right and bottom edges of the paper.

1.6 Line Spacing and Formatting

The following guidelines should be observed in line spacing and formatting:

- The spacing between the top margin and the chapter number should be (1.5) line spacing
- The spacing between the chapter number and the title, and between the title and the first line of a text should be (4) line spacing;
- The spacing between the title of sub-section and the first line of a text should be (1.5) line spacing
- The spacing between paragraphs should be (1.5) line spacing
- The number and the title of sub-section should be aligned with the left margin
- The first line of a paragraph should be indented by 1.27 cm (0.5 inch) from the left margin
- A new paragraph should not begin on the last line of a page
- The spacing between the last line of a text and a table, or a figure or an illustration should be double (1.5) line spacing;
- The spacing after a full stop should be two (2) character spacing.
- The spacing after a comma (,) should be one (1) character spacing.

1.7 Pagination

The thesis or dissertation pages should be counted and numbered. The page numbers should be printed at the center of the bottom page. Numbering should be as follows:

i. The Preliminary pages, starting from the title page should be numbered using small letter Roman numerals (i, ii, iii, etc.);
ii. The first page should be counted as “i” but not printed.
iii. The text including all chapters should be numbered using Arabic numbers. The first page of the text should be counted as “1” and followed to the rest of the chapters pages.
iv. The numbering will not appear on the Appendixes and list of publications.

1.8 Chapters Numbering

Numbering of all chapters should be written in Bold Times New Roman font size 12, centralized and start in a new page.The title of each chapter should be centered and not underlined and written in bold block letters.

1.9 Numbering and font size for headings and sub-headings

The numbering for the heading and sub-heading should be aligned with the chapter number in Bold, font 12 with each word capitalized.

No	Chapter	Example
1	Chapter 1: Introduction	1.1 General Overview 1.1.1 Global Perspective 1.1.2 National Perspective 1.2 Research Background 1.3 Problem Statement 1.4 Research aim and Objectives
2	Chapter 2: Literature Review	2.1 Country Context 2.1.1 Regional Facts and Figures 2.2 Variable 1 2.3 Variable 2 2.4 Schematic Diagram
3	Chapter 3: Materials and Methods	3.1 Research Design 3.2 Methods 3.2.1 Quantitative 3.3 Data Collection
4	Chapter 4: Results and Discussion	4.1 Descriptive Statistics 4.2 Correlation 4.3 Regression 4.3.1 Hypothesis test 1 4.3.1 Hypothesis test 2
5	Chapter 5: Conclusion and Recommendations	5.1 Conclusion 5.2 Recommendations

1.10 Number of pages

The length of thesis or dissertation (including tables, figures and other illustrations in the text) is as follows:

- Master's Thesis or Dissertation: up to 100 pages (maximum 30.000 word) for complementary, and up to 200 pages for full thesis(maximum 50.000 word)
- Doctoral Thesis: up to 300 pages(maximum 100.000 word)

(Note: These limits do not include appendices.)

1.11 Binding

The thesis must be bounded properly with hard cover after final approval. The cover colour for thesis or dissertation is as follows:

- Master: dark blue
- Doctorate: dark black

1.12 Thesis Front Cover and Spine

The front cover should be written as the thesis title page. The student's name, degree and the year of the thesis or dissertation submission should be written on the spine.

2. FORMAT AND APPEARANCE

2.1 Title page

This page should include the name of Sudan University of Science and Technology, College of Graduate Studies, full title of the thesis or dissertation in English and Arabic languages, the degree title, the full name of the student and the supervisor, and the date of thesis submission (month and year) in the same order. All information should be centralized.

2.2 Statement of the degree to be awarded

This statement should be written on the Title Page. It should state the purpose and the award for which the thesis is submitted. Examples of statements for various purposes and awards are listed below:

Master's Dissertation (By coursework and research)

A dissertation submitted in partial fulfilment ofthe requirements for the award of the degree of Master of ..... (specialization)

Master's Thesis (By research)

A thesis submitted in fulfilment of the requirements for the award of the degree of Master of ..... (specialization)

Doctor of Philosophy Thesis

A thesis submitted in fulfilment of the requirements for the award of the degree of Doctor of Philosophy (specialization)

2.3 Examiners' approval letter

The examiners' approval letter for master and doctorate degree is mandatory and should be signed by the supervisor and examiners after the comprehensive evaluation of

the research work and presentation. Both internal and external examiner should declare that the thesis/dissertation/ is satisfactory in terms of scope and quality for the award of the degree.

