

**ENERGY UTILISATION IN A TEXTILE MILL: A  
CASE STUDY OF SOUTHERN RANGE NYANZA  
LIMITED (NYTIL)**



**SSENYONJO DENIS**

**BU/UG/2009/83**

**A DISSERTATION SUBMITTED TO THE DEPARTMENT OF TEXTILE AND  
GINNING ENGINEERING FOR THE AWARD OF BACHELOR OF SCIENCE IN  
TEXTILE ENGINEERING OF BUSITEMA UNIVERSITY**

**MAY 2013**

## DECLARATION:

I do hereby declare that this research report is original and has never been submitted for any other degree to any other University.

Signed.....*Denis* 29/05/2013

SSENYONJO DENIS

Supervisors

1. Mr. Ssembatya Martin

Busitema University

Signature.....*Ssem*.....Date.....29/05/2013

2. Eng. Wandera Wafula Jonnie

Busitema University

Signature.....Date.....

3. Mr. Rwawiire Samson

HoD, Textile and Ginning engineering

Busitema University

Signature.....Date.....



## **DEDICATION**

I dedicate this research report to my parents for their love for education through their hard work to make everyone have a better education in the family. Thanks for being my role models in this life.

Once more I dedicate this report to my relatives, brothers, sisters and well wishers for your support morally, materially and academically. God bless you all.

## **ACKNOWLEDGEMENT**

I want to thank the almighty God for without his mercy I wouldn't have come this far as regards to this research report.

It is amongst the greatest clichés when writing a supervised research report to say a “big thanks to your supervisors”. And as much as I despise starting my report with a stereotype, I really do have to express my collective gratitude towards Mr. Ssembatya Martin, Mr. Ddumba Joseph, Mr. Rwawiire Samson HoD and Eng. Wandera Wafula Jonnie, I say a “big thanks” not only for their guidance and patience during this research but also for their mentoring throughout all my brief encounters during the course of writing this research report. Special thanks go to all fellow students especially those of Textile and Ginning Engineering for their encouragement and advice, without them this research wouldn't be successful.

## **LIST OF ACRYNOMS AND ABBREVIATIONS**

B/C ratio	Benefit Cost Ratio
CFL	Compact Fluorescent Lights
CMMS	Computerized Maintenance Management System
CRES	Centre for Renewable Energy Sources
ECCJ	Energy Conservation Centre Japan
ECMs	Energy Conservation Measures
ECOs	Energy Conservation Opportunities
EHV	Effective Heating Value
EMO's	Energy Management Opportunities
<i>EMT</i>	Energy Medical Technician
EUAC	Equivalent Uniform Annual Cost
FHWA	Federal Highway Administration
GHG	Green House Gases
HHV	High Heating Value
IRR	Internal Rate of Return
LCC	Life cycle cost
LED	Light Emitting Diode
NPW	Net Present Worth method
NRDC	Natural Resources Defense Council
NYTIL	Nyanza Textile Industries Limited
ROI	Return on Investment
SAE	Society for Automotive Engineers
SMEs	Small Medium Enterprises

## LIST OF TABLES

Table 1: Brightness in lumens expected from different wattage light bulbs (www.earthy.com).....	9
Table 2: Thermal Energy Use in Dyeing Plants (Average of Japan) (ECCJ, 2007).....	11
Table 3: Energy consumption for petrol, diesel and kerosene in litres.....	19
Table 4: Energy consumption for coffee husks in kg.....	20
Table 5: Energy consumption for electricity in kWh.....	20
Table 6: Productivity indicators of kgs of coffee husks/kg of yarn for 2011 and 2012.....	25
Table 7: kWh per kg of yarn for 2011 and 2012.....	26
Table 8: Measured KW, KVA, KVAR and PF for different sections.....	28
Table 9: Provides statistics on lighting gadgets for some of production departments.....	30
Table 10: Thermodynamic properties of saturated steam at a steam pressure of 100 psi.....	34
Table 11: Surface temperatures for 4'' un insulated steam line.....	35
Table 12: Surface temperature measurements for 10'' un insulated steam line.....	35
Table 13: Total Annual kg loss of the coffee husks.....	36

