FACULTY OF ENGINEERING

DEPARTMENT OF WATER RESOURCES AND MINING ENGINEERING

WATER RESOURCES ENGINEERING FINAL YEAR PROJECT

DESIGN AND FABRICATION OF A THERMODYNAMICS WATER HEATING SYSTEM

BY

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A final year project report submitted to the Department of Mining and Water Resources Engineering as a partial fulfillment of the requirements for the award of a Bachelor of Science degree in Water Resources Engineering

DECLARATION

I **WAMIMBI AMBROSE** solemnly declare that this final year project report is a result of my own efforts and tremendous work done during the research period and it has never been submitted to Busitema University or any other institution of higher learning for any academic award.

NAME: WAMIMBI AMBROSE

REG NO: BU/UP/2016/633

SIGNATURE: …….

DATE: …….

APPROVAL

This is to certify that this project report was written under the guidance of my supervisor on the topic ***"Design and fabrication of a thermodynamic water heating system*** " and is now ready for submission to the department of Busitema University.

MR. MUYINGO EMMANUEL

Main supervisor

Sign: …….

DATE: ……...

ACKNOWLEDGEMENT

I would like to extend my sincere thanks to the almighty GOD who has gifted me with life and has enabled me to reach this academic height as he has been the provider of all the necessary requirements.

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Let me convey my heartfelt appreciation to my supervisor Mr Muyingo Emmanuel for their advice as well their guidance during the preparation of this report. Not forgetting my classmates

ABSTRACT.

There is recognizable development in the exploitation of solar energy in such countries for power generation from single solar panels for residential to multiple panels for industrial and grid application. Another success in the exploitation of solar energy is in the solar water heaters industry. The use of solar heaters in meeting both domestic and industrial water heating demands replaces the use of convectional energy sources like fossil fuels, charcoal, fire wood.

Solar water heaters (SWH) use radiation from the sun to heat solar collectors and then transfer the heat to water. The current technology of SWH is the thermo syphon principle where the flow of the heating fluid is defined by the difference in the fluid density presented by the temperature difference of the fluid. This technology is widely used and applied in flat plate collectors.

However, G.L Morrison notes that these collectors are generally associated with high heat losses of up to 20% and low efficiencies. On the other hand, the typical SWH requires mounting a complex heavy panel and system onto the roof and if the radiation intensity is high for a long period of time, boiling normally occurs. This system also heavily depends on the sun's radiation to heat water which means it turns out to be ineffective in the wet or cold season when the solar radiation and intensity are low.

This research therefore was on developing a sustainable water heating system that addresses the above the challenges whereby the system uses a refrigerant fluid instead of water for heat transfer hence making it light weight and less dependent on solar radiation to heat water. Therefore this study was carried out to design the different system components of the thermodynamics water heating system, fabricate and assemble the system, test the performance of the thermodynamics water heating system and perform an economic analysis of the system leading to a reduced dependency on fossil fuels for water heating by the use of ambient temperatures around the panels to heat the water and it is in line with the thirteenth goal of the UN SDGs.

The system is designed for a domestic household of 6 members. According to United Nations, the amount of water recommended for drinking, washing, cooking and maintaining proper hygiene is a minimum of fifty litres per person per day. Therefore, for a family of 6 members, an

average of 300 litres of water would be needed. However, not all the 300litres will require heating, so assuming that only a fifteenth (1/15) of this needs heating then we shall need heating of about 20litres of water.

Testing of the prototype for the system performance was carried out both during day and night and revealed that the prototype heats water with efficiency of 83.64% during day and efficiency of 83.3% during night. With the initial investment of 675,000 Ug shillings, the economic analysis of the project was carried out using Net Present Value (NPV) method, and the project was evaluated to have the NPV of 1,929,677 Ug shillings and the benefit – cost ratio is 2.83. This therefore, implies that the project is viable since the value was positive and greater than one.

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