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ASSESSMENT OF RED AND WHITE CLAY EVAPORATIVE RATE IN SIMULATING PERSPIRATION WITH TEXTILE

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Abstract

Urban residents in most Malaysian cities are experiencing thermal discomfort from exposure of high environment temperature due to the emergence of urban heat island situation (UHI) and climate change. To increase comfortability of urban residents, a thermal comfort study needs to be done by assessing suitable material to be used as a thermal comfort sensor that can indicate heat exposure. This study aims to fabricate white clay and red clay pots with additional textile insulation in simulating sweating process under a controlled environment. Specifically, it was done to evaluate the evaporation rate of red and white clay as well as the effects of additional textile cover towards the evaporation rate. This research covered the aspects by adding textile insulation and checking for suitability of red and white clay pots as a thermal comfort sensor material. The study was conducted by carrying out experimental procedures to measure the evaporation rate and surface temperature of the red and white clay material in the condition of with and without textile cover by using cotton and polyester textile under a controlled environment, whereby the heat exposure towards the material is regulated. The findings showed that the saturated red and white clay pots could simulate perspiration process through the evaporation rate under controlled environment and the additional cotton and polyester textile provided greater evaporative cooling effect for the material. Therefore, the relationship between the evaporation rate of porous material and sweating mechanism will be the driving force for expansion on the innovation of human thermal comfort sensor in evaluating human thermal comfort in the future to maintain comfortable surroundings.

Keywords: Evaporation rate, Perspiration, Red clay, Textile, White clay.

1. Introduction

Urbanization causing the surrounding natural city lands started to be replaced with dense concentration of built spaces and artificial surface materials, such as pavements. Those rapid development processes contributed to the loss of green areas. Since the natural land area is being narrowed, tree crowns that can prevent penetration of sun rays and storage of energy decreased, causing radiation of accumulated energy that leads to temperature increase. As a result, humans will be exposed to direct heat and the increment of temperature will deteriorate thermal comfort amongst people and influenced the human's productivity while doing tasks. Thermal comfort depends on a person's desirable state of mind in terms of the sensation that he/she is feeling, i.e., either hot or cold [1]. As stated by Elnabawi and Hamza [2], the study of thermal comfort should be done by considering the integration of a few factors, which included physical, psychological and physiological aspects. All factors should be considered in the process of evaluating thermal environment. Enescu [3] explained that to achieve and maintain heat balance between the human body and environment, the body needs to go through a process known as thermoregulation. Naturally, a human body has its natural way to cool down the skin through sweat evaporation to adapt with heat conditions. The evaporative cooling efficiency of the skin is affected by the volume of perspired moisture that attached to the skin [4]. Consequently, the balanced sweating evaporative rate is crucial for heat dissipation process of the human body in adapting with the rising temperature nowadays. Sweating may play an important role as the physiological factors in assessing human thermal comfort.

In this respect, the usage of sweating thermal manikin in assessing outdoor thermal comfort is becoming more frequent worldwide, as it can avoid humans from going through direct exposure to sunlight in evaluating the thermal comfort. According to Lei [5], the purpose of sweating thermal manikin invention is to analyse the thermal interface between the human body and ambient environment. Comparing it to human subjects' usage, this type of testing is good in repeatability and high in accuracy. The thermal manikin is generally known as an indicator used to evaluate thermal comfort of the surrounding, as it has characteristics that is almost like human physiological systems, specifically the human skin. It was invented to enhance the conception and understanding by analysing thermal interface between the human body and ambient environment on the surroundings, mainly for the assessment of thermal comfort [6]. The usage of various types of thermal manikins is becoming more common worldwide, as it produces valuable data, emphasising direct trials with human subjects.

According to Mandal et al. [7], sweating thermal manikin is generally used to evaluate the thermo-physiological comfort of clothing, as it is capable to imitate the conditions that is comparable to the human body and simulate metabolic heat production and perspiration process. Sweating is a significant thermoregulatory process that assists in the dissipation of heat and prevents the human body from becoming overheated. Moreover, one of the typical uses of sweating thermal manikin is to evaluate the thermal and evaporative resistance of clothing [8]. Sweat evaporation can provide a cooling effect to the human body and prevents the increase in body temperature above values that lead to heat-related illnesses. Utilisation of sweating thermal manikin is helpful in studying the heat and mass transfer of the human body.