2.4 Declaration of the Status of Thesis or Dissertation

2.4.1 Declaration by the Student

The student should sign a declaration form that the thesis or dissertation is his/her own, and that it is not submitted for any other degree.

2.4.2Declaration by the main Supervisor

The supervisor should sign a declaration form that the thesis or dissertation is student own, and that it is not submitted for any other degree.

2.5 Assigning the copyright to CGS, SUST

The student should sign a declaration to assign the copyright and thus the ownership to the College of Graduate Studies at Sudan University of Science and Technology.

2.6 Introductory page

The introductory page can include Verse from Holly Quran or Hadith with reference.

2.7 Dedication

The dedication should be brief and concise. It should not contain a chart, a picture, numbers or any other related materials.

2.8 Acknowledgement

The acknowledgements statement should be short. The student may acknowledge the assistance of individuals or/and organizations for providing support, time and resources to accomplish the thesis or dissertation work.

2.9 Abstract

The abstract is one of the main parts of the thesis or dissertation. It should be written in English/other language and Arabic languages, with the English/other language one first if it is the language of thesis or dissertation, and vice versa.

The abstract should be brief, written in one paragraph, printed in one page without numbering or bullets, single line space without reference citation. It should states the main objective of study, problem definition, methodology adopted, the main results and recommendation of the research .

2.10 Table of Contents

It informs the reader about the contents of the thesis or dissertation. It is highly recommended to generate the table of contents using MS office advanced features.

2.11 List of Tables

The list of tables also has their significance for readers to check the relevant findings at glance. It should contain the page number and the title of Table. The required font is Times New Roman size 12 with1.5 line spacing.

2.12 List of Figures

All diagrams, photographs, drawings, graphs, charts and maps presented in the thesis will be included as figures. The list of figures should contain the page number and title of Figure.

2.13 List of Symbols /Abbreviations

The symbols/abbreviations and acronyms used in the thesis or dissertation should be listed alphabetically.

2.14 List of Appendices

The list of appendices should be pointed out on this page with their title and page number.

2.15 Citation in the text

The citation is related to the previous work done by other researcher in the past and the resources from which the information or idea were obtained. The purpose is to acknowledge the work of others, to demonstrate the body of knowledge in which the

work is based on and to lead others for further study. In-text citation must be written according to the style mentioned in the reference section. The citation of tables and figures should be mentioned as source under each table and figure.

2.16 Quotations in the Text

A quotation must be written within the text between two inverted comas [“ ”] and in italic format [*italic*]. The students must ensure that quotations don’t exceed 15 % of the text.

2.17 Tables in the Text

The tables must be using numerals following each chapter. A caption should be written in a single line space and positioned at the top of the table and aligned right. Each table should be positioned after it is being cited for the first time in the text. All tables in the chapter can also be grouped together and positioned at an appropriate location at the end.

Table 2.1: Types of pressure atomizer and their applications

Types	Applications
Plain orifice	Jet engine, ramjets, diesel engines and afterburners
Simplex	Industrial furnace and gas turbines
Duplex	Gas turbine combustors
Dual orifice	Various aircraft and industrial gas turbines
Spill return	Wide range of combustors

2.18 Figures in the Text

The figures must be using numerals following each chapter. A caption should be written in a single line space and positioned at the bottom of the figure and aligned right. Each figure should be positioned after it is being cited for the first time in the text. All the figures in the chapter can also be grouped together and positioned at an appropriate location at the end. All the figures must be clear and of high quality.

