

Energy Consumption of Automotive Cabin Air Purification Systems

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Heating and cooling system in an automobile is to provide thermal comfort and a good indoor air quality (IAQ) to the occupants of the vehicle. The current HVAC (heating ventilating and air conditioning) systems for automobiles have both cooling and heating coils along with various filters (particulate, carbon, HEPA, etc.) to control cabin air temperature and to eliminate particulate matter from the air and to absorb odors, cigarette smoke or volatile organic compounds (VOCs) from the cabin air. The power consumption is an important factor in the design and development of a good HVAC system. This is extremely important in the design is for an electric vehicle. In this paper, the following two systems have been investigated for power consumption.

1. HVAC unit with a HEPA filter; Filter size: WXHXD (mm): 250X180X65; same HVAC unit as Figure 1.
2. HVAC unit (Figure 1) with UV-C/A LEDs based on photocatalytic process with Particulate (D 35mm) & TiO₂ (D 4mm) filters; with same W & H as HEPA filter.

The following are the major conclusions:

1. The power consumption of a HVAC unit with a HEPA filter is on average higher by 57% (21~71% over the airflow range) over UV based photocatalytic system
2. Note that an HVAC unit with a HEPA filter is unable to eliminate viruses and pathogens. On the other hand, a UV-LED based photocatalytic system is able to eliminate all viruses and pathogens instantaneously.
3. One other major conclusion is that the performance characteristics of a HEPA filter is different from a standard particulate filter. This is due to a three-layer design of a HEPA filter. The pressure drop characteristics of the tested HEPA filter was almost a straight line with a regression coefficient close to 0.98.
4. The system developed by the author (UV based photocatalytic system) use less power in comparison to a system with HEPA filter.
5. The UV based photocatalytic air purification system is currently the best option available for purification of the cabin air, especially viruses and pathogens including COVID-19.

Figure 1. Developed HVAC unit with UV & Titanium Dioxide Filter

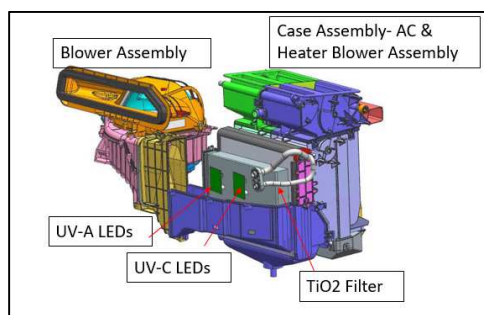


Figure 2. Test Results- Power Consumptions

