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UNIVERSITI MALAYSIA SABAH

BORANG PENGESAHAN STATUS TESIS@

JUDUL: EFFECTS OF ~~SEDIMENTATI~~ AUDIBLE SOUND ON SEDIMENTATION OF SAGO

IJAZAH: SARJANA MUDA FIZIK DENGAN ELEKTRONIK

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EFFECTS OF AUDIBLE SOUND ON SEDIMENTATION OF SAGO

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THIS DISSERTATION IS SUBMITTED IN PARTIAL FULFILMENT OF THE BACHELOR DEGREE IN SCIENCE WITH HONOURS

SCHOOL OF SCIENCE AND TECNOLOGY
UNIVERSITY MALAYSIA SABAH
KOTA KINABALU

MARCH 2006

DECLARATION

I verify that this thesis is my own work except where material is taken from the work of others, in which case it is acknowledge.

20th March 2006

YUEN YUE HUN

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ACKNOWLEDGEMENT

My greatest thanks and appreciation sincerely dedicated to my final year project supervisor, Ms Teh Mee Teng for her undivided attention in guiding any of the undergraduate students who came to seek her guidance for their final year project. Being the role model for all, she has provided us with her knowledge and advice generously at all times. I hereby take this opportunity to express my gratitude for her continuous guidance and advice throughout the project.

I would also like to extend my heartiest gratitude to my Co-supervisor, Dr. Jedol Dayou for all his knowledge shared and advice given to me. Special appreciation also goes to the lab assistants of the School of Science and Technology namely Mr. Rahim who help gather all the necessary instruments and equipments for the success of completing my experiment.

Special thanks to my course mates especially Ooi Yit Chieuh, Mathew and Heay Wey Yih for their help, support, hard work and commitment throughout this project.

Finally, I extend my appreciation to my family members for their support and love.

ABSTRACT

The effect of audible sound is tested on the sedimentation of sago and its effect is analyzed. The sago is mixed with water in a beaker while an audible sound source is fixed at its mouth. The sedimentation is measured by fixing a light source and a light sensor just opposite of each other where the beaker is situated in the middle. The concept used is when the sago particles sediment at the base of the beaker, the light intensity detected by the light sensor will increase. Which means the higher the light intensity, the more sago particles have been sedimented. The graphs of light intensity versus time and also light transmission percentage versus time are plotted. The results from the experiment prove that the applied audible sound with an increase frequency will increase the sedimentation rate of sago as well. However, the increased sedimentation rate is peaked at 7.5 kHz audible sound and starts declining when the higher the frequency above 7.5 kHz is applied. This is because the sound pressure level increases with the frequency which increases the sedimentation rate of sago. Subsequently, the sound pressure level of the frequency range higher than 7.5 kHz will not increase the sedimentation rate but decreases it. Therefore, 0 Hz audible sound has the least effect on the sedimentation of sago with 9.53 $\%min^{-1}$ while 7.5 kHz audible sound has the most effect with 10.55 $\%min^{-1}$.

