FOREIGN MATERIAL DETECTION IN AGARWOOD BY USING THERMAL IMAGING TECHNIQUE

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STUDENT DECLERATION

" I hereby declare that the work in this thesis is my own except for the summaries and quotations which have been duty acknowledge "

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SUPERVISOR'S DECLARATION

"I hereby declare that I have read this thesis and in my opinion this report is sufficient in terms of scope and quality for the award of degree of bachelor of mechanical engineering (plant and maintenance)".

Signature :.....

Name of Supervisor :.....

Date :.....

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ABSTRACT

Agarwood is extremely valuable wood in Malaysia. This wood is increasingly becoming an attraction among businessmen and entrepreneurs in Malaysia who want to expand the value of the wood. Agarwood basically have several grades of A, B, C and D. Each grade has its own price where it is judged by the shape, hardness and colour of the wood. Dark wood is more expensive than brown colour wood. Agarwood has several advantages such as fragrance and medicines. During the production of Agarwood, it requires some method for the production of Agarwood, for example drilling and injured the tree. After 6 to 9 months, after forcing the agarwood, a farmer will ensure that the trees will produce Agarwood. The probability of Agarwood occurs when inoculant injection failed to produce Agarwood. This often occurs when not using a genuine injection. A working paper was produced to find a solution for detecting the presence of Agarwood in the tree. Thermal imaging is one of the tools that are used to detect the presence of Agarwood. Thermal imaging is a tool that detects the heat contained in the object. Thermal imaging normally used to detect cracks in buildings, plant and pipeline in the detection for misalignment and imbalance of rotation machine. In this study, thermal imaging was used to detect the production of Agarwood in the tree with the use of thermal energy sources such as hair dryer and vibration of the shaker. This method is measured based on the condition of heat source. For the hair dryer, the condition of observation is based on the position of heat direct where front and beside. For the vibration shaker is vibrothermograhpy method was observe based on wet and dry condition.

ABSTRAK

Kayu gaharu merupakan kayu yang sangat berharga di Malaysia. Kayu ini semakin menjadi tarikan dikalangan pengusaha dan usahawan di Malaysia yang ingin mengembangkan lagi nilai kayu tersebut. Kayu gaharu secara asasnya mempunyai beberapa gred yang terdiri dari A,B, C dan D. Setiap gred mempunyai harga yang tersendiri dimana penilaian melalui bentuk, teras dan warna kayu tersebut. Kayu yang berwarna gelap lebih mahal berbanding kayu yang berwarna coklat cair. Kayu gaharu ini mempunyai beberapa kelebihan seperti bau wangi dan ubat ubatan. Ketika penghasilan kayu gaharu ia memerlukan beberapa cara untuk penghasilan kayu gaharu, sebagai contoh penggerudian dan melukakan pokok tersebut. Selepas 6 ke 9 bulan selepas penghasilan kayu gaharu, Pertani akan memastikan bahawa pokok akan menghasilkan kayu gaharu. Keberangkalian penghasilan kayu gaharu terjadi apabila inkulen atau suntikan yang tidak asli gagal menghasilkan kayu gaharu. Perkara ini sering terjadi apabila penggunaan suntikan yang tidak asli. Satu kertas kerja telah dihasilkan bagi mencari jalan penyelesaian bagi mengesan kehadiran kayu gahru didalam pokok. Pengimejan haba merupakan salah satu alatan yang digunaka bagi mengesan kehadiran kayu gaharu. Pengimejan haba merupakan alatan yang megesan haba yang terdapat didalam objek. Kebiasan Pengimejan haba digunakan bagi mengesan keretakan bangunan, saluran paip di kilang dan pengesanan bagi juling dan ketidakseimbangan mesin putaran. Dalam kajian ini, Pengimejan haba telah digunakan bagi mengesan penghasialan kayu gaharu didalam pokok. Dengan penggunaan sumber tenaga haba seperti pengering rambut dan getaran daripada alatan getaran. Kaedah yang diguna kan berdasarkan alatan yang digunakan bagi memberi haba. Pengering rambut diguna kan pada kayu di kedudukan hadapan dan tepi, manakala getaran adalah vibrothermography dilihat dalam dua keadaan iaitu basah dan kering.

