LESAGE – Matisse

CABIN AIR QUALITY IMPROVEMENT BY SMART AIR FILTRATION WITH ENERGY SAVINGS IN VEHICLES

Résumé

Requirements on air quality are constantly increasing. The objective is to protect the passengers from ultrafine particles and harmful gases, particularly in very small volumes such as car cabins. In order to satisfy more ambitious requirements on air quality, the single filter approach is extended to a smart multistage filtration system with advanced technologies such as HEPA.

In addition, heating and cooling of cabin air drains energy, especially for electric vehicles. This energy comes from the battery, and, thus, cannot be used for car propulsion. With an efficient filtration system, the ventilation system can be regulated to minimize the energy consumption for heating or cooling. This can be mainly accomplished by reducing the flow of fresh air passing through blower by operating the recirculation mode.

However, the amount and duration of recirculated air is limited as the accumulation of humidity and CO_2 can quickly generate discomfort. Besides, the ventilation system must also deal with the air entering the cabin by other means than the blower operation. This "infiltration", triggered by the vehicle speed, allows pollution to enter the cabin without any filtration stage nor thermal treatment.

The thesis investigation work is built around a system approach methodology. A complete 1D-simulation model is calibrated with experimental results from a dedicated test rig and an electric vehicle. The results showed a significant improvement of the cabin air quality and a reduced energy consumption for cabin thermal management.

Mots-clés : Ventilation, Thermal Comfort, Pollution, Ultrafine particles, Infiltration