8th.World Congress on Computational Mechanics (WCCM8)
5th.Europian Congress on Computational Methods in Applied Science and Engineering(ECCOMAS2008)
June30-July5,2008
Venice,Italy

Study of cascade impacter pollen sampling device

Hideki AOI[1], Kunio FUNAMI[2], Hiroyuki MIYAMOTO[2], Yue ZHAO[3], Yorito ISHIKAWA[)]

1) Hiroshima Kokusai Gakuin University 6-20-1 Nakano Aki-ku Hiroshima Japan,
e-mail: aoi@hkg.ac.jp,
2) Chiba Institute of Technology, 3) Hiroshima Kokusai Gakuin University,
4) Ibaraki Hitachi Joho Service Ltd.

Key Words: *cascade impacter, pollen, pollinosis, Navier-Stokes equation*

ABSTRACT

This study provides a description of a new design for a cascade impacter sampling device for pollen.

Every spring, people who suffer from pollinosis are plagued by symptoms that include runny nose and sneezing. This allergic condition is caused by airborne pollen. The number of people who suffer from allergies is increasing every year. The types of pollen that produce allergic reactions differ between individuals. Therefore, knowledge of the type and number of pollen grains in the air is important for pollen forecasts.

We have developed a new type of cascade impacter pollen collection device in order to catch airborne pollens. The designed sampling device consists of four stages. The diameter of the nozzle in each stage decreases in the downstream direction. An air pump is applied at the lowest position. Any pollen present in the air is forcibly collected and collides with a plate covered with an adhesive film. The pollen adheres to the plate, which is situated downstream from the nozzle.

Due to the difference in velocity between the individual plates, heavy pollen grains are collected at the plates positioned upstream and the lighter pollen grains are collected at plates downstream. By counting the number of airborne pollen grains adhered at each plate position, we can estimate the size and number of airborne pollen grains.

We performed airflow analysis using Navier-Stokes equations and the two-equation model of turbulence flow (k- ε model). Based on this analysis, we designed the newly developed cascade impacter. The analysis of behavior of pollens and air was performed

using the Euler-Lagragian method. The specific weight of pollens is necessary for the analysis. However, no reference data was available which describe the specific weight of pollens. Therefore, we used experimental data of alder pollen captured in a previous study. Having the specific weight as a parameter, we executed the analysis so as to obtain good agreement with the experimental results and determined the specific weight. Using this value, we analyzed the behavior of various sizes (20～80 μ m) of pollens with respect to the effects of airflow. We calculated at which stage pollens were captured as function of air velocity. Based on the results, we propose a new four-stage design and an appropriate air flow rate.

REFERENCES

[1] H.AOI et al., Study of a novel pollen capture method based on fluid dynamics, ECCOMAS 2000, Barcelona, September 11-14, 2000

[2] H. AOI et al., Development of cascade impacter pollen sampling device, ECCM 2001, Cracow, Poland, June 26-29, 2001

[3] H. AOI et al., Improvement of Cascade Impacter Pollen Sampling Device, WCCM5, Vienna, Austria, July7-12, 2002

[4] H. AOI et al., Development of pollen sampling device using cascade impacter, ICCES2005, Chennai, India, Dec 1-6, 2005