RESERARCH INTO THERMAL DECOMPOSITION OF INDOOR SUSPENDED BIOPARTILES

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ABSTRACT
Airborne fungi in indoor air has the possibility to cause the air pollution problems of the fungally infection syndrome and the allergy syndrome, etc. in residence environments. Because the carcass of airborne fungi becomes an allergen, it is difficult to remove the allergen effectively only by mere sterilization. In this research, the pyrolysis of fungi was examined by using the heat of the high temperature from the heater used the combustion of natural gas.

INTRODUCTION
Fungi suspended in indoor air are closely related to health problems, such as fungally infectious diseases and allergic illness. The dead bodies of airborne fungi turn out to be allergens. An effective allergen removal technique rather than just sterilization is therefore called for. With this in mind, the authors carried out the trial manufacture of a hot air gas heater with the function of thermally decomposing fungi (hereinafter referred to as the "removal device"). This removal device was examined in relation to its heating sterilization and thermal decomposition characteristics.

EXPERIMETAL METHODS
Fungus Removal Evaluation Method
A hot air gas heater was placed on the floor in a laboratory which had an internal capacity of 16m^3 and a ventilation rate of 0.04 cycles per hour. The fungi used for the evaluation were *aspergillus niger* and *aspergillus oryzae.* Each was mixed with zeolite with a particle size of 3 through 5 μm, and the initial number of fungi in the laboratory was set to 1,500 through 3,000 CFU/m^3. To collect the fungi, an RCS air sampler (made of Biotest) was positioned at three locations, at a heater air inlet and outlet ports and inside the laboratory. In the laboratory, the air sampler was positioned at a height of 1.2 meters above the floor. The number of fungi collected by means of the air sampler was quantified, based on the colony formed on an exclusive medium to which fungi had stuck after cultivating the medium at 27 °C for a period of 3 days.

Volatile Organic Compound Removal Evaluation Method[1)]
Inside the laboratory used to evaluate the removal of fungi, a formalin solution was evaporated to adjust the formaldehyde concentration to 0.5ppm. A DNPH-silica cartridge (made by Waters) was used at an air flow rate of 1 liter per minute to collect 10 liters of formaldehyde. To quantify the formaldehyde collected in the DNPH, it was liquated with acetonitrile and analyzed by means of a high-performance liquid chromatograph (Model LC-6AD made by Shimazu Seisakusho).

RESULTS
Removal Device Configuration
Fig. 1 shows the configuration of the removal device. The removal device was subjected to five hours of heat treatment at 550 °C after being formed into the fins of the stainless steel material with a high transition metal content, including molybdenum and chrome. The removal device was positioned within the path at a

location where the temperature was between 500 and 600°C. Fungi and chemical substances passed along this path in 30 to 50ms.

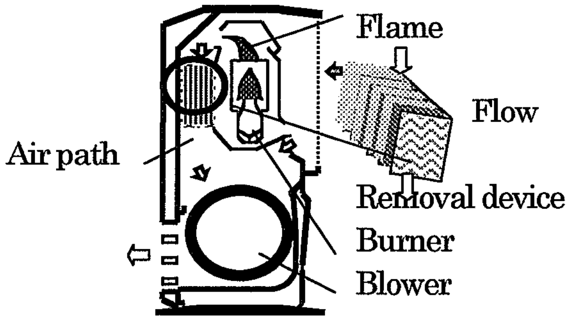

Figure 1. External view of trial-manufactured system equipped with removal device

Evaluation with Removal Device

1)Fungus Removal Evaluation

With the heating output of the removal device set to 3.78kW and the air flow at 2.5 cubic meters per minute, airborne fungi were reduced to a measurable level or less in 10 minutes (Fig. 2). In the blank mode (heating output = 0kW; air flow = 2.5 cubic meters per minute), airborne fungi remained at 80% of their initial number. 30ms is theoretically obtainable as the time for fungi to pass through this metal fin. According to the fungus disappearance temperature vs. time formula prepared by Yamayoshi et al., a thermal decomposition time of 28ms is required, calculated from the fins' mean temperature. [2] Those fungi which had passed through the fins could be deemed thermally decomposed.

2) VOCs Removal Evaluation

VOCs removal was evaluated in a laboratory under the same conditions as those for fungus removal, and the formaldehyde concentration decreased to 0.15ppm in 20 minutes as shown in Fig. 3. Bearing in mind that the natural attenuation would turn blank, it can be gathered that approximately 70% of the volatile organic compounds were thermally decomposed. Since the removal device had a surface temperature of at least 500 °C, formaldehyde must have been decomposed into carbon dioxide and water.

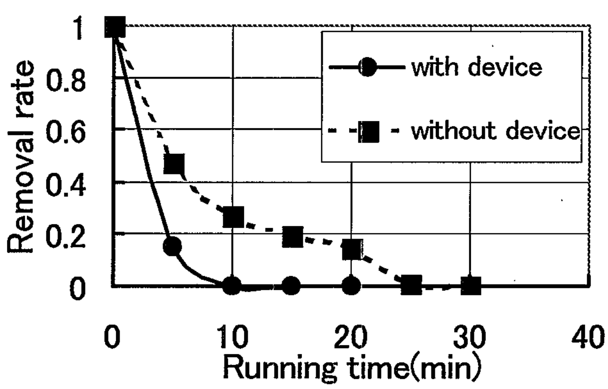

Figure 2. Removal device's effectiveness in removing fungi

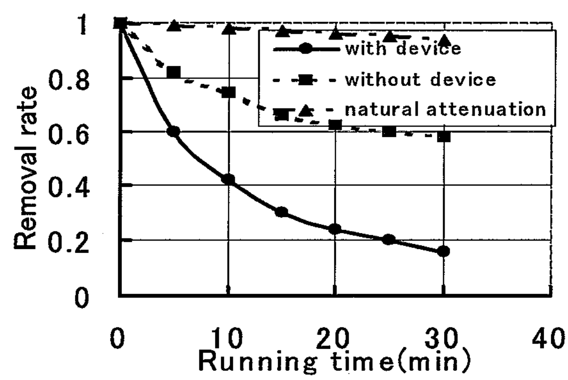

Figure 3. Removal device's effectiveness in removing formaldehyde

DISCUSSION

We studied the technology allowing us to suppress bioparticles and chemical substances, by making use of the pyrogenic heat generated by a removal device instead of applying any chemicals. This study has shown that bioparticles can be thermally decomposed by placing a removal device with a number of metal fins made from some transition metals in the air path. The removal device was also proven to be capable of thermally decomposing VOCs

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