

INVESTIGATION ON FEASIBLE
MATERIALS AND METHODS FOR INDUCING NATURAL
DEHUMIDIFICATION IN TROPICAL LIVING ROOM

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This report is submitted in accordance with requirement for the
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“I verify that this report is my own work except for the citation and quotation that the source has been clarified for each one of them”

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To my father, Jamaludin Bin Salleh, my mother, Jaiamah Binti Hamid, my brothers and my beloved one, Fatima Zahara Binti Mohd Ali, for supporting me throughout this project and for their understanding in the way I am

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ABSTRACT

Humidity is the amount of water vapour in the air which is normally taken to mean relative humidity. High humidity makes people feel hotter because it reduces the effectiveness of sweating to cool the body by reducing the evaporation of perspiration from the skin. Thus, the study on possible materials and methods is conducted and a room is designed to experiment on dehumidification in order to achieve comfort. The method used in preparing this project includes the literature study on comfort design for tropical dwelling, the analytical study on humidification and dehumidification methods, the study on how to achieve comfort using natural methods, the study on possible materials and methods to be used for natural dehumidification, the test field selection, the selection of material as desiccant, the building of prototype cell, and the experiment for inducing natural dehumidification. The dry-bulb temperature, wet-bulb temperature, and relative humidity are determined to measure comfort variation at different time of the day and at different weather conditions. From the analysis based on result tabulated, a discussion is carried out to discuss the methods used, materials performance, and limitations of experiment conducted. The different reading of relative humidity indicates the comfort variation. More effective design and method is recommended for inducing natural dehumidification in tropical living room.

ABSTRAK

Kelembapan adalah jumlah wap air di udara yang ia biasanya diertikan kelembapan relatif. Kelembapan yang tinggi membuat orang merasa lebih panas kerana ia mengurangkan keberkesanan peluh untuk mendinginkan tubuh dengan mengurangkan pengewapan peluh daripada kulit. Dengan demikian, kajian terhadap bahan dan kaedah yang mungkin telah dilakukan dan sebuah bilik telah direka untuk menguji terhadap penyahlembapan untuk mencapai keselesaan. Kaedah yang digunakan dalam menyediakan projek ini meliputi kajian ilmiah terhadap keselesaan reka bentuk kediaman tropika, kajian analitis terhadap kaedah lembapan dan penyahlembapan, kajian tentang bagaimana untuk mencapai keselesaan dengan menggunakan kaedah semulajadi, kajian terhadap bahan-bahan dan kaedah-kaedah yang mungkin digunakan untuk penyahlembapan secara semulajadi, pemilihan tempat ujikaji, pemilihan bahan sebagai bahan pengering, pembinaan prototaip sel, dan ujikaji untuk mencetuskan penyahlembapan semulajadi. Suhu kering, suhu basah, dan kelembapan relatif ditentukan untuk mengukur variasi keselesaan pada waktu yang berbeza dalam sehari dan pada keadaan cuaca yang berbeza. Daripada analisis berdasarkan hasil yang dijadualkan, perbincangan dilakukan untuk membincangkan kaedah-kaedah yang digunakan, prestasi bahan-bahan, dan batasan-batasan kajian mengenai ujikaji yang dilakukan. Bacaan kelembapan relatif yang berbeza menunjukkan variasi keselesaan. Reka bentuk dan kaedah yang lebih berkesan telah dicadangkan untuk mencetuskan panyahlembapan secara semulajadi di kediaman tropika.

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LIST OF SYMBOL

$h_{dry\ air}$	=	Enthalpy of dry air, kJ/kg Enthalpy
$\Delta h_{dry\ air}$	=	change of dry air, kJ/kg Constant pressure
c_p	=	specific heat, kJ/kg · K
T	=	Temperature, °C or K
ΔT	=	Change in temperature, °C or K
ω	=	Specific or absolute humidity, kg H ₂ O/kg dry air
P_v	=	Vapour pressure, kPa
ϕ	=	Relative humidity
T_{dp}	=	Dew point temperature, °C
T_{wb}	=	Wet-bulb temperature, °C
ε	=	Column efficiency
W_{in}	=	Work input, kJ
W_{out}	=	Work output, kJ

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CHAPTER 1

INTRODUCTION

1.1 General

Humidity is the amount of water vapour in the air. In daily language, the term "humidity" is normally taken to mean relative humidity which defined as the ratio of the partial pressure of water vapour in a parcel of air to the saturated vapour pressure of water vapour at a prescribed temperature. Humidity may also be expressed as absolute humidity and specific humidity. Relative humidity is an important metric used in forecasting weather. Humidity indicates the likelihood of precipitation, dew, or fog. High humidity makes people feel hotter outside in the summer because it reduces the effectiveness of sweating to cool the body by reducing the evaporation of perspiration from the skin. This effect is calculated in a heat index table (*Internet reference*, 21 August 2009).

Dehumidification is the process of reducing the moisture in the air which serves to increase the cooling power of air. In terms of architecture, dehumidification is the condensation of water vapour from air by cooling below the dew point. It also is the removal of water vapour from air by chemical or physical methods (*Internet reference*, 18 September 2009).

Desiccant has been used as one of the natural method to solve the problems due to the high humidity environment. A desiccant is a hygroscopic substance that induces or sustains a state of dryness (desiccation) in its local vicinity in a moderately well-sealed container. Commonly encountered pre-packaged desiccants

are solids, and work through absorption or adsorption of water, or a combination of the two. Desiccants for specialised purposes may be in forms other than solid, and may work through other principles, such as chemical bonding of water molecules. Pre-packaged desiccant is most commonly used to remove excessive humidity that would normally degrade or even destroy products sensitive to moisture. Drierite, silica gel, calcium sulfate, calcium chloride, montmorillonite clay, and molecular sieves are commonly used as desiccants (*Internet reference*, 21 August 2009).

1.2 Objectives

The objectives of this project are:

1. To study on comfort design for tropical dwelling/house.
2. To do the analytical study on humidification and dehumidification methods.
3. To study on how to achieve comfort using natural methods.
4. To study on possible materials and methods to be used for natural dehumidification.

1.3 Scopes

The scopes of study for this project are:

1. To do literature study on comfort design for tropical dwelling.
2. To build prototype cell to experiment on dehumidification.
3. To measure comfort variation at different time of the day.
4. To explore natural method and material for low humidity in the cell.