PPF004: Poster presentation

Development and Evaluation of Cool and Clean Air Motorcycle Helmets

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Abstract

According to a recent Taiwan EPA report, $PM_{2.5}$ concentration emitted for motorcycle tailpipes could exceed 730 μg/m^3, depending on the brand and the model. When idling at traffic lights, motorcyclists could be exposed to $PM_{2.5}$ of up to 460 μg/m^3, which is much higher than the World Health Organization standard of 10 μg/m^3.

Motorcyclists expose to significantly higher $PM_{2.5}$ than others. The aims of this study was to design a FFH (Full Face Helmet) that provides clean air and cool temperature inside the helmet to decrease particle exposure and increase comfort for motorcyclists.

A commercial FFH was modified to receive cool and clean air in a way similar to the powered-air-purified-respirator commonly used in industrial settings. A small wind tunnel was used to simulate the turbulence motorcyclists might encounter while driving on the road. The parameters included the supply air flow rate to the helmet (Q_s), the velocity in the wind tunnel (V_e) and breathing flow rate which is a combination of tidal volume (V_t) and breathing frequency. A condensation particle counter was used to measure particle number concentrations both inside (C_{in}) and outside (C_{out}) the FFH, where the parameters were used to calculate the protection factor ($PF = C_{out}/ C_{in}$).

Results showed that the *PF* of the FFH increased with increasing Q_s, but decreased with increasing wind speed and breathing flow rate. At breathing flow rate of 7.5 L/min, *PF* increased from 1 to 1000 as Q_s increasing from 0 to 50 L/min, under calm air condition. Meanwhile, the *PF* decreased from 1000 to 3 when wind speed increased from calm air to 5 m/s. Consequently, applying a higher Q_s and/or using an adjustable visor that seals tightly around the neck would achieve a higher level of protection. In conclusion, this study demonstrated the feasibility of incorporating clean and cool air systems into the helmet.