PREDICTING EXTRUSION PROCESS PARAMETERS IN NIGERIA CABLE INDUSTRIES USING ARTIFICIAL NEURAL NETWORK

ADESANYA AYOKUNLE OLUSOLA

(11CK012394)

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BY

ADESANYA AYOKUNLE OLUSOLA

(11CK012394)

B.Eng Electrical and Electronics Engineering, Covenant University, Ota.

A DISSERTATION SUBMITTED TO THE SCHOOL OF POSTGRADUATE STUDIES IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF THE MASTER OF ENGINEERING (M.Eng.) DEGREE IN ELECTRICAL AND ELECTRONICS ENGINEERING IN THE DEPARTMENT OF ELECTRICAL AND INFORMATION ENGINEERING, COLLEGE OF ENGINEERING, COVENANT UNIVERSITY.

JANUARY, 2020

ACCEPTANCE

This is to attest that this dissertation has been accepted in partial fulfilment of the requirements for the award of the degree of Master of Engineering in Electrical and Electronics Engineering in the Department of Electrical and Information Engineering, College of Engineering, Covenant University, Ota, Nigeria.

Mr. John A. Philip ……..
(Secretary, School of Postgraduate Studies) **Signature and Date**

Prof. Akan B. Williams ……..
(Dean, School of Postgraduate Studies) **Signature and Date**

DECLARATION

I, ADESANYA, AYOKUNLE OLUSOLA (11CK012394) declare that this dissertation is a representation of my work, and is written and implemented by me under the supervision of Doctor Ademola Abdulkareem of the Department of Electrical and Information Engineering, Covenant University, Ota, Nigeria. I attest that this dissertation has in no way been submitted either wholly or partially to any other university or institution of higher learning for the award of a masters' degree. All information cited from published and unpublished literature has been duly referenced.

ADESANYA, AYOKUNLE OLUSOLA ……

Signature and Date

CERTIFICATION

This is to certify that the research work **titled "PREDICTING EXTRUSION PROCESS PARAMETERS IN NIGERIA CABLE INDUSTRIES USING ARTIFICIAL NEURAL NETWORK**" is an original research work carried out by **ADESANYA, AYOKUNLE OLUSOLA** meets the requirements and regulations governing the award of Master of Engineering (M.Eng.) degree in Electrical and Electronics Engineering from the Department of Electrical and Information Engineering, College of Engineering, Covenant University, Ota, and is approved for its contribution to knowledge and literary presentation.

Dr Ademola Abdulkareem ……

(Supervisor) Signature and Date

Prof. Emmaunel Adetiba ……

(Head of Department) Signature and Date

Prof. Ogbonnaya I. Okoro ……

(External Examiner) Signature and Date

Prof. Akan B. Williams ……

(Dean, School of Postgraduate Studies) Signature and Date

DEDICATION

This research work is dedicated first and foremost to God Almighty, the custodian of all wisdom, knowledge, and understanding, for His grace and favor throughout the duration of carrying out this research. Then to my family for their endless support and love.

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS AND SYMBOLS

$\sum$	Summation
f	Activation Function
ANN	Artificial Neural Network
Cu	Copper
Al	Aluminum
PVC	Polyvinyl Chloride
PE	Polyethylene
XLPE	Cross-linked polyethylene
PID	Proportional Integral Derivative
LDPE	Low-Density Polyethylene
HDPE	High-Density Polyethylene
MDPE	Medium-Density Polyethylene
LLDPE	Linear Low-Density Polyethylene
AC	Alternating Current
DC	Direct Current
Mpa	Mega Pascal
LM	Levenberg Marquardt
MLP	Multilayer Perceptron
MATLAB	Matrix Laboratory
MSE	Mean Square Error
R	Regression
MAPE	Mean Accuracy Percentage Error
MRE	Mean Relative Error
RMSE	Root Mean Square Error

ABSTRACT

Cable manufacturing in a developing country like Nigeria today is faced with different problems during the thermoplastic extrusion processes due to the complex nature of the parameters that are involved in the process. These process parameters which include melt temperature, pressure, and screw speed generally impact the quality of the insulation in electrical cables. The main consequence of the problem is the low and variable output rate from extruder causing cable defects and non-uniform diameter along the cable length. This7 often increases the production time and cost in the extrusion process. Different research has been done to improve extrusion output quality in developed countries. However, there are still some problems in achieving consistent product quality as most of the developing countries still use the trial and error techniques which involves full-size experiments to determine the process parameters and cable insulation thickness in the thermoplastic extrusion process. The main purpose of this research is to determine the realistic extrusion process parameters and cable insulation thickness in the thermoplastic extrusion process in Nigeria cable manufacturing industries with the use of an artificial neural network. The use of an artificial neural network to predict extrusion process parameters before plant execution will make extrusion process operations more efficient. This technique also bridges the gap that exists between theoretical analysis and real manufacturing system. The neural network was developed in a MATLAB environment and was trained with an appropriate learning algorithms. The neural network model developed is capable of predicting manufacturing process parameters and insulation thickness for different thermoplastic materials in the thermoplastic extrusion process.

Keywords: Artificial Neural Network (ANN), Extrusion, Thermoplastic, Electrical Cables.