

**DEVELOPMENT OF AN ANN BASED PLANT CONTROLLER
FOR BIOMASS DOWNDRAFT PACK BED GASIFIER**

Ganegoda Vidanage Charaka Rasanga

(1215283K)

Degree of Master of Science

Department of Electrical Engineering

University of Moratuwa

Sri Lanka

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G. V. C. Rasanga,
128815K,
Department of Electrical Engineering,
Faculty of Engineering,
University of Moratuwa.

ABSTRACT

Energy crisis and emerging negative impacts on environment are the leading factors of industries to increase the share of sustainable resources in the energy production. Biomass based solutions have become as an alternative for fossil fuels due to its availability and sustainability. There are several energy conversion method to utilized biomass, among them. gasification is the one of main energy conversion method. However, biomass gasification has shortcomings due to the barriers like unpredictable variability of biomass properties, process complexity, and controllability of the process.

There are several types of gasification types. Downdraft back bed biomass gasifire is the most suitable one for small power application (10-1000kW) and it is beneficial over the other types because of less complexity of construction and low carbon footprint.

Aim of this study is to develop an artificial neural network based on plant controller for biomass gasifier. Biomass gasification process model was developed using feedforward neural network model (FFNN) and neural network based nonlinear autoregressive model with external output (NNARX). According to results, NNARX showed the best performance for prediction of process output.

The effectiveness of the neural network based internal model controller (IMC) was successfully tested for gasification plant. Two experiments were carried out using 12kg of coconut shells. One experiment plant was run with proposed neural network internal model controller (NNIMC) while second experiment was done without NNIMC and blower was operated at constant reference RPM.

Developed NNIMC was tested using 15kW pack bed imbert type downdraft biomass gasifire and controller algorithms. Performance of introduced IMC was analysed using 72 minutes of continuous plant operation. The analysis revealed that 12% of gasification efficiency can be improved while increased the performance in terms of stability by the introduced of NNIMC.

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LIST OF ABBREVIATIONS

Abbreviation	Description
AI	: Artificial Intelligent
ANN	: Artificial Neural Network
CFB	: Circulating Fluidized Bed
DC	: Direct Current
ER	: Equivalence Ratio
FBNN	: Feedback Neural Networks
FFNN	: FeedForward Neural Networks
HMFNN	: Hybrid Multilayer FeedForward Neural Networks
IC	: Internal Combustion
IMC	: Internal Model Controller
NN	: Neural Network
NNARX	: Neural Network based nonlinear Autoregressive model with external output
NNIMC	: Neural Network Internal Model Controller
RNN	: Recurrent Neural Networks