



**BUSITEMA
UNIVERSITY**
Pursuing Excellence

FACULTY OF ENGINEERING

DEPARTMENT OF CHEMICAL AND PROCESS ENGINEERING

ACADEMIC YEAR 2017/2018

FINAL PROJECT REPORT

**PROJECT TITLE; DESIGN AND CONSTRUCTION OF A PHYSICAL SOYBEAN OIL
REFINERY ON A SMALL SCALE**

BY KASIRIVU MOSES AQURAM

BU/UP/2016/143

TEL. 0704437819

EMAIL: moses.kasirivu.5@gmail.com

SUPERVISOR: MR. KIYEMBA ANDREW

ABSTRACT

Soybean oil is the common name for the oil obtained from the beans of the plant, (*Glycerine max* (L) Merr, ranked as the number one most edible oil in the world, which is 85% unsaturated.

This project was designed and constructed to help soybean oil refinery to improve on the quality of the oil through physical refining at a low cost and environmentally friendly adoption.

The design of the machine involves the processing stage of degumming, bleaching, and deodorization, which are critical points in refining. Experimental conducts are carried out to investigate and analyze the physio chemical properties of the crude and purified oil. The performance of the prototype machine was tested 78.6% efficiency and purifying factor pf 0.612 and deductions using Anova showed that there was a significant change between the treatments of both the purified and crude soybean oil.

DECLARATION

I KASIRIVU MOSES AQURAM, **BU/UP/2016/143**, do declare that the work contained in this project proposal work is my original work except where explicit citations have been made. Therefore, it has never been submitted to any institution of higher learning for any academic award.

Signature.....

Date.....

APPROVAL

This project proposal is compiled and submitted to the Department of Agro processing Engineering for examination with the approval of my supervisor.

Mr. Kiyemba Edward

Signature.....

Date.....

ACKNOWLEDGEMENT

Most importantly, I thank God for the gift of life He has offered to me to accomplish this project proposal and gather all the necessary information to compile this report.

My sincere appreciation goes to my supervisor and all other lecturers for the guidance and time they sacrificed.

I am greatly indebted to my mum; Miss NAMATOVU DOROTHY TRACY and the other family members. They have been there for me amidst all challenges. In scarcity of resources, they have sacrificed their time, spared their advice and the very last of their property for me. Surely, there is nothing I can give to pay them other than praying for God's providence and blessings upon them. I also owe gratitude to my fellow students due to their unique trait of teamwork and cooperation and the necessary guidance they equipped me with during the compilation of this project proposal

LIST OF FIGURES

Figure 1 leading soybean produces in 2013/2014	6
Figure 2 soybean production in eastern and central Africa.....	7
Figure 3 soybean seed	8
Figure 4 Acid activated bleaching earth	23
Figure 5 Activated carbon.....	24
Figure 6 PROPOSED SOYBEAN OIL REFINERY	26
Figure 7 PROPOSED SETUP FOR DEGUMMING SECTION.....	27
Figure 8 PROPOSED SETUP FOR THE BLEACHING SECTION	28
Figure 9 PROPOSED SET UP FOR BLEACHING AND DEODORISATION TANK	29
Figure 10 SOYBEAN OIL REFINING ROUTES	30
Figure 11 A GRAPH SHOWING COMPARISON BETWEEN MOISTURE CONTENT OF CRUDE OIL AND PURIFIED OIL.....	46
Figure 12 A graph showing comparison between acid value of crude oil and purified oil	47
Figure 13 A graph showing comparison between peroxide value of crude oil and purified oil.....	49
Figure 14 CONDUCTING LAB EXPERIMENTS	54
Figure 15 SHOWING PROTOTYPE OPERATION AND ITS FINAL PRODUCT	55

