



UNIVERSITI PUTRA MALAYSIA

***DEVELOPMENT OF MATERIAL SELECTION EXPERT SYSTEM FOR
POLYMER-BASED COMPOSITE MATERIALS***

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**DEVELOPMENT OF MATERIAL SELECTION EXPERT SYSTEM FOR
POLYMER-BASED COMPOSITE MATERIALS**

By

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**Thesis Submitted to a School of Graduated Studies, Universiti Putra
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Degree of Master of Science**

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**DEVELOPMENT OF MATERIAL SELECTION EXPERT SYSTEM FOR
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Chairman: Mohd Sapuan Salit, PhD, PEng

Faculty: Engineering

The main objective of this research was to determine the most optimum polymer based composite material for engineering applications. Three engineering application involved in the material selection of polymer based composite are small boat for marine application, thyristor for electronic application and interior car panel for automotive application. The objective was achieved by proposing material selection framework and implementing expert system approach using IF/THEN logic rules. Various attributes and criteria such as tensile strength, tensile modulus, flexural strength, flexural modulus, impact strength, density, and water absorption of polymer based composite were considered. To determine the most suitable material for polymer based composite for engineering application, expert system shell Exsys Corvid software was used. The research covered the development of user interface for easy customization, material database using MetaBlock system, rule-based system, and constraint satisfaction and constraint

violation. The research revealed that 63% glass fibre reinforced vinyl ester composite is the most suitable for small boat and 40% glass fibre polycarbonate composite for thyristor body casing and 30% glass fibre polyphenylene ether composite for interior car panel. The sensitivity analysis is performed by adjusting the range of design requirements in order to verify the developed material selection system sensitivity. Overall, it can be concluded that the proposed material selection approach allows designer to determine the most suitable materials for polymer based composite engineering application.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains

**PEMBANGUNAN SISTEM PAKAR PEMILIHAN BAHAN UNTUK
KOMPOSIT BERASASKAN POLIMER**

Oleh

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Objektif utama kajian ini ialah untuk menentukan komposit berasaskan polimer untuk aplikasi kejuruteraan. Tiga aplikasi kejuruteraan terlibat dalam proses pemilihan bahan iaitu bot kecil untuk aplikasi merin , thyristor untuk aplikasi elektronik dan panel dalam kereta untuk aplikasi automotif. Objektif ini tercapai dengan mencadangkan kerangka pemilihan bahan dan melaksanakan pendekatan sistem pakar dengan menggunakan peraturan logik IF/THEN. Pelbagai atribut dan kriteria seperti kekuatan tegangan, modulus tegangan, kekuatan lenturan, kekuatan hentaman, kekuatan mampatan, ketumpatan, penyerapan air, dan harga komponen bagi komponent komposit berasaskan polimer dipertimbangkan. Untuk menentukan bahan yang paling sesuai untuk komponen kejuruteraan, perisian Exsys Corvid digunakan. Kajian ini merangkumi pembangunan antara muka mesra pengguna untuk memudahkan penyesuaian, pangkalan data bahan menggunakan sistem MetaBlock, sistem bersasaskan peraturan, kepuasan

kekangan dan pelanggaran kekangan. Kajian ini mendedahkan bahawa komposit vinil ester diperkuatkan dengan 63% gentian kaca adalah yang paling sesuai untuk boat kecil, komposit polikarbonat diperkuatkan dengan 40% gentian kaca untuk thyristor dan komposit polifenailin eter diperkuatkan dengan 30% gentian kaca untuk panel dalaman kereta. Analisis sensitif dibuat dengan mengubah julat keperluan reka bentuk untuk mengesahkan sensitiviti sistem pemilihan bahan yang dibangunkan. Pada keseluruhannya, dapat disimpulkan bahawa cadangan kerangka pemilihan bahan komposit berasaskan polimer membolehkan pengguna untuk menentukan bahan yang paling sesuai untuk aplikasi kejuruteraan komposit berasaskan polimer.

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I certify that a Thesis Examination Committee has met on to conduct the final examination of Mohd Fairuz Abd Manab on his thesis entitled "Prototype Expert

System for Material Selection of Polymer based Composites for Boat Components” in accordance with the Universities and University Colleges Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U.(A) 106] 15 March 1998. The Committee recommends that the student be awarded the Master of Science.

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DECLARATION

I declare that the thesis is my original work except for the quotations and citations which have been duly acknowledged. I also declare that it has not been previously and is not concurrently, submitted for any other degree at Universiti Putra Malaysia or at other institutions.

MOHD FAIRUZ ABD MANAB

Date: 25 July 2011

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