(GS08) Airborne pollen

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GS08-P01 (510)
Highly-efficient downflow air-purifier for indoor airborne pollen removal

Toshiki Takahashi, Akinori Hashimoto

Department of Electronic Engineering, Gunma University, Japan, t-tak@el.gunma-u.ac.jp

Pollen of Japanese cedar (*Cryptomeria japonica*) is allergenic and it is transported into a house room by wind and airflow through open windows and doors, and on person's clothes. Therefore, highly-efficient air purification is needed to remove indoor pollen and to avoid hay fever. Under this circumstance, an air-purifier is a convenient countermeasure against indoor airborne pollens. We study possibility of less common type air-purifier, which generates downflow through its inlet. Downflow is commonly introduced in clean rooms of for example semiconductor manufacturing; it enhances removal of impurity particles. In order to study numerically properties of the pollen motion in downflow generated by an air-purifier, we use the computation software named CAMPAS (CFD and Aerosol Motion Property Analysis Suite). In the present study, an air-purifier is set near the wall of a square room with 5 m of side and 2.5 m of height. The air-purifier has the inlet on the upper surface and the outlet on the front surface facing the opposite side wall. The air can be exhausted from the outlet with an elevation angle in order to study its effect on removal performance. Using the CAMPAS software, we calculate the indoor turbulent flow by a large-eddy simulation model and the pollen motion. It is found that removal performance depends on the elevation angle. Comparing with a commercially available air-purifier, removal performance of our proposed air-purifier exceeds performance of commercial air-purifier when the outlet directs the upper of the opposite wall. This is because trajectory of outlet airflow can connect to the region where the inlet downflow affects.

Keywords: *Cryptomeria japonica*, large-eddy simulation, particle tracking, indoor air, purification efficiency.

GS08-P02 (176)
Removal efficiency of airborne allergic pollens by air-purifier

Akinori Hashimoto, Toshiki Takahashi

Department of Electronic Engineering, Gunma University, Japan, t10802401@gunma-u.ac.jp

In spring, Japanese cedars (*Cryptomeria japonica*) produce pollens, and one out of five or more people are believed to be suffering from hay fever. It is important for pollen allergy sufferers to remove indoor airborne pollens rapidly and effectively. Indoor airborne pollens fall eventually on the floor, and fallen pollens would be crushed and scattered again in the indoor air; it lengthens the hay fever season. An air-purifier is a convenient countermeasure against airborne pollens. In order to study properties of the pollen motion in an indoor air generated by an air-purifier, we have developed the computation software named CAMPAS (CFD and Aerosol Motion Property Analysis Suite). Using the CAMPAS software, we can analyze the pollen motion in a turbulent flow and can find efficiency of an air-purifier for pollen removal. However, particle tracking has been made in a previously calculated flow by the CAMPAS, and resultantly pollens have been traced in a steady airflow so far. In the present study, we modify the algorism and flow of calculation in the CAMPAS, and a coupled simulation of the indoor airflow and pollen motion is carried out. The indoor turbulent flow in a typical Japanese room is calculated by a large-eddy simulation model. The proposed coupled simulation model enables to consider effects of the temporal change of flow structure and to reproduce a movable louver controlling the exhaust angle. We will present the difference of air purification efficiency for between steady and unsteady flow cases.

Keywords: *Cryptomeria japonica*, large-eddy simulation, particle tracking, indoor air, purification efficiency.

GS08-P03 (177)
Development of the indoor pollen motion computation software

Akinori Hashimoto[1], Toshiki Takahashi[1], Kensaku Matsumoto[2], Ken-ichi Uzaki[2]

[1] *Department of Electronic Engineering, Gunma University, Japan, t10802401@gunma-u.ac.jp*
[2] *Department of Civil and Environmental Engineering, Gunma University, Japan*

Airborne allergenic pollens of cedar (*Cryptomeria japonica*) in spring become a social problem in Japan from the early 80's. Since it is difficult to protect invasion of pollens into a residential space, rapid removal of pollens is essential to prevent pollen exposure or to relieve symptoms of allergies. As a countermeasure against indoor pollens, an air-purifier is convenient and popular device that is easily introduced into a living room. In order to study properties of pollen motion in a turbulent air flow generated by an air-purifier, we have developed the computation software (CAMPAS: CFD and Aerosol Motion Property Analysis Suite). The CAMPAS consists of four tools. Firstly, it is able to simulate a turbulent flow by a large-eddy simulation (LES) model. Validity of the flow simulation has been checked by comparing with the other CFD software, Code_saturne. It appears that overall flow structure is similar between the results from the Code_saturne and CAMPAS. The second tool of the CAMPAS is pollen particle-tracking in indoor airflow. It is useful to investigate the effectiveness of the air-purifier for pollen removal. Thirdly, visualization tools are also implemented, by which vector plot and pollen motion are shown graphically. Animation of pollen motion is also available. Finally, the CAMPAS software is able to find the effective region for pollen removal and the fallen pollen distribution on the floor. Using the CAMPAS software, we will propose an efficient flow generation to remove indoor pollens. As a result, we will be able to develop a high-efficient

airborne pollen cleaner. If, in the program, the pollen particles are set to distribute uniformly within the room, then half of these eventually will fall on the floor. However, it is observed that the fallen pollen is mostly distributed behind and to the side of the air-purifier where the inlet flow of the air-purifier has no effect.

Keywords: *Cryptomeria japonica*, CFD, indoor air-flow, large-eddy simulation, air-purifier.