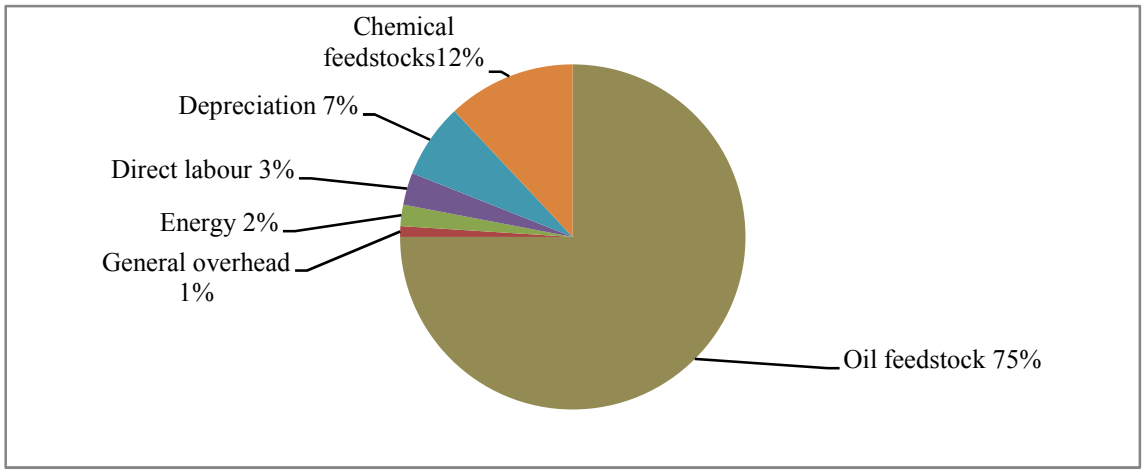

Figure 2.5: General cost breakdown for production of biodiesel

Figure 3.3: Close-up of spray

2.19 References

References are detailed description of items from which information were obtained in preparing the thesis or dissertation. References should be arranged using Harvard referencing style as will be detailed in the following section.

2.20 Appendices

Appendices are supplementary materials which are lengthy and/or not necessary to be included in the text. These include tables, figures, charts, data used for analysis, example of questionnaires, computer program listings, and others. Appendixes can be named as Appendix A, Appendix B, and so on, depending on types and quantity to be included with specific titles given.

3. REFERENCE STYLE

The details of the published or unpublished references cited in the text should be located in the list of references at the end of the thesis or dissertationusing Harvard style (author-year). The examples below shed more light on this process.

i. If the name of an author is not written as part of a sentence, both the name and year of publication should be written in parentheses.

‘‘The development of largescale production of feedstocks in Sudan requires careful selection of production sites. Some aspects to be considered include the existence and livelihood of nomadic families who depend on herding animals (Elhaj, 2013)’’.

Note: If there are two authors for a cited reference, both names should be written. If there are more than three authors for a cited reference, use “et al”. after the name of the first author as follows:

‘‘RSM is a set of mathematical and statistical approaches which are useful for analysing and modelling of difficulties in which a response of interest is affected by several factors and the objective is to optimize the response (Shang andTadikamalla, 1993)’’.

‘‘Biodiesel has been in use in many countries such as United States of America, Malaysia, Indonesia, Brazil, Germany, France, Italy and other European countries. Malaysia is considered as one of the top biodiesel producing countries (Mofijur et al, 2014)’’.

ii. If the name of an author is written as part of a sentence, the year of publication should be written in parentheses.

“Works by Yao (1993) have shown that in order to maintain the behavior link between the off springs and their parents, the use of crossover operator should be avoided.”

More examples for applying Harvard referencing style for different resources are listed in the tables below

Books (Hard Copy)		
Material Type	**In-Text Example**	**Reference List Example**
Book: single author	(Holt,1997) or Holt (1997) wrote that...	Holt, D.H.,1997, *Management principles and practices*, Prentice-Hall, Sydney.
Book: 2 authors	(Desikan, S. and Ramesh, G. ,2006)	Desikan, S. and Ramesh, G. (2006). *Software testing*. Bangalore, India: Dorling Kindersley, p.156.
Book: 3 and more authors	(Bond et al.,1996)	Bond, WR, Smith, JT, Brown, KL & George, M 1996, *Management of small firms*, McGraw-Hill, Sydney

Journal Articles		
Material Type	**In-Text Example**	**Reference List Example**
CMO article	(Jennings ,1997)	Jennings, P. (1997), 'The performance and competitive advantage of small firms: a management perspective', *International Small Business Journal*, 15 (2), 63-75.
Journal article (Print): two authors	(Conley and Galeson, 1998)	Conley, TG and Galeson, D.W.(1998) 'Nativity and wealth in mid-nineteenth century cities', *Journal of Economic History*. 58, (2) 468-493.
Journal article (Print): three and more authors	(Haseeb et al., 2011)	Haseeb, M, Bibi, Aneesa, & Rabbani, Wahab. (2011). Problems of projects and effects of delays in the construction industry of Pakistan. *Australian Journal of Business and Management Research, 1*(6), 41.