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LIST OF ABBREVIATIONS

VT	Vibrothermography
PT	Pulse Thermography
LT	Lock In Thermography
FFT	Fast Fourier Transform
HVAC	Heating, Ventilation and Air Conditioning
IR	Infrared Radiation
FPA	Focal Array
NDT	Non Destructive Test

CHAPTER 1

INTRODUCTION

1.1 Background

Thermography is a method that uses for certain experiment and testing for the product. Thermal imaging is popular for a plant and maintenance engineer, and also as a method to detect the defect on the plant or piping lines. It used to detect the different temperature based on the parameter is temperature. Most of this thermography parameter is temperature different because the defect can be detected by using the different colour of the imaging. Thermal imaging has become much more popular over the past 10 years because uncooled micro bolometer technology has lowered prices significantly on the infrared (IR) equipment.

Furthermore, the potential for thermography is the limitations of thermal imaging that will help to decide to use perform of thermal imaging or use the electrochemical in diagnostic the condition based maintenance. There a few abilities of thermal imaging that can be used such as scan for heat loss, air leakage, HVAC systems, and roof moisture detection. Thermal imaging technology has created a more efficient and safer method of measurement. The benefits of thermal imaging impact many aspects of your job such as can a lower the cost of detecting the location potential failure, can increase the productivity because thermal imaging to provide fast and accurate measurement and last is reduce the risk of the user distance from the hazard.

Malaysia is one of the countries that produce fragrant wood and the famous name called as “Karas”. Agarwood tree or karas can be found in the jungle of Kelantan, Perak, Pahang and Terengganu jungle even though it is a rare species (Noratikah et al, 2015). Agarwood is the valuable wood now day that has a higher price. The agarwood became more popular after the research was finding the resin of agarwood a very useful for health

and agawood also can be perfume for room space or office. Makeable of this trade was finding a good quality of agarwood that have higher quality of resin and the black spot on the wood. Some of this farmer was using a foreign material for make sure the agarwood tree became mature or aged. The farmer was finding man who expert for does the job of injecting the insulin (foreign material) in the tree. After a few months or mostly need wait for six months, the resin was curing the tree and became agarwood. The problem is when the tree was injected with insulin, there are few trees a failure to become agarwood and the resin not exists. The farmer only knew when cut down the tree, for make sure there a no waste of tree , a farmer need a some like scanner or x-ray to detect the foreign material in the tree. In this problem, Thermal imaging is the suitable equipment that can use for detecting the foreign material in the agarwood.

Thermal imaging was using a camera that uses a heat as parameter to detect the foreign material. Thermal imaging is the visible radiation pattern that can convert object of visible image. This two-dimensional temperature mapping technique has potential for characterizing products of several operations of agricultural and engineering. Thermal imaging has been successfully adopted for studying plant physiology, irrigation scheduling, and yield forecasting in agricultural field. Likewise maturity evaluation, detection of bruises in fruits and vegetables (Digvir S Jayas, 2005), detection of spoilage in agricultural produces by microbial activities, and detection of foreign materials are the potential post-harvest operations to use thermal imaging. In this experiment, thermal imaging was using for detecting the foreign material in agawood. The agarwood as a basement for experiment, the parameter for this experiment is the density of resin, the density of agarwood, the temperature and the type of wood. This experiment was carrying out in the lab in FKM cubic.

1.2 Problem Statement

Identification on the quality of agarwood is very complicated. The common problem faces by agarwood farmers those use modern inoculation technique in harvesting the resin into verify the conditions of the formed resin itself. In general, process to cut down the tree and perform a visual inspection across the cutting areas. Somewhere, cut down the trees which do not achieved a good quality of agarwood resin are waste for

farmers as it stopped. the formation of agarwood resin and lost the planted trees to gain a good resin.

