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Study on Ventilation Volume of EV in the case of Transport for COVID-19 Patient

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The number of covid-19 patient is increased in Japan. The transport of covid-19 patient will be asked by EV vehicle at future.

It is examined the EV problem in the case of transport for covid-19 patient. Firstly, it is focused on the ventilation volume that is originated by the electric power at transport. Secondly, it is focused on the temperature control operation that is done by ventilation volume at start of driving in a cabin. As a result, it is confirmed that ventilation volume is decided by the number of people in a cabin. The examining method of temperature control operation will be discussed at future.

Here, k, Q are ventilation volume per unit time (ventilation volume), carbon dioxide emission volume respectively. C(t), C_B, C_H are carbon dioxide concentration in a cabin, fresh air, carbon dioxide discharge part respectively, in the case of time t. V_2 is the volume in a cabin. And ventilation volume (k), it is asked that $k = B \times V_2/60$. Here, B is ventilation rate. V_2 is cabin volume. Environmental conditions of a cabin are shown in Fig.1.

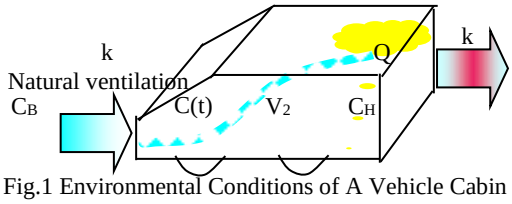

Fig.1 Environmental Conditions of A Vehicle Cabin

Fistly, carbon dioxide concentration is obtained by the equation (1) in a cabin.

$$C(t) = Q \times (1 - e^{-\frac{k \times t}{V_2}}) / k \qquad (1)$$

Carbon dioxide concentration 1000 ppm and ventilation volume 30 m^3/hr/person are recommended by SHASE (The Society of Heating, Air-Conditioning and Sanitary Engineers of Japan) in the room.

Secondly, it is examined the ventilation volume 30 m^3/hr/person (500 Liter/min/person) in a car.

Here, it is examined that cabin volume are 2,000, 3,000, 3,900 Liter. Ventilation volume are 500, 1,000, 1,500, 2,000 Liter/min.

It is shown the carbon dioxide concentration value at cabin volume 3,000 Liter in Fig.2 and 3. Calculated condition are followings. Passenger number is from one to four. Firstly driving condition is 40 min and after that the door opening condition is 20 min, it is repeated in Fig.3. First 40min is 500 L/min, second one is 1,000, third one is 1,500, fourth one is 2,000 L/min at Fig.3. Carbon dioxide concentration is reached to 1,000 ppm at 500 L/min/person in Fig.2. It is understood that carbon dioxide concentration is reached at 1,000 ppm/person in Fig.3.

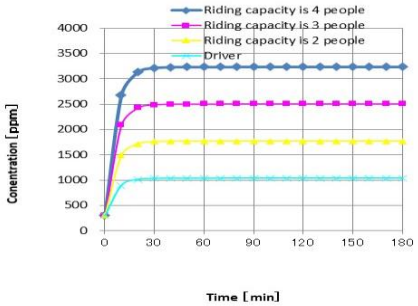

Fig.2 Example of carbon dioxide concentration

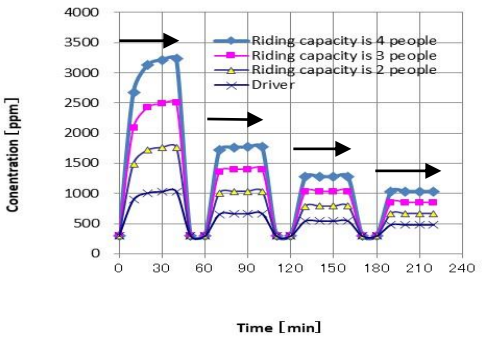

Fig.3 Example of carbon dioxide concentration

Thirdly, it is examined that temperature control operation is done by ventilation volume at start of driving in a cabin. Here, ventilation volume condition is 200 L/min. It is based on the data that 4 air changes per hour at 3,000 Liter in cabin volume.

It is shown the carbon dioxide concentration value on three person at cabin volume 3,000 Liter in Fig.4.

Temperature control operation time is needed at two min. In order to reduce the carbon dioxide concentration in EV cabin, temperature control operation will be done at first, next passenger will get in EV cabin.

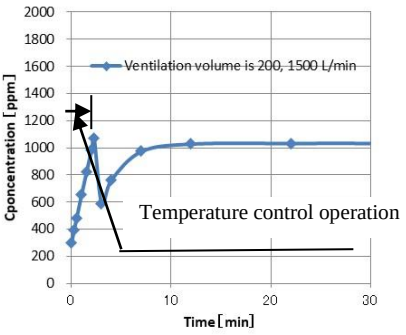

Fig.4 Temperature control operation example