Internet/Websites		
Material Type	In-Text Example	Reference List Example
Webpage: no author	(Improve indigenous housing ,2007) *Use first few words of the page title*	*Improve indigenous housing now, government told,* 2007. Available from: <http://www.architecture.com.au/i-cms?page=10220>. [accessed February 2009].

Conference Papers & Proceedings		
Material Type	In-Text Example	Reference List Example
Conference proceeding paper:	(Riley,1992)	Riley, D., 1992, Industrial relations in Australian education, in *Contemporary*

print		*Australasian industrial relations: proceedings of the sixth AIRAANZ conference*, ed. D Blackmur, AIRAANZ, Sydney,124-140.
Conference proceeding paper: electronic	(Fan, W., and Pathak, R., 2000)	Fan, W., and Pathak, R., 2000, 'Personalization of search engine services for effective retrieval and knowledge management', *Proceedings of the twenty-first international conference on information systems*, 20-34. Available from: ACM Portal: ACM Digital Library. [accessed June 2004].
Conference proceeding paper: unpublished	(Brown, S. and Caste, V., 2004)	Brown, S. and Caste, V., 2004, Integrated obstacle detection framework. Paper presented at the *IEEE Intelligent Vehicles Symposium*, IEEE, Detroit, MI.

Standards & Patents		
Material Type	In-Text Example	Reference List Example
Patent	(Cookson 1985)	Cookson, AH 1985, *Particle trap for compressed gas insulated transmission systems*, US Patent 4554399.
Standard: retrieved from a database	(Standards Australia 2008)	Standards Australia 2008, *Personal floatation devices - General requirements,* AS 4758.1-2008. Available from: Australian Standards. [accessed December 2008].
Standard: published	(Standards Australia/New Zealand Standard 1994)	Standards Australia 1994, *Information processing - text and office systems - office document architecture (ODA) and interchange format: part 10: formal specifications,* AS/NZS 3951.10:1994, Standards Australia, NSW.

Thesis		
Material Type	In-Text Example	Reference List Example
Thesis: unpublished	(Hos, 2005)	Hos, J.P., 2005, *Mechanochemically synthesized nanomaterials for intermediate temperature solid oxide fuel cell membranes.* PhD thesis, University of Western Australia.
Thesis: published	(May, 2007)	May, B., 2007, *A survey of radial velocities in the zodiacal dust cloud.* Bristol UK, Canopus Publishing.
Thesis: retrieved from a database	(Cincura ,2012)	Cincura, M., 2012, *Beyond profit-centric: transcendent business modelling*. PhD thesis, Swinburne University of Technology. Available from: Trove.

		[August 2013].

Tables and figures		
Material Type	In-Text Example	Reference List Example
All or part of a table, figure, or data used in text: from a print journal	*Note*. From [*or* The data in column # are from] 'Evaluating the effectiveness of best management practices using dynamic modelling' (Ackerman & Stein 2008, p.634)	Ackerman, D & Stein ED 2008. 'Evaluating the effectiveness of best management practices using dynamic modelling', *Journal of Environmental Engineering*, 134 (8), 629-639. *Add in-text citation to the text of the illustration's caption.*
All or part of a table, figure or data used in text: from a book	*Note*. From [*or* The data in column # are from] *Thermophysical properties of fluids* p. 113 (Assael 1998, p.70)	Assael, M 1998, *Thermophysical properties of fluids,* Imperial College Press, London. *Add in-text citation to the text of the illustration's caption.*
All or part of a table, figure or data used in text: from the web	*Note*. From [*or* The data in column # are from] *International merchandise imports Australia*, *January 2009* (ABS 2009)	Australian Bureau of Statistics 2009, *International merchandise imports Australia*, *January 2009* (No. 5439.0). Available from: <http://www.abs.gov.au/ausstats/abs@.nsf/mf/5439.0?OpenDocument>. [6 March 2014]. *Add in-text citation to the text of the illustration's caption.*

APPENDIX A: TITLE PAGE

Font point: 12
Font type: Times New Roman
Line spacing: 1.5
Alignment: Center

2.5 cm

SUDAN UNIVERSITY OF SCIENCE AND TECHNOLOGY

COLLEGE OF GRADUATE STUDIES

3 cm

A GUIDE TO THESIS AND DISSERTATION WRITING

العنوان باللغة العربية

3 cm

A Thesis Submitted in Fulfillment of the

Requirements for the Award of the Degree of

Doctor of Philosophy (Mechanical Engineering)

