[Test Report]

Verification of the Effects of Removing Airborne Influenza Virus with a Home Air Purifier

Virus Research Center, Clinical Research Department
Sendai Medical Center, National Hospital Organization

仙医ウ No. 26-002
Sep 25, 2014

1. Purpose of the test

   An air purifier was used to examine and evaluate the effects of removing airborne influenza viruses.

2. Client requesting the test

   Name: Mitsubishi Electric Corporation Living Environment Systems Laboratory

   Location: 5-1-1 Ofuna, Kamakura City, Kanagawa Prefecture

3. Sample virus used in this test

   Influenza A virus A/Aichi/2/68(H3N2)

4. Test equipment

   Household air purifier MA-E100J – Air volume (flow rate) during testing: 10.0 m^3/min

5. Test method

   1) Cultivation and preparation of sample virus

      The influenza virus was cultured in an allantoic cavity of an embryonated chicken egg, and the allantoic fluid obtained therefrom was used as the sample virus solution.

   2) Test chamber

      The test chamber consists of an outer chamber and an inner chamber, with the volume of the inner chamber measuring 25 m^3. A compressor-type nebulizer for virus spraying (OMRON NE-C28) and a fan for agitation (YAMAZEN YAR-VJ19) have been installed in the interior. The temperature and humidity of the interior can be adjusted. In this test, the temperature was set at 23 °C and the humidity at 30%.

   3) Test procedure

      The test was performed in accordance with the procedure shown on Table 1. A test device was set up on the floor from the wall in the chamber, and 3.5 ± 0.3 mL of influenza virus allantoic fluid adjusted to 10^7 PFU/mL (PFU: Plaque forming unit) was sprayed and suspended using the aforementioned compressor-type nebulizer for 5 minutes. After collecting the airborne influenza virus from the first spray (00:00) with a gelatin filter, the operation of the test equipment was started. After that, the airborne influenza virus in the chamber was collected over time, and the viral infectivity of the influenza virus was measured. The collection of the airborne influenza virus with the gelatin filter was performed by aspirating the air in the chamber at 40 L per minute for 2 minutes (= 80 L) per collection.

Table 1. Test procedure

Test operation	Devices used	Test equipment operating time (minutes)				
		0	*	*	90	
Homogenization of the air in the test chamber	Stirring fan	→				
Spraying (atomization) of test viruses	Nebulizer	5 minutes →				
Test product operation	Test equipment		→	→	→	→
Airborne virus collection	Gelatin filter	2 minutes →		2 minutes →	2 minutes →	2 minutes →

