UNIVERSITI TEKNOLOGI MARA

PREDICTION OF THE PHYSICAL PROPERTIES OF DEGRADABLE PLASTICS USING ANFIS

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ABSTRACT

Degradable plastic is produced by combining different percentages of additives such as oil palm biomass (OPB), palm oil (PO) and starch with polyethylene (PE). Currently, experiments are carried out in laboratories to determine the formulation of degradable plastics with the most bioactive components and desirable physical properties measured by melt flow index (MFI), melting point (MP) and density. The procedure is time consuming and costly. Therefore, a different approach is required to minimize the time consumption, production cost and labour cost. In this research, an Adaptive Neuro-Fuzzy Inference System (ANFIS) and linear regression (LR) models have been developed and utilized to predict the physical properties of degradable plastics. The prediction accuracy of ANFIS and LR models are assessed by comparing simulated results with the actual lab results using root mean square error (RMSE), correlation coefficient (R), coefficient of determination (R^2) and adjusted R square ($\bar{R}^2$). ANFIS and LR models are found to have compatible prediction performances. The findings show that ANFIS model is capable of determining the desirable input-output relationships in degradable plastic production as reflected by the small RMSE values, high R and R^2 values. Furthermore the difference between R^2 and $\bar{R}^2$ values is small which indicates that the addition of new variable does not contribute to the over fitting of ANFIS model. It was also found that different membership functions used in ANFIS has an impact on ANFIS prediction performance. The developed ANFIS model can be used as a guide for the production of degradable plastic with some intended physical requirements.

ACKNOWLEDGEMENTS

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CHAPTER 1
INTRODUCTION

1.1 Overview

Modeling properties of fibre reinforced polymer composites is very important in minimizing cost and time consumption in the production of degradable plastics. Degradable plastics are defined as materials made from natural fibre (e.g. kenaf, rice hull, wood flour and cotton) and synthetic thermoplastics (e.g. polyethylene, polypropylene and polystyrene) (Shinoj *et al.*, 2010). Degradable plastics do not contribute to the current ecological and environmental problems thus a good substitute for the existing non-degradable plastics (Thakur & Singha, 2010).

In general, traditional equations derived for the solution of real world problems are not suitable for modeling non-linear functions such as the function governing the formulation of degradable plastics production. Similarly, these traditional methods lack the ability to deal with imprecise and uncertainties in polymer studies (Kadi & Assaf, 2002). Thus, alternative methods for solving real world problems are highly needed (Zaheeruddin & Garima, 2006). Soft computing techniques such as Adaptive Neuro-Fuzzy Inference System (ANFIS), Fuzzy logic, Genetic algorithm and Artificial neural network provide suitable alternative methods for dealing with non-linearity and uncertainties in polymer studies (Mohd Dom, 2009). Research has shown that ANFIS is capable of predicting the properties of fibre reinforced polymer composites with high accuracy (Jarrah *et al.*, 2002). Therefore this research attempts to utilize soft computing technique namely ANFIS in predicting the physical properties of fibre reinforced polymer composites. The

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