Master of Science

3 cm

SEPTEMBER 2019

2.5 cm

APPENDIX B: EXAMINERS' APPROVAL LETTER

"I/We* hereby declare that I/we* have read this thesis or dissertation and in my/our* opinion this thesis is sufficient in terms of scope and quality for the award of the degree of Master of ……. (Specialization) or Doctor of Philosophy (specialization)

Signature _____
Name of Supervisor _____
Date

Signature _____
Name of Co-Supervisor _____
Date

Signature _____
Name of External Examiner _____
Date

Signature _____
Name of Internal Examiner _____
Date

**Delete as necessary*

APPENDIX C1: DECLARATION OF THE STATUS OF THESIS OR DISSERTATION BY STUDENT

I hereby declare that this thesis or dissertation "*TITLE OF THE THESIS OR DISSERTATION WRITING*" is the result of my own research except the citations in the references. The thesis has not been accepted for any degree nor concurrently submitted in candidature for any other degree.

Signature : _____

Name of Student : _____

Date : _____

APPENDIX C2: DECLARATION OF THE STATUS OF THESIS OR DISSERTATION BY SUPERVISOR

I hereby declare that this thesis or dissertation "*TITLE OF THE THESIS OR DISSERTATION WRITING*" is the result of my own research except the citations in the references. The thesis has not been accepted for any degree nor concurrently submitted in candidature for any other degree.

Signature : _____

Name of Supervisor : _____

Date : _____

APPENDIX D: ASSIGNING THE COPYRIGHT TO CGS, SUST

DECELARATION

I, the signing here under, declare thatI'm the sole author of the thesis or dissertation for the Master of Science or Doctor of Philosophy entitled "*TITLE OF THE THESIS OR DISSERTTAION*", which is an original intellectual work. Willingly, I assign the copy-right of this work to the College of Graduate Studies (CGS), Sudan University of Science and Technology (SUST). Accordingly, SUST has all the rights to publish this work for scientific purposes.

Candidate's signature : _____

Candidate's name : _____

Date : _____

APPENDIX E: INTRODUCTIVE PAGE

بِسْمِ اللَّهِ الرَّحْمَٰنِ الرَّحِيمِ

IN THE NAME OF ALLAH, THE MOST BENEFICENT, THE MOST MERCIFUL.

Source: Al-Quran

OR

بسم الله الرحمن الرحيم

قال تعالى :

(وَلَا تَحْسَبَنَّ الَّذِينَ قُتِلُوا فِي سَبِيلِ اللَّهِ أَمْوَاتًا بَلْ أَحْيَاءٌ عِنْدَ رَبِّهِمْ يُرْزَقُونَ * فَرِحِينَ بِمَا آتَاهُمُ اللَّهُ مِنْ فَضْلِهِ وَيَسْتَبْشِرُونَ بِالَّذِينَ لَمْ يَلْحَقُوا بِهِمْ مِنْ خَلْفِهِمْ أَلَّا خَوْفٌ عَلَيْهِمْ وَلَا هُمْ يَحْزَنُونَ * يَسْتَبْشِرُونَ بِنِعْمَةٍ مِنَ اللَّهِ وَفَضْلٍ وَأَنَّ اللَّهَ لَا يُضِيعُ أَجْرَ الْمُؤْمِنِينَ)

صدق الله العظيم

آل عمرآن الآية (169 - 171)

APPENDIX F: DEDICATION

I would like to dedicate my thesis OR dissertation
To my parents, friends and fellow members
without whom it was almost impossible for me
to complete my thesis work.

APPENDIX G: ACKNOWLEDGEMENTS

ACKNOWLEDGMENTS

Praise is to ***ALLAH***, the almighty, who graciously favored me to get over this work and enable me to accomplish this achievement.

I would like to thank and acknowledge my supervisor for his vital encouragement and support, may Allah bless him. My thanks are also expressed to my co supervisor for the considerable effort in guiding me through the experimental work.

I would like to convey my sincere thanks and appreciationto my dear*colleagues and friends* for sharing knowledge and experiences. Also, I would like to take this opportunity to thank ***(name of organization or institute, country name)***, who sponsored part of my research work.

