

PRODUCTION AND OPTIMIZATION OF ACTIVATED  
CARBON FROM WASTE ORANGE PEELS USING  
MICROWAVE PYROLYSIS

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SCHOOL OF OCEAN ENGINEERING  
UNIVERSITI MALAYSIA TERENGGANU  
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PRODUCTION AND OPTIMIZATION OF ACTIVATED CARBON FROM  
WASTE ORANGE PEELS USING MICROWAVE PYROLYSIS

By  
WONG YEE MUN

A PITA research proposal submitted in partial fulfilment  
of the requirements for the award of the degree  
of Bachelor of Technology (Environment)

SCHOOL OF OCEAN ENGINEERING  
UNIVERSITY MALAYSIA TERENGGANU  
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**SCHOOL OF OCEAN ENGINEERING  
UNIVERSITI MALAYSIA TERENGGANU**

**VERIFICATION AND APPROVAL FORM**

This PITA research report entitled *Production and Optimization of Activated Carbon from Waste Orange Peels using Microwave Pyrolysis* prepared and submitted by Wong Yee Mun, Matric No.UK29652 in partial fulfillment of the requirements for the award of the degree of Bachelor of Technology (Environment) has been examined and is recommended for approval of acceptance.

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## DECLARATION

I hereby declare that this PITA research report entitled *Production and Optimization of Activated Carbon from Waste Orange Peels Using Microwave Pyrolysis* is the result of my own research except as cited in the references.

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## **PRODUCTION AND OPTIMIZATION OF ACTIVATED CARBON FROM WASTE ORANGE PEELS USING MICROWAVE PYROLYSIS**

### **ABSTRACT**

Global production of oranges is massive due to the high consumer demands in orange fruit and its by-products. Over 40 % of the orange fruit is disposed as fruit waste after industrial processing, and this could decrease landfill capacity and create environmental pollution problems. Recent researches have discovered the potential of converting waste orange peels (WOP) into orange peel activated carbon (OPAC). Hence, the aim of this research is to optimize the production of activated carbon from WOP using response surface methodology. WOP will be carbonized at 700 W for 20 minutes using microwave pyrolysis. Next, the orange peel char (OPC) produced will be chemically activated using sodium hydroxide and potassium hydroxide via microwave pyrolysis, under different conditions. The chemical activation of OPC will be conducted with optimization of three parameters: microwave power (W) ( $x_1$ ), microwave irradiation time (min) ( $x_2$ ) and impregnation ratio between OPC and chemical ( $x_3$ ). The activated carbon produced from optimized operating parameter set has a high AC yield of 97 %wt and an adsorption efficiency of 28.5 mg/g on removal of Malachite Green (MG) in water. All in all, the research is able to recycle WOP into useful material (activated carbon) for other applications.



# PENGHASILAN DAN PENGOPTIMUMAN KARBON AKTIF DARIPADA KULIT OREN MELALUI PIROLISIS MENGGUNAKAN KETUHAR GELOMBANG MIKRO

## ABSTRAK

Penghasilan oren yang tinggi di seluruh dunia adalah disebabkan permintaan pengguna yang tinggi terhadap buah oren dan juga produk buatan daripada oren. 40 % daripada kandungan buah oren akan dibuang sebagai sisa selepas diproses dan sisa oren telah mengurangkan kapasiti tapak pelupusan di samping menambah beratkan masalah pencemaran alam sekitar. Terdapat banyak kajian tentang potensi kulit oren sebagai bahan untuk menghasilkan karbon aktif. Oleh itu, maklumat kajian ini ialah mengoptimumkan penghasilan karbon aktif menggunakan kulit oren melalui *response surface methodology*. Proses karbonisasi kulit oren melalui pirolisis menggunakan ketuhar gelombang mikro akan dilakukan dengan kuasa sebanyak 700 W selama 20 minit. Selepas itu, pengaktifan kimia oleh natrium hidrosida dan kalium hidrosida akan dilakukan terhadap arang melalui pirolisis menggunakan ketuhar gelombang mikro di bawah keadaan yang berbeza. Pengaktifan kimia terhadap arang akan dioptimumkan dengan memanipulasikan tiga parameter: kuasa gelombang mikro (W) ( $x_1$ ), masa yang diperlukan untuk pirolisis arang (min) dan nisbah arang dengan bahan kimia untuk proses pengaktifan kimia ( $x_3$ ). Pengoptimuman parameter pengaktifan kimia dijangka akan menghasilkan karbon aktif yang mempunyai keberkesanan penjerapan setinggi 28.5 mg/g dalam air pewarna Malachite Green (MG) dan hasil karbon setinggi 97% wt. Secara konklusinya, kajian ini mampu menukarkan kulit oren menjadi bahan yang berguna untuk aplikasi yang lain.