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Determination of Properties and Heat Transfer Rate through building boundary of Corn Cob Cement Material for Applying to be Construction Material

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Abstract

In order to reduce heat transferring through building boundary affecting the increase of energy efficiency, the development of property of construction material is significant. An effective way to be used is the utilization of agricultural waste, biomass such as palm, bagasse, coconut shell which has fiber structure, mixing with cement material to be formed as concrete. This research aims to develop and test the property of concrete, which have structure of mixing between corn cob and cement material. With the large amount of agricultural residue, corn cob is selected for this study. Test of physical, mechanical and thermal properties of corn cob cement material is performed. Comparison of property of cement materials consisting of different types of fibers, corn cob, palm, bagasse, coconut shell, is investigated one another. Two house models consisting of the structure of pure and corn cob cement materials with the same size of 2 x 2 m² in each are fabricated. Each house is positioned to face to the sun all day. Conduction heat transfer rate passing through boundary in each house models is determined and compared each other. Evaluation of suitability of use of corn cob cement material for applying with construction purpose is given.

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1. Introduction

Currently, demand of commercial energy tends to increase annually, especially in business and industrial sectors. This has been caused by a few factors of developing economy and country stability resulting in increased expenses of energy for various households. In order to reduce this concern, many researchers seek other alternative energies such as solar, wind, hydro, biomass and etc. which are utilized in different energy purposes. For Thailand, major areas are used for cultivation such as rice, corn, several types of fruit etc. Corn for animal has been mainly cultivated in many provinces of Northern Thailand which examples are Chiangmai, Chiangrai and Mae Hongson. Referring from Statistical Department of Agriculture [1], cultivated corn area in 2013 is found approximately 1,206,631.5 Hectare. Harvesting area of corn, 1,145,908.6 Hectare, is yielded as 5,062,828 ton per year. Corn obtained is transformed to be food for human and animal and the rest is exported. During harvesting period, there is agricultural waste of corn, namely corn cob, which this waste is free, not normally utilized and eternally burnt. The burning process releases greenhouse gases influencing environment problem. Thus, instead of burning, corn cob should be brought to be utilization. Nowadays, demand of residential building has been growing rapidly, especially in metropolis area as well as competition of residence market is higher continuously. This can be observed from the surveying results which show cost index of residence for the second quarter in 2016 is shifted highly. For areas of Bangkok, Nonthaburi and Samut Pragarn, residence cost is 5% increased [2]. However, whenever the growth of residence in forms of condominium, apartment and high office building tends increasingly, concern of energy efficiency in building is very significant. This concern involves directly with properties of used concrete material, physical, mechanical and thermal properties, respectively. Thus, improving the property of concrete for applying with construction purpose is essential to obtain higher energy efficiency. This helps reduce the requirement of electricity for any electrical appliances such as air-conditioner and others. From the previous researches [3,4,5,6,7], mixing biomass fiber, which is waste obtained from many types of agricultural product, with cement material can improve the property of mixed concrete but there has been no appearance of the practical result of corn cob. Additionally, this research focuses on improving the property of concrete with mixing between corn cob and cement material. Varying the percentage of corn cob mixed with cement material to determine the properties of mixed concrete has been performed. The results show the optimum percentage of corn cob to be selected for mixing with cement material and able to apply to be construction material in practical way. Mixed concrete consisting of optimum percentage of corn cob is used to construct a sample of house and another one is constructed by using conventional concrete. Outdoor testing to determine heat transfer rate through boundary of each samples of house is also performed and compared each other.

2. Experimental Procedure

2.1. Preparing Mold of Mixed Concrete

A mold of mixed concrete is fabricated consisting of mixture between cement material and corn cob. For ratio of mixture, it can be tabulated as below and shown in Figure 1.

Table 1 Ratio of mixture of concrete

Items	Mortar (g)	Sand (g)	Water (g)	Corn cob (g)
Formula1 (Conventional)	1,000	200	400	0
Formula2	1,000	200	400	30 (2.5%bywt)
Formula3	1,000	200	400	60 (5.0%bywt)
Formula4	1,000	200	400	120 (10%bywt)

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