## LIST OF FIGURES

Figure 1: A typically integrated vertical textile processing chain .....	5
Figure 2: Fuel expenditure proportions .....	21
Figure 3: Coffee husks consumption .....	22
Figure 4: Electricity consumption .....	23
Figure 5: Consumption in petrol, diesel and kerosene. ....	23
Figure 6: Indicator Values Kg of Coffee husks per kg of Yarn 2011/2012 .....	25
Figure 7: Specific electric energy consumption kWh per Kg of Yarn 2011 .....	27
Figure 8: Specific electric energy consumption kWh per Kg of Yarn 2012 .....	27
Figure 9: Lagged steam lines in processing	
Figure 10: Un lagged 4" steam line	
.....	33
Figure 11: VVT-H-3500 Spl Isotex thermic boiler.....	42
Figure 12: Adilapidated refractory brick work in the boiler house .....	42
Figure 13: A poorly lagged distribution pipe .....	42
Figure 14: FB089, Flitech Boiler PVT LTD steam boiler in action .....	43
Figure 15: open air drying technique .....	43

## **ABSTRACT**

Energy efficiency is simply using less energy to achieve the same purpose. With energy investment being one of the main cost factors in a textile industry, this research was aimed at identifying energy efficient and saving technologies that could optimize energy consumption in NYTIL, the case study.

This involved determination of current energy consumption trends of the factory in hydro power, coffee husks, kerosene, petrol and diesel by carrying out an energy audit. This was done with the use of preliminary energy audit. The trends show a decrease in energy consumption especially in hydro power, and coffee husks, an indicator of energy efficiency. Tables and graphs were used to show different energy consumptions and trends in chapter four of results and discussions.

Also different energy management and conservation measures suitable for NYTIL were identified such as use of LED energy savers in all lighting systems, improvement on power factor, re-insulation of all steam lines etc.

Furthermore, economic analysis on the energy efficient strategies was carried out for some of the technologies to prove their feasibility and the results show better performance if implemented.

Finally the research indicates conclusions and different recommendations derived from the chapter four of results and discussions. Basically they emphasize what the company should do to achieve energy efficiency, so as to maintain the energy consumption trends on a decrease.



## TABLE OF CONTENTS

DECLARATION:.....	i
DEDICATION.....	ii
ACKNOWLEDGEMENT.....	iii
LIST OF ACRYNOMS AND ABBREVIATIONS.....	iv
LIST OF TABLES.....	v
LIST OF FIGURES.....	vi
ABSTRACT.....	vii
1.0 INTRODUCTION.....	1
1.1 Background of the project.....	1
1.2 Problem statement.....	2
1.3 Justification.....	2
1.4 Objective(s) of the research.....	3
1.4.1 Main objective.....	3
1.4.2 Specific objectives.....	3
1.5 Scope.....	3
2.0 LITERATURE REVIEW.....	4
2.1 Textile processes.....	4
2.2 Energy auditing.....	6
2.2.1 Types of Energy auditing.....	6
2.2.2 Energy parameters normally measured.....	7
2.3 Energy-efficiency improvement opportunities in the textile industry.....	8
2.3.1 Steam boiler energy saving opportunities.....	8
2.3.2 Lighting system energy saving opportunities.....	8
2.3.4 Steam lines energy saving opportunities.....	12

2.3.5 Combine preparatory treatments in wet processing .....	12
2.4 Economic analysis .....	12
2.4.1 Cost/Effectiveness .....	13
2.4.2 Cost/Minimization.....	14
2.4.3 Cost/Benefit .....	14
2.4.4 Limits of Economic Analysis.....	14
3.0 METHODS AND MATERIALS .....	15
3.1 Equipments and tools.....	15
3.2 Data collection.....	15
3.2.1 Reviewing the existing literature .....	15
3.2.2 Observations .....	15
3.2.3 Consultations.....	15
3.3 Preliminary energy audit.....	15
3.4 Equations and models .....	16
3.5 Economic analysis of the energy saving strategies .....	17
3.5.1 Establishing alternative design strategies .....	17
3.5.2 Determining activity timing and agency costs.....	17
3.5.3 Estimation of user costs.....	17
3.5.4 Determination of life-cycle cost.....	17
3.5.5 Simple payback period (SSP) .....	18
3.6 Data Presentation and Analysis.....	18
3.7 Documentation .....	18
4.0 RESULTS AND DISCUSSION .....	19
4.1 Current overall energy consumption of NYTIL.....	19
4.2 Energy consumption trends of NYTIL. ....	22