APPENDIX H1: ABSTRACT IN ENGLISH

ABSTRACT

This research aimed at the optimization of parameters required for the production of biodiesel from crude jatropha oil using the conventional transesterification method, and to investigate the performance of the produced biodiesel as a fuel when blended with conventional diesel fuel. High free fatty acid (FFA=22.5%)Crude jatropha oil sourced from Malaysia was the subject of pretreatment process at optimized condition by using Response Surface Methodology (RSM) for optimization. The higher FFA level has successfully reduced to less than 1%, at optimum conditions of 12.29:1% (w/w) methanol to oil ratio, 0.225% (v/v) of H_2SO_4 at maintained reaction temperature of 65^oC and 180 min of reaction time.Atwostep-transesterificationprocess wasadopted toproducebiodieselfrom crude jatropha oil sourced from Sudan (FFA=4.5%). The oil was subjected to pretreatment step under obtimized reaction condition of 0.225 v/vsulfuricacid (H_2SO_4),8.25:1w/wmethanol(MeOH)to oil mole ratio, reaction temperature of 65°C, and 180 min of reactiontime. Moreover, the estrified oil was subjected to alkaline base step using optimized base-catalystprocessparametersof 0.5w/wpotassium hydroxide (KOH),4.5:1 w/wmethanolto oilmole ratio,reaction temperatureof60°Cat120minofreactiontime. The basic chemical and physical properties of the produced biodiesel was found to be within the ASTMD6751specifiedlimits. This biodiesel was subjected to Brake Specific Fuel consumption, Engine power and Engine torque performance test in diesel engine in different blends ratios with diesel (B5, B10, and B20). The results showed that the brake specific fuel consumption for jatropha biodiesel blendsis generally higher compared to the diesel fuel while the brake power output and the engine torque developed by jatropha biodiesel blends was less than that for diesel fuel. Also, the results of exhaust emissions indicate that all jatropha biodiesel blends have the tendency to reduce the CO_2 emission and produce lower emissions of unburned hydrocarbon at all engine speeds while its NOx emissions were higher compared to diesel fuel at all engine speeds. Furthermore, our findings revealed that all blends of jatropha biodiesel were able to combust at all equivalence ratios implying that the burner can be operated for its full range of power when using jatropha biodiesel blends. Based on the obtained results, it was concluded that biodiesel can successfully be used as a fuel for diesel engines.

APPENDIX H2: ABSTRACT IN ARABIC

المستخلص

إستهدف هذا البحث تحديد القيم المثلي للمتغيرات المطلوبة لانتاج الوقود الحيوي من زيت الجاتروفا عن طريق المعالجة الكيميائية والتحقق من أدائه كوقود بعد خلطه مع وقود الديزل التقليدي بنسب مختلف تصل الي 20%. تم اجراء عملية المعالجة الكيميائية لزيت جاتروفا ماليزي المصدر(نسبة الأحماض الدهنية الحرة= ٪22.5) باستخدام منهجية الاستجابة السطحية (RSM) وقد انخفض مستوىالأحماض الدهنية الحرة بنجاح إلى أقل من 1 ٪ ، عند اضافة الميثانول الي الزيت بنسبة 1:12.29و0.225 ٪ من حامض الكبريتيك عند درجة حرارة 65°C وزمن تفاعل 180 دقيقة. لانتاج الوقود الحيوي من زيت الجاتروفا المستخلص في السودان، تم اخضاع الزيت الي معالجة كيميائية من خطوتين. في الخطوة الاولي تم تقليل مستوىالأحماض الدهنية الحرة الموجودة في الزيت من 4.5% إلى أقل من 1 ٪ ، عند اضافة الميثانول الي الزيت بنسبة 1:8.25و0.225 ٪ من حامض الكبريتيك عند درجة حرارة 65°C وزمن تفاعل 180 دقيقة. في الخطوة الثانية تم الحصول علي البايوديزل بنسبة 92% عند استخدام هيروكسيد البوتاسيوم كمحفز قلوي بنسية 0.5% من الزيت واضافة الميثانول بنسبة 1:8.25 عند ظروف تفاعل °C 60و120 دقيقة. وقد وجد ان مواصفات البايوديزل المنتج يقع ضمن حدود المواصفات الامريكية ASTM D6751. تم إختبار اداء محرك ماكينة الديزل من حيث الإستهلاك النوعي للوقود ،عزمالدوران، والقدرة الناتجة وذلك باستخدام وقود الديزل وخليط من وقود الجاتروفا الحيوي المخلوط بوقود الديزل العادي بنسب مختلفة تصل الي 20%، عند سرعات مختلفة للماكينة (1100 – 2500 دورة/الدقيقة). وقد بينت النتائج انه يزيد الإستهلاك النوعي للوقود عند استخدام البايوديزل عند كل سرعات الماكينة ، بينما يقل عزم الدوران والقدرة الناتجة. كذلك بينت نتائج الانبعاثات للعادم ان استخدام البايوديزل بنسب خلطه المختلفة (5%, 10%, 20%) يقلل من انبعاثات ثاني أكسيد الكربون والانبعاثات الناتجة من الهيدروكربونات غير المحترقة عند كل سرعات المحرك. بينما تزيد انبعاثات أكاسيد النيتروجين مقارنةبالديزل العادي. بالاضافة الي ذلك بينت النتائج أن البايوديزل بنسب خلطه المختلفة قادراً على الاحتراق في جميع نسب التكافؤ وعليه يمكن تشغيل أي حارق بطاقته الكاملة عند استخدام خليط وقود الديزل الحيوي بنسب تصل الي 20% مع وقود الديزل. من كذلك نستنتج أن وقود الديزل الحيوي المنتج من زيت الجاتروفا يمكن أن تستخدم بنجاح كوقود لمحركات الديزل