Table of Contents

ABSTRACT	i
DECLARATION	ii
APPROVAL	iii
ACKNOWLEDGEMENT	iv
LIST OF FIGURES	0
CHAPTER ONE	3
1.1. BACKGROUND	3
1.2. PROBLEM STATEMENT.	4
1.3. MAIN OBJECTIVE	4
1.4. SPECIFIC OBJECTIVES.	4
1.5. SCOPE OF THE STUDY	5
1.6. JUSTIFICATION OF THE STUDY.	5
1.7. PURPOSE OF THE STUDY	5
2.1. SOY BEAN	6
2.1.1. Soy bean anatomy	7
2.1.2. Benefits of soybeans.	8
2.2. Crude soybean oil	9
2.2.1. Composition and constituents of crude soy bean oil	10
2.2.2. Quality of crude soybean oil	11
2.3. Finished products quality (RBDSBO)	12
2.5. PURIFYING METHODS OF SOYBEAN OIL.	14
2.5.1. CHEMICAL PURIFYING	14
2.5.2. Physical purifying	16
2.5.3. Physical purifying versus chemical purifying for soybean oil	17
2.6. Theory of degumming and bleaching.	18
2.6.1. What is degumming?	18
2.6.2. Types of degumming	18
2.6.3 Degumming agents	20
2.7 BLEACHING	21
2.7.1. Types of bleaching method.	21
2.7.2. Mechanisms of bleaching process	22
2.7.3. Bleaching agents	22

2.7.4. Acid activated earth versus natural/neutral earth for soybean oil	25
CHAPTER 3: METHODS AND MATERIAL	26
3.1. Proposed description of the soy bean oil refinery	26
3.2. CONCEPTUAL DIAGRAM FOR THE PROPOSED SOYBEAN OIL REFINERY	26
3.3. THE REFINERY PROPOSED WORKING PRINCIPLE	27
DEGUMMING SECTION	27
Bleaching and deodorization section	28
Soybean oil refining routes	30
3.4. Design considerations of the soybean oil refinery.	30
Specific objective one: Design a small-scale physical soybean oil refinery.	31
Specific objective two: Fabricate the components of the machine based on the design specifications	35
Specific objective three: test for the performance of the prototype.	35
Specific objective four: comparing deductions	35
Specific objective five: Carrying out economic analysis	36
CHAPTER 4: RESULTS AND DISCUSSIONS	37
4.1. DESIGN CALCULATIONS AND DISCUSSION FOR THE MACHINE COMPONENTS 37	
4.2. FABRICATION AND ASSEMBLY OF MACHINE COMPONENTS	39
4.3. PERFORMACE OF THE PROTOTYPE	41
4.4. COMPARING DEDUCTIONS	42
EXPERIMENTAL RESULTS	42
ECONOMIC EVALUATION OF THE MACHINE	49
CHAPTER 5: CONCLUSIONS AND RECOMMENDATIONS	52
5.1. CONCLUSIONS	52
5.2. RECCOMENDATION	52
6.0. CHAPTER 6; REFERENCES	53
APPENDICES	54

CHAPTER ONE

1.1. BACKGROUND

Soybean scientifically called (*Glycine Max*) is the most nutritious crop in the world containing approximately 40% protein and 20% oil according to Singh et al. (1987) and Weingarten (1987), both of which are vital in human and animal diet. There are very many varieties of soya. However, for this study only major varieties are targeted which include; Maksoya 1N means Makerere soya, the first soya variety in Uganda discovered by the Makerere agriculture research institute likewise to Maksoya 2N and 3N, Namsoya 4M means Namulonge soya, fourth soya variety in Uganda discovered by the Namulonge Agriculture Research institute. With the available technology for processing soybeans at the industrial and household level, soybean has become one of the most promising food crops available to improve the diet of millions of people in the world. The protein in soybean is balanced with all essential amino acids, which the body cannot manufacture.

Soybean has a variety of products since it has a good nutritive value such products include soybean flour which is rich in vitamins, mineral acids, and edible oil weighing about 20%. Soya milk contains about 2.86% proteins 1.74% carbohydrates and Fat 1.61%. and many more others. Since its nutritionally superior soy foods were highly recommended for children under 5 years, expectant mothers, and HIV patients.

Soybean oil is the common name for the oil obtained from the beans of the plant *Glycine max* (L.) Merr. It is ranked as the number one most important edible oil in the world which is 85% unsaturated, comprising of linolenic acid oleic acid which has been shown to reduce the risk of heart diseases by lowering cholesterol by 33%. What proves it to be better than other edible oils it's because it's cholesterol-free.

Soybean oil is obtained by cleaning, drying, or dehulling before entering the process. The dehuller removes soybean hulls since hulls absorb the oil yet it's the main yield we need. At the same time magnets are used to remove the iron from the soya bean. Soya beans are also heated to coagulate the soy protein to make oil extraction easy.

The soybean oil extracted is crude containing free fatty acids and other impurities including gums which are phosphatized. This oil has to go under refining. There are two types of refining observed