

Abstract

This research investigates the thermal performance of green roof that uses natural substrate for growing Manila grass. The natural substrates are coconut husk fiber, rice hull, rice husk ash, sand and pumice with 9 types of combination ratio and density. The growing of Manila grass in the 9 types of natural substrate combinations are compared with those in the soil. The experimental results show that rice hull is unsuitable for growing Manila grass since it absorbs water too much. The selected 6 types of substrate combinations are examined for the thermal performance using the Lysimeter and temperature measurement methods. The Lysimeter experiments assess the reduction of heat in the surrounding air by evapotranspiration process, by means of growing Manila grass in a specific tank and measuring water consumption. The temperature measurements test the internal surface temperature and temperature of air in the testing boxes compared to those of the bare concrete roof. The testing boxes of 1.00 meter x 1.00 meter x 0.85 meter are constructed from the polystyrene foam of 0.15 meter of thickness and concrete roof of 0.1 meter of thickness. The study of heat reduction is classified into two case studies: (1) the weight of substrate is 200 kilograms per square meter and (2) the depth of all substrates is 0.125 meter. All of the testing boxes are placed in the outdoor field.

The experimental results of reduction of heat in the surroundings with equal mass of growing substrates show that coconut husk fiber + sand and rice husk ash + sand reduce heat more than that of soil by 1.25 times and 1.14 times, respectively. For the equal depth of growing substrates, the coconut husk fiber + sand and rice husk ash + sand shows reduction of heat more than that of soil by 1.10 and 1.04 times, respectively.

In both cases of equal mass and depth, it is found that the substrate with pumice mixing reduces more heat transfer to the room than those without the pumice in the substrate. The differences of air temperature in the room are 1.0 to 2.1 °C during peak time with two hours of thermal time lags. During the heat dissipation nighttime, the substrates with pumice show reduction of air temperature less than those without pumice in the substrate by 0.2-2.1 °C.

Comparing to the bare-concrete roof, the air temperature in the room with green roof is less than that of the bare-concrete roof by 5.0-7.2 °C during the peak time with the thermal time lags of 2-4 hours. Regarding the heat dissipation during nighttime, the bare-concrete roof reduces air temperature in the room more than that of the green roof by 1.2-2.4 °C.

Therefore, the green roof is more suitable than bare-concrete roof concerning the heat reduction in the surrounding air and indoor air. The green roof with natural substrate culture is better than those with the soil because of the weight reduction in the building structure.