4.3 Electrical Energy .....	24
4.3.1 Productivity indicators.....	24
4.3.2 Electrical Drives Power Factor (PF) Correction .....	28
4.4 Light energy .....	30
4.4.1 Total lighting energy consumption within the selected departments.....	31
4.4.2 Expected total lighting energy consumption after incorporation of LED energy savers .....	31
4.5 The economic viability of the investment .....	31
4.5.1 Life cycle cost (LCC) .....	31
4.5.2 LCC with use of CFLs energy saving lighting gadgets.....	31
4.5.3 LCC with use of LED energy saving lighting gadgets.....	32
4.5.4 Simple payback period (SSP) .....	33
4.6 Thermal Energy (Poor lagging and large exposed areas) .....	33
4.6.1 Heat loss Q for un lagged steam lines .....	35
4.6.2 Heat loss Q for insulated steam lines .....	36
5.0 CONCLUSION AND RECOMMENDATIONS.....	38
5.1 Conclusion.....	38
5.2 Recommendations.....	38
REFERENCES .....	40
APPENDICES .....	42

## CHAPTER ONE

### 1.0 INTRODUCTION

#### 1.1 Background of the project

With the current competitive global business environment, investors are looking for ways of reducing total production costs without affecting the volume of production and product quality so as to meet their customer expectations. With various energy efficiency opportunities existing in every textile plant, many of them are not implemented in textile plants often because of un reliable information on how to implement energy-efficiency measures, owing the fact that a majority of textile plants are categorized as small medium enterprises small scale enterprises (SMEs) (Ali Hasanbeigi, 2010).

Energy optimization is very vital element as regards to the company's economy and environmental protection since end of pipe remedies can be expensive and inefficient. Therefore energy efficiency can be a profitable venture within manufacturing environment (Worrell and Galitsky, 2004). About 34% of energy is consumed in spinning, 23% in weaving, 38% in chemical processing and another 5% for miscellaneous purposes. Electrical power dominates consumption pattern in spinning/weaving, while thermal energy is major for chemical processing (Aravin Prince, 2012).

Thermal energy in textile mill is mostly used in two operations, that is, in heating of water and drying off water during steaming. Steam is generated by employing boilers using different energy sources like fuel such as coal, firewood, coffee/rice husks, furnace oil and lately low sulphur heavy stock oil available from the refineries as fuel having average calorific values of 4200, 6200, 10280 and 10700 Kcal respectively etc (Aravin Prince, 2012). Energy conservation is influenced through machine modification, use of proper chemical recipes and new technologies. The possibilities of utilizing new energy resources like solar energy, wind power, tidal power, nuclear energy, etc. are to be explored. (Aravin Prince, 2012).

## REFERENCES

Ali Hasanbeigi (2010), Energy-Efficiency Improvement Opportunities for the Textile Industry, China Energy Group, Energy Analysis Department, Environmental Energy Technologies, Division Lawrence Berkeley National Laboratory, Berkeley, U.S.A.

"Life Cycle Cost And Good Practices", by H. Paul Barringer, P.E. Barringer & Associates, Inc., Humble, TX, presented at NPRA MAINTENANCE CONFERENCE May 19-22, 1998, San Antonio Convention Center, San Antonio, Texas.

Mr. G G Vaghela DGM, Mr. C M Bhagia (TS) Sr MGR (TS) Ms. Shilpy J Shah Design Engineer (Process), Energy Conservation and Optimization of Boiler Performance G.S.F.C's Experience, India.

Jayant Sathaye, Lynn Price, Stephane de la Rue du Can, and David Fridley (2005), Assessment of Energy Use and Energy Savings Potential in selected Industrial Sectors in India, Energy Analysis Department, Environmental Energy Technologies Division, Lawrence Berkeley National Laboratory, Berkeley, U.S.A.

