In Japan, cedar has been widely used as a building material. Its most bark is thrown away. However, the use of cedar bark, which is fibrous and durable, as insulation material would be effective from the standpoint of using materials that are friendly to the environment. Therefore, the heat conductivity ratio of insulation material made from processed cedar bark has been calculated experimentally; and its possibilities for such usage have been reviewed. Experiments were conducted on the following: (1) coarsely frayed cedar bark, (2) cedar bark finely blended in a mixer, (3) styrofoam board used for comparison purposes. The laboratory at Utsunomiya University calculated the coefficient of thermal conductivity resulting from the experiment by calibrating the temperatures above and below the experimental subject plus the ambient temperature surrounding it. The results of the experiment were as follows: (1) using styrofoam board, the coefficient of thermal conductivity was 0.045W/mK. In the cases of (2) coarse cedar bark and (3) fine cedar bark, the coefficients of thermal conductivity were not all that different from each other, at 0.073W/mK and 0.076W/mK respectively. When the high temperature was set at 76°C, condensation was observed inside the experimental material involving tree bark by the water contained in the material.

Key word:Cedar Bark, Thermal Insulation Material, Waste Curtailment, Practical use of a Natural Material

1. Introduction

In Japan, cedar has been widely used as a building material. Its bark has long been recognized as something to be used for a roofing material because of its durability. Today, that kind of roofing has been replaced by industrial material, with the result that most cedar bark is thrown away. However, the use of cedar bark, which is fibrous and durable, as insulation material would be effective from the standpoint of using materials that are friendly to the environment. Therefore, the heat conductivity ratio of insulation material made from processed cedar bark has been calculated experimentally; and its possibilities for such usage have been reviewed.

2. Outline of the experiments

In Japan, JIS1412 is used in experiments concerning the calculation of thermal conductivity ratios; but figure 1 illustrates a simple calibration method involving the locations on the specimens at which their thermal flows were calibrated and a formula by which their thermal physical properties were calculated. In other words, the heat capacity and the highest and lowest temperatures of the specimens and the ambient air temperature are calibrated in order to calculate the thermal conductivity ratio. Table 1 illustrates the computation formula.
Experiments were conducted at the Utsunomiya University laboratory using three types of specimens: 1) coarsely frayed cedar bark, 2) cedar bark finely blended in a mixer, and 3) styrofoam board used for comparison purposes. Figure 2 illustrates the measurements relating to the specimens. Table 2 illustrates the dates and times of the experiments, plus the specimen weights. Figures 3–5 illustrate the use of cedar bark particles as specimens plus a situation in which cedar bark is crammed into an acrylic board.

3. Results of the experiments

Figures 8–10 illustrate the results of the experiments involving temperatures, thermal flows, and time variations in thermal conductivity ratios. Figure 7 illustrates the specimens’ surface temperatures, taken by thermal cameras during the experiments.

In contrast to the surface temperatures, the interior temperatures of the specimens remained constant at 37.2–40.70 degrees centigrade. Also, horizontal heat flow was controlled by the insulation material. Moreover, the weights of the specimens immediately before and after the experiments did not change.

As for the styrofoam board, the temperature above the “can” t1 reached 80 degrees centigrade, while the temperature above the specimen t2 was only 30 degrees centigrade. The temperatures gradually decreased to the point that t1 was 40 degrees centigrade and t2 became 17 degrees centigrade, indicating a temperature differential of about 25 degrees centigrade. During that time, the thermal flow was 140–40W/m² although the flow was somewhat different at the specimen’s top and bottom; and the thermal conductivity ratio was 0.055–0.045W/mK.

In the case of the cedar bark, the temperature above the can t1 was 76 degrees centigrade, while the temperature above the specimen t2 was 30 degrees centigrade. T1 eventually dropped to 53 degrees centigrade, while t2 dropped to 28 degrees centigrade, resulting in a temperature differential of 25 degrees centigrade. During that time, the thermal flow, which differed at the top and the bottom of the specimen, was 100–80W/m². The thermal conductivity ratio was 0.10–0.08W/mK. However, 30 minutes after the start of the experiment, condensa-
tion occurred inside the specimen. It probably occurred because of water in the cedar bark reaching a high temperature (Figure 11).

Then, in the case of the cedar bark, the experiment was conducted with the water temperature being lukewarm. The temperature above the can was 47 degrees centigrade and the temperature above the specimen was 25 degrees centigrade. t1 eventually dropped to 28 degrees centigrade, while t2 dropped to 16 degrees centigrade. During that time, no condensation occurred, and the thermal flow as 100~40W/m2, with the thermal conductivity ratio being 0.10~0.07W/mK.

Table 3 illustrates the thermal conductivity rates resulting from the experiments:

1. In the case of the styrofoam board, the mean value between 4~6 AM on February 6 was used.
2. In the case of the cedar bark coarse, the mean value between 2~4 PM on February 6 was used.
3. In the case of the cedar bark fine, the mean value between 4~6 AM on February 7 was used.

The thermal conductivity ratio for the styrofoam board was 0.0045W/mK, showing a somewhat larger value than the commonly considered value. The thermal conductivity ratios for the cedar bark were 0.073W/mK and 0.076W/mK regardless of the size of the bark.

Some points to be noted following the experiments are that it took some time to stuff the cedar bark and that internal condensation might occur as a result of sunlight heating the inside of the wall. Therefore, tree bark needs to be thoroughly dried.

4. Conclusion

Regardless of the size of the cedar bark, the thermal conductivity ratios were 0.073W/mK and 0.076W/mK. Thus, the use of cedar bark as an insulation material is quite effective from the standpoint of environmental friendliness.

References

1. JIS1412