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NUMERICAL STUDY TO REDUCE ENERGY CONSUMPTION FOR DEFOGGING VEHICLE WINDSHIELDS

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Abstract

Based on Computational Fluid Dynamics (CFD) real-scale simulations of a vehicle cabin, different demisting windshield strategies are investigated in terms of energy consumption. The numerical model includes an original approach concerning condensation phenomenon on the windscreen. The simulations are carried out under winter conditions, considering different supply air velocities and air temperatures through the demisting grids. On the one hand, the results show that the level of supply air velocity considerably influences the vehicle windshield defogging. On the other hand, it was found that the air introduced with higher temperatures does not notably improve the demisting process. In addition, the numerical data reveal that there are no major differences concerning demisting efficiency for air supply velocities higher than 6 m/s. This indicates that it is possible to achieve optimal defogging in terms of energy efficiency by appropriately adapting the supply air flow rate. This can lead to important improvement of electric vehicles (EVs) range. For instance, an air supply velocity of 6 m/s instead of 12.5 m/s (for 40 minutes of defogging), leads to an energy saving of nearly 7 kWh meaning 10% of battery capacity for typical EVs or 35 km of extended range (considering an average EV range of 350 km). Finally, the numerical model developed in this study can be used for other conditions or demisting solutions (e.g. heated windshield) to get more complete data regarding the improvement of energy efficiency for EVs defogging strategies.

Key words: CFD modeling, electric vehicles (EVs), windshield condensation

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