ABSTRAK

Kesan bunyi boleh dengar diperiksakan ke atas pemendakan sago dan dikaji kesannya. Sago dicampurkan dengan air dalam bikar di mana suatu sumber bunyi boleh dengar ditetapkan di atas mulut bikar. Pemendakan diukur dengan menetapkan suatu sumber cahaya and suatu pengesan cahaya secara bertentangan yang mana bikar diletakkan di tengah-tengah antara mereka. Konsep yang digunakan ialah apabila zarah-zarah sago mendak pada dasar bikar, keamatan cahaya yang dikesan oleh pengesan cahaya akan bertambah. Ini membawa maksud bahawa lebih tinggi keamatan cahaya, lebih banyak zarah-zarah sago yang telah mendak. Graf keamatan cahaya berlawan masa dan juga graf peratusan laluan cahaya berlawan masa diplotkan. Keputusan daripada eksperiment telah membuktikan bahawa penggunaan bunyi boleh dengar dengan peningkatan frekuensi akan meningkatkan kadar pemendakkan sago juga. Tetapi, peningkatan kadar pemendakkan ini memuncak pada 7.5 kHz bunyi boleh dengar dan mula menurun apabila peningkatan frekuensi melebihi 7.5 kHz digunakan. Ini adalah disebabkan oleh takat tekanan bunyi meningkat dengan frekuensi yang mana meningkatkan kadar pemendakkan sago sama sekali. Akan tetapi, takat tekanan bunyi di mana julat frekuensi yang lebih tinggi daripada 7.5 kHz tidak akan meningkatkan kadar pemendakkan tetapi menurunkannya. Oleh itu, 0 Hz bunyi boleh dengar mempunyai kesan yang paling kurang terhadap pemendakkan sago dengan 9.53 %min^{-1} manakala 7.5 kHz bunyi boleh dengar mempunyai kesan yang paling banyak iaitu 10.55 %min^{-1}.

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LIST OF SYMBOLS

q	rate which fluid flows through a unit cross-section of rock material
k	permeability
μ	fluid viscosity
τ	shear stress
v	fall velocity
ρ	density
g	gravity's acceleration
r	radius of the particle
η	coefficient of viscosity
I	intensity
P	power
A	area
B	bulk modulus
V	volume
p	pressure

CHAPTER 1

INTRODUCTION

1.1 Introduction

Sago palm is chosen as the sample for this project is because that one of the processes in extracting the sago starch requires the sago to be sedimented. The mentioned process actually starts with the pulverizing of the sago pith (which is the inner part inside the palm's trunk) along with its trunk. This process will result in a mixture of sago starch fiber and also the palm's fiber. In order to obtain the sago starch, water is added into the mixture and channeled to a settling container. In the settling container, the sago starch will sediment at the bottom of the container while the trunk's fiber will be floating above the water. This is due to the fact that wood has a lower density than water. Therefore, the objective of the project is to analyze the effect of sedimentation of sago if an audible sound source is applied to it.

1.2 Sago Palm

The sago is a by product of the sago palm where Figure 1.1 is the palm. Scientifically, it is associated with the name, *Metroxylon* sagu (Doelle, 1998). It is one of the main staple food crops in Southeast Asia and the Pacific. Naturally, the palm can be found abundantly on peat soil and swampy areas. Currently, 28,000 hectares are planted with the sago palm (LCDA, 2005) while it was estimated around two million hectares existed in the wild (Doelle, 1998). The most valuable component of the sago palm is its starch which is extracted from the pith.

Figure 1.1 Sago palm.

1.3 Research Goal

The research goal for this project is to analyze the sedimentation rate of sago when provided an audible sound source based on different frequencies which is between 20Hz and 20 kHz.

1.4 Objective

The objective of this project is to examine and analyze the sedimentation rate of sago when it is supplied with an audible sound source and without the source. Besides that, the frequency range of the audible sound source that increases the rate of sedimentation is also analyzed. Lastly, the factors that contribute to the sedimentation rate are investigated.

1.5 Scope

The scope of the research is emphasized on sedimentology and also the physics of sound. In sedimentology, the aspects of conducting an experiment on sedimentation will be given more focusing. While in physics of sound, sound wave and its characteristics will be emphasized.

CHAPTER 2

LITERATURE REVIEW

2.1 Sago Starch

The processes of extracting the sago starch are as shown in Figure 2.1:

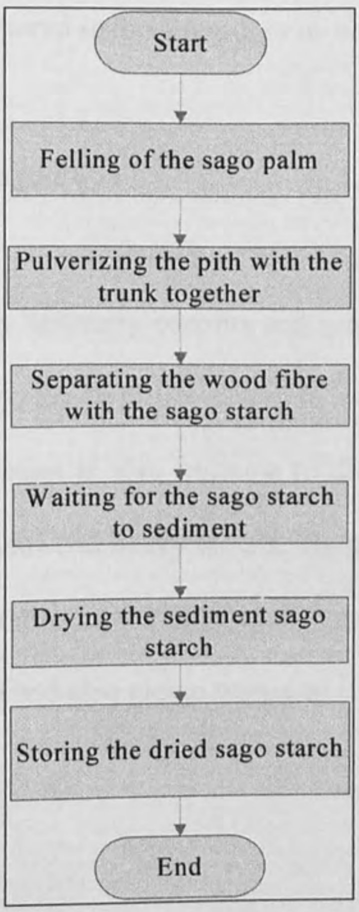

Figure 2.1 Process of extracting the sago starch.

1) A sago palm is felled and debarked, leaving only the trunk of the palm.
2) The pith is then pulverized with an adze together with the sago palm trunk. Traditionally, a wooden plank with long nails hammered onto it surface is use to pulverized the pith.
3) The pulverized pith is washed and channeled to a settling container while passing through a series of sieves. This is done to separate the sago starch from the trunks wood fibre.
4) After settling down at the bottom of the settling container, the sago starch will be taken out to be dried under the sun. Most processing factories will use the rotary vacuum drum drier, followed by hot air drying to dry the sago starch.
5) The dried sago is then stored in the storeroom or being packed for selling purpose.

2.1.1 Beneficial Qualities of Sago Palm

Like the coconut, the sago palm has many benefits and is quite a remarkable plant due to its special characteristics. Firstly, the crop grows well in swampy, acidic peat soils where most other crops cannot. The palm is also immune to drought, fire, floods and strong winds, namely faecal contaminants and heavy metals. Therefore, sago forest can acts as a carbon sink for carbon sequestration, meaning it is the crop par excellence for its worth for mitigating greenhouse effect and also global warming (Chew et *al*., 1999).

Secondly, the sago starch will continue to accumulate in the trunk of the sago palm until the flowering stage. The farmer can thus postpone the felling of the palms for up to 3 years, until the next flowering stage, without any significant loss in starch content or quality. In other words, the price elasticity of supply of sago can be quite elastic, unlike most agricultural products which usually result in poor returns during good harvests (Chew et *al*., 1999).

Thirdly, the non-pith parts of the sago palm trunk are used as building materials for local and urban houses, sheds or other buildings. Besides this, it can be used as resources for composting (biofertiliser), gasification and energy production (Doelle, 1998).

Finally, sago palm is relatively easy to plant as it only has a handful of pests or diseases. The sago beetle is one of the examples where it bores into the trunks of the sago palms and leaving its eggs inside. Consequently, the larvae of the beetle are regarded as a highly-esteemed delicacy by the local population (Chew et *al*., 1999).

However, the most recent breakthrough in sago starch research is in the manufacture of biodegradable plastics (where most kinds of plastics are not), alcohol, ethanol and citric acid (Aziz et *al*, 2004).

2.2 Sedimentation

Sedimentation is derived from the word 'sediment'. Sediment is any particulate matter that can be transported by fluid flow and which eventually is deposited as a layer of solid particles on the bed or bottom of a body of water or other liquid (www.wikipedia.com). Sediment is also defined as the solid material that settles at the bottom of a liquid (Oxford dictionary). Therefore, sedimentation is the process of deposition by settling of the sediment (www.wikipedia.com).

In a sedimentation process, the sediment is most likely the cause of the sedimentation rate as perceive by most sedimentologist. Therefore, sedimentologists have compile and recognized these five fundamental properties to clearly define the sediment used (Blatt et *al*, 1972). They are:

a) Composition, meaning the kind of grains and their abundance,
b) The sizes of the grains,
c) The shapes of the grains,
d) The orientations of the grains, and
e) The packing of the grains.

Although the above five are considered as fundamental properties, however, more than five types of measurements are usually required to define and characterized the properties of the sediment. The others include permeability, viscosity and shear stress.

