



**BUSITEMA  
UNIVERSITY**  
*Pursuing Excellence*

**FACULTY OF ENGINEERING**

**DEPARTMENT OF CHEMICAL AND PROCESS ENGINEERING**

**FINAL YEAR PROJECT**



**DESIGN AND CONSTRUCTION OF A COFFEE ROASTER MACHINE**

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**BU/UG/2014/9**

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*A final year project submitted to the Department of Chemical and Process Engineering in partial fulfillment of the requirement for the Award of the Bachelor's Degree in Agro-Processing Engineering of Busitema University,*

**MAY, 2018**

## **ABSTRACT**

Coffee roasting is one of the most important stages in processing drinking coffee to enhance flavors and ease grinding. It is a process of pyrolysis (time temperature dependent) which, by increasing the temperature of the coffee from room temperature to 180°C and above, brings about marked physical and chemical changes in the beans that improve the quality of coffee and make it easier to prepare.

~~The purpose of this study was to design and construct a coffee roaster machine for helping coffee farmers improve on the quality of their products (roasted coffee) which would yield high market prices hence improving their economic wellbeing and this was achieved by roasting under controlled time and temperature conditions in order to reduce loss of desired aromas to the environment and attain uniform roasting of the beans.~~

The design of the various machine parts was carried out by analyzing forces acting on them. Force analysis led to selection of proper materials to withstand the forces to avoid failure. Stainless steels of various grades were the main materials recommended to be used because they are food grade, strong and durable. Engineering drawings of the various components were drawn before the various components were constructed and then machine parts fabricated. A fully functional prototype resulted after all the above operations. Testing of the prototype was carried out and the figures revealed that the machine was 75.0% efficient. The coffee roaster has a total cost of 1,417,000 UGX which includes all the taxes, cost of material, machinery and hired labor to construct the machine plus overhead costs. The cost evaluation analysis of the project was based on the payback period method, the project was evaluated to breakeven in 1.23 years and on net present value method with NPV of 1,000,739 UGX over a period of five years.

**DECLARATION**

I **GUMISIRIZA JANE** declare to the best of my knowledge that this project report is as a result of my research and effort and it has never been presented or submitted to any institution or university for any academic award.

DATE 23<sup>rd</sup> May 2018

SIGNATURE [Signature]

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**APPROVAL**

This project report has been submitted to the department of chemical and processing Engineering for examination with approval from the following supervisors:

**Ms. KABASA MARY**

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SIGNATURE .....

DATE.....

**MAIN SUPERVISOR**

**Mr. KILAMA GEORGE**

SIGNATURE ..... 

DATE 31/07/2018 .....

**CO-SUPERVISOR**

## **DEDICATION**

I dedicate this report to my mother **Mrs. MBAMBU BEATRICE** and guardian **Mr. KAMBASU MOSES**, lecturers and friends for their love and continued support in my education

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## **ACKNOWLEDGEMENT**

First and foremost, I thank the Almighty God who has enabled me to do this project and granted me healthy life.

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## **1.0 Chapter one: Introduction**

### **1.1 Background of the study**

Coffee is one of the most consumed beverages and is the second largest traded commodity after petroleum in the world (Mussatto et al., 2011). In 2014, the estimated amount consumed globally was 149 million bags à 60 kg of coffee approximately 17.8 billion packages of coffee bought in common food stores (Bondesson, 2015). The coffee tree belongs to the Rubiaceae family, genus *Coffea* (Organizaci and Internationale, 2001) and is one of the most important cash and perennial crops in Uganda playing a major role in the livelihoods of many poor people and is a major foreign exchange earner in Uganda. The government agency responsible for the coffee sector (Uganda Coffee Development Authority (UCDA), estimates that about 500,000 households depend on coffee production. There are two main types of coffee grown in Uganda namely Arabica and Robusta coffee. Annual production on average is made up of 15% Arabica and 85% Robusta. Small-scale producers with less than three hectares of land produce about 90 percent of Uganda's coffee (Snipes, 2017).

After harvesting, coffee can be pulped in two ways that is dry and wet processing. In the wet method the cherry is squeezed in a pulping machine or pestle and mortar which removes the outer fleshy material (mesocarp and exocarp) leaving a bean covered in mucilage. This mucilage is fermented and dispersed. The bean is washed and dried. Whereas dry processing is natural and dry processed coffee is normally preferred for its fuller flavor. Prior to roasting, other additional operations associated with processing green coffee beans like hulling, decaffeination are carried out. The coffee roasting process consists essentially of cleaning, roasting, cooling, grinding, and packaging operations (Brando et al., 2009).

Roasting is a time temperature dependent process. The roasting temperature needs to be between 180 to 240<sup>o</sup>c for 6-8 minutes (coffee bean with 11% moisture content). The final flavor of the coffee is heavily dependent on how the beans are roasted. The degree of roast is usually assessed visually by watching the thin white line between the two sides of the bean until it turns to brown. Coffee is also known to have over 700 different compounds and thus has numerous industrial uses especially in the chemical industry and thus provides many opportunities for value addition investment (Valkila et al., 2010). This cubs the challenges associated with selling and exporting

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