German Electrical and Electronic Manufacturers' Association (ZVEI), Frankfurt/Main Federal Industrial Association of Germany for House, Energy and Environmental Technology (BDH), Frankfurt/Main (2010), Energy efficiency, Federal ministry of economics and technology (MWI), Berlin, Germany.

J.N.Vohra B.Text, M.Tech, F.I.E., C.Eng (I), L.M.I.M.A, Coordinator -NITMA, Scope of Energy Saving in Textile Industry: A seminar on "Enhancing competitiveness through Energy Efficiency-Focus Textile Industry" held on 16th July, 2010 at Hotel Park Plaza, Punjab, India.

Linda Greer (February 2010), **NRDC's Ten Best Practices for Textile Mills to Save Money and Reduce Pollution.**

BECO Institute for Sustainable Business (Oct 2009), Final Report: Responsible Sourcing Initiative. Cleaner Production Opportunity Assessment in Four Chinese Textile Companies.P. 8;

S. Barclay and C. Buckley (1993), Waste Minimization Guide for the Textile Industry – A Step Towards Cleaner Production, Volume III. In: UNEP/IEO ICPIIC International Cleaner Production Information Clearing House.

*NRDC: ZJG Addchance Dyeing and Finishing Company, JhangJiaGang. July 22<sup>nd</sup>, 2009.*

E-Textile Toolbox. "Regular Maintenance of the Compressed Air System". From [www.e-textile.org/previewmeasure.asp/OptD=22&&lang=ind](http://www.e-textile.org/previewmeasure.asp/OptD=22&&lang=ind) as accessed on 10<sup>th</sup>, October, 2012).

Susan Barclay, Chris Buckley(2000), Waste Minimization Guide for the Textile Industry, The Pollution Research Group University of Natal, Durban, South Africa.

"Budgeting and Maintenance", Conklin & de Decker: Aviation Information, Available from: <http://www.conklindd.com/Page.aspx?hid=1188> (accessed on 10<sup>th</sup> October, 2012).

S.ASHOK, How to save energy in textile mill, PCRA faculty, Coimbatore.Sunbeam GmbH, Berlin BONUM news + marketing, Hamburg German Energy Agency (dena), Berlin German Engineering Federation (VDMA), Frankfurt/Main.

[http://www.wbdg.org/design/secure\\_safe.php](http://www.wbdg.org/design/secure_safe.php) and [http://www.wbdg.org/design/consider\\_benefits.php](http://www.wbdg.org/design/consider_benefits.php) retrieved on 6 November 2012.

Asta Guciute Scheving (January 2011): Life Cycle Cost Analysis of Asphalt and Concrete pavements, Reykjavik University, Iceland.

Aravin prince (2012): Energy conservation in textile industries & savings. Asst Prof/ Textile Chemistry at DKTE Society Textile Engineering College, Ichalkaranji, Maharashtra, India

[www.tradingeconomics.com/uganda/inflation](http://www.tradingeconomics.com/uganda/inflation) (retrieved on 15 March 2013).

Uganda Bureau of Statistics, Plot 9, Colville Street P.O. Box 7186, Kampala, March 2013.

Ontario Hydro: Power factor, Energy Management Series, Cos Phi Inc.240 Huckins St, P.O. Box 24 Goderich, Ontario.

[www.EngineeringToolBox.com/](http://www.EngineeringToolBox.com/) and [www.engineeringtoolbox.com/saturated-steam-properties-d\\_101.htm](http://www.engineeringtoolbox.com/saturated-steam-properties-d_101.htm) (retrieved on 23<sup>rd</sup>, March, 2013).

Steven P. Bray, Andrew J. Cramer, Alexander R. Kaufman, Nicholas T. Sadlouskos, Fred A. Ungerman III , Steam Loss In Miami University Piping System , Mechanical and Manufacturing Engineering, Miami University, Oxford, OH 45056.

Society for Automotive Engineers, SAE (1999): Handbook of Maintenance Management and Engineering, By Mohamed Ben-Daya.

Walls & Smith, (1998): Pavement Management.