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LIST OF FIGURES/SCHEMES

APPENDIX L: LIST OF ABBREVIATIONS

LIST OF ABBREVIATIONS

ASTM	-	American Standard of Testing Materials
ASTM D6751	-	American Standard Specification for biodiesel
AV	-	Acid Value
B0	-	Petroleum Diesel
B5	-	5% Jatropha Biodiesel + 95% Petroleum Diesel
B10	-	10% Jatropha Biodiesel + 90% Petroleum Diesel
B15	-	15% Jatropha Biodiesel + 85% Petroleum Diesel
B20	-	20% Jatropha Biodiesel + 80% Petroleum Diesel
B100	-	100% jatropha Biodiesel
BSFC	-	Brake Specific Fuel Consumbtion
CFD	-	Computational Fluid Dynamics
CFPP	-	Cold filter plug point
CJO	-	Crude Jatropha oil
CME	-	Canola Methyl Ester
CI	-	Cetane Index
CN	-	Cetane Number
CO	-	Carbon Monoxide
CO2	-	Carbon Dioxide

APPENDIX M: LIST OF SYMBOLS

LIST OF SYMBOLS

θ_m	–	Mean half angle (°)
A_p	-	Total inlet ports area (m2)
A/F	-	Actual Air-Fuel Ratio
d_0	-	Discharge orifice diameter (m)
Ds	-	Swirl chamber diameter (m)
ΔP_L	-	Pressure differential across nozzle (Pa)
ρ	–	Density of the liquid (kg/m3)
μ_L	–	Dynamic viscosity of the liquid (kg/m.s)
θ	-	Maximum spray cone half-angle (°)
ϕ	-	Equivalence Ratio
v_L	-	Kinematic viscosity of liquid (m^2/s)
σ	-	Surface tension (N/m)
mFUEL	-	Fuel Mass Flow Rate
m AIR	-	Mass of Air

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APPENDIX O:CHAPTER LAYOUT AND NUMBERING

CHAPTER II

LITERATURE REVIEW

2.1 Introduction

Literature review attempts to discover major publications and reports that will provide an insight understanding about the topic and related issues. The review also reveals the limitations encountered in the area of research which is related to the biodiesel industry worldwide.

This chapter gives a general overview of global energy consumption and emissions production trends followed by discussing the potential of biodiesel as a renewable energy resource, benefits uses of biodiesel, biodiesel standards and policies, biodiesel feedstocks- mainly *Jatropha Curcas* as non-edible vegetable resources, oil extraction methods, biodiesel production processes- mainly transesterfication of Jatrophaoil, properties and qualities of biodiesel, engine performance and exhaust emissions, fuel oil burners and spray characteristics of biodiesel.

2.1.1 Biodiesel Production Processes

2.1.1.1 Transesterification Process