Figure 1.1: Agarwood trees in the forest in Malaysia

On the other hand, thermal imaging technique is an advanced non-destructive inspection technique use in electrical system, condition based monitoring and structure health monitoring. It has potential to locate failures, defect or foreign materials based on the thermal signatures from the temperature images. This study has an objective to utilize the technology for inspection of different wood densities use to stimulate the formation of agarwood resin in the agarwood trees

1.3 Objective

The main objective of this project is to detect the foreign material in agarwood. This project is focus on the inspection of the agarwood itself. Beside, during the completion of this research, the objective need to be achieve are:

i. To determine the existed of high density core in agarwood based on the condition of the wood

ii. To study the ability of thermal imaging technique to detect the foreign material in agarwood.

1.4 Scope of Project

Method that uses in this experiment is thermal imaging for detecting surface of defect or crack object. Thermal imaging is non-destructive test (NDT) method. Thermal imaging is the one of the accurate method of detection for the gas leakage but it can use for other experiment or test. This thermal imaging also known as infrared testing, it can be divided into two categories passive and active infrared. The passive thermography, in its use as a non-destructive thermal investigation in the search of hidden defects or damages in the road or bridge pavement structure, together with information on the degradation mechanism, serves as an early diagnostic tool, which completes the methodologies utilised for the survey of the state of the paving. For the active infrared is the object test is thermally excited, the main scope of the experiment are the thermal imaging use for detecting the foreign material in agarwood. By using the thermal imaging it can detect the foreign material that was produced in agarwood. Based on the parameter, thermal imaging can detect by using thermography or infrared that needs a different temperature of the object. To get a different temperature of object, those need a different type of density of object. For the wood has a different density of resin, resin most likely oil. The result image it can be classifying the foreign base of the colour of image of thermography result. The experiment scopes are using a thermal imaging for detecting the foreign material that have in agarwood.

Figure 1.2: Foreign material in agarwood have a different colour

(Source: https://vietnamagarwood.files.wordpress.com/2014/02/inoculation-of-agarwood-tree.jpg)

CHAPTER 2

LITERATURE REVIEW

This chapter will contain the summarizing of all the literature review gathered from many academic book and journal as resources. This chapter discuss on properties of agarwood and thermography technologies available in non-destructive applications. The infrared thermal imaging is aimed to investigate the formation of agarwood resin in the stem of agarwood tree.

2.1 Agarwood Trees

The forest treasure agarwood or the name aloeswood, eaglewood and also gaharu. Agarwood is most popular tree in Malaysia with a fragrant wood and the unique smell. Agarwood can be finding in all forest in Malaysia such as Kelantan, Johor and Terengganu. In previous review Noratikah et al (2015) was classified the type or agarwood, there are five species that of agarwood that record in Malaysia where A malaccensis, A microcarpa , A hirta, A.rostrata and A beccariana. The entire name a based on science name that depend on type of tree that produce the agarwood and all the species are able to produce a resin or oil that have high quality. Different agarwood have a different quality of oil that produce by agarwood. Usually, agarwood from the low grade have a low quality and cheap compare to high grade of agarwood.

Figure 2.1: Example of foreign material in agarwood

(Source: https://gaharujinkou.wordpress.com/natural-oud-oil-agarwood)

Recent evidence suggests that by the author (Norazah et al, 2013). Agarwood tree can be found in the forest and plantation in Malaysia. Aqualaria malaccensis is one of the names of agarwood in Malaysia, this tree has been found at Sarawak (Tawan, 2004) .This species that is a source of gaharu , that has been noted as being locally frequent in the middle in west Sarawak and fairly common spread to a state. This type of agarwood trees produce seed after 7-9 year, while other species only once produce seed on their life cycle. Agarwood only existed when the tree of agarwood is injury or illness, and has been cure using the antibody to against the illness. For the agarwood tree that lives in plantation was injected with inoculation to form the agarwood.

2.2 Formation of Agarwood

The success of agarwood plantation depends on the stimulation of agarwood production in the trees (Selina et al.2013). Based on the research, agarwood was form when the tree are cut or bleed off the tree and the resin from the tree cure back by using a resin, that the agarwood form and resin that cure the tree is agarwood oil and after several month after the treatment agarwood from on the tree. Illustration of induction methods commonly used in agarwood formation. In natural maturation process, no induction or injury is required but need years to achieve considerable amount of resin synthesis.