Permeability is the property which measures the ease with which fluid moves through a sedimentary rock (Blatt et *al*., 1972). It measure the rate q which fluid flows through a unit cross-section of rock material is inversely proportional to the fluid viscosity μ and is directly proportional to the pressure gradient dp/dx in the direction of flow (Darcy's Law):

$$q = \frac{k}{\mu}\frac{dp}{dx} \tag{2.1}$$

The coefficient of proportionality k is called the permeability (Blatt et *al*, 1972).

Viscosity however has a strong relationship with shear stress. It is defined by Newton's law of viscosity which states that the rate of deformation of a fluid in a direction normal to a surface is proportional to the force per unit area (shear stress) applied parallel to the surface:

$$\tau = \mu\frac{du}{dy} \tag{2.2}$$

where τ is the shear stress, du/dy is the rate of deformation, and μ is the coefficient of proportionality, called the *dynamic viscosity* of the fluid (Blatt et *al*., 1972).

2.2.1 Sedimentation Technique

The mentioned property should be adequately enough to define the property of sago. In order to determine the sedimentation rate of sago, the settling technique will be used. This method's objective is to work out the settling velocity (Blatt et *al*, 1972) or fall velocity (Sengupta, 1994) where they measure the rate which the sediment settles in still

REFERENCE

Aini, N. R., 2004, *Proses Pemendapan Tanah Dengan Menggunakan Tenaga Bunyi Yang Boleh Didengar*, Universiti Malaysia Sabah, Kota Kinabalu.

Aziz, A., Daik, R., Ghani, M. A., Daud, N. I. N. and Yasmin, B. M., 2004, *Hydroxypropylation and Acetylation of Sago Starch,* http://www.ikm.org.my/Journal%20Vol6/048_054_Rusli%20Daik.doc

Berg, R. E. and Stork, D. G., 1995, *The Physics of Sound 2nd Edition*, Prentice Hall, New Jersey,

Blatt, H., Middleton, F., Murray, R., 1972, *Origin of Sedimentary Rocks*, Prentice-Hall, New Jersey.

Chew, T. A., Isa, A. H. M. and Mohayidin, M. G., 1999, *Estimating the Environmental Benefits of Sago Cultivation*, http://www.econ.upm.edu.my/~peta/sago/sago.html

Dan O'Brien, 1998, *Everything you wanted to know, but were afraid to ask*, Mallory Sonalert Inc, New York.

Doelle, H.W., 1998, *Socio-economic microbial process strategies for a sustainable development using environmentally clean technologies: Sagopalm a renewable resource*, http://www.cipav.org.co/lrrd/lrrd10/1/doel101.html

Fahy, F. J., 1995, *Sound Intensity 2nd Edition*, E & FN Spon, London.

Halliday D., Resnick R., Walker J., 2001, *Fundamentals of Physics: the Sixth Edition*, John Wiley & Sons Inc, New York.

Lord, P. (ed), Thomas, F. L. (ed), 1963, *Noise Measurement & Control*, Heywood & Company LTD, London.

Maciborski, J. D., Dolez, P. I. and Love, B. J., 2003, *Construction Of Iso-concentration Sedimentation Velocities Using Z-axis Translating Laser Light Scattering*, http://www.sciencedirect.com

Ruddle, K., Rondinelli, D. A., 1983, *Transforming Natural Resources for Human Development: a Resource Systems Framework for Development Policy*, http://www.unu.edu/unupress/unupbooks/80469e/80469E05.html

Sengupta, S., 1994, *Introduction to Sedimentology*, A. A. Balkema Publishers.

www.tenma.com

www.wikipedia.com

Wulfinghoff, D. R., 1999, *Energy Efficiency Manual*, Energy Institute Press, Maryland.

Yeap, K.S., 2005, *Light sensor: Collecting light data and sending it to a PC*, Universiti Malaysia Sabah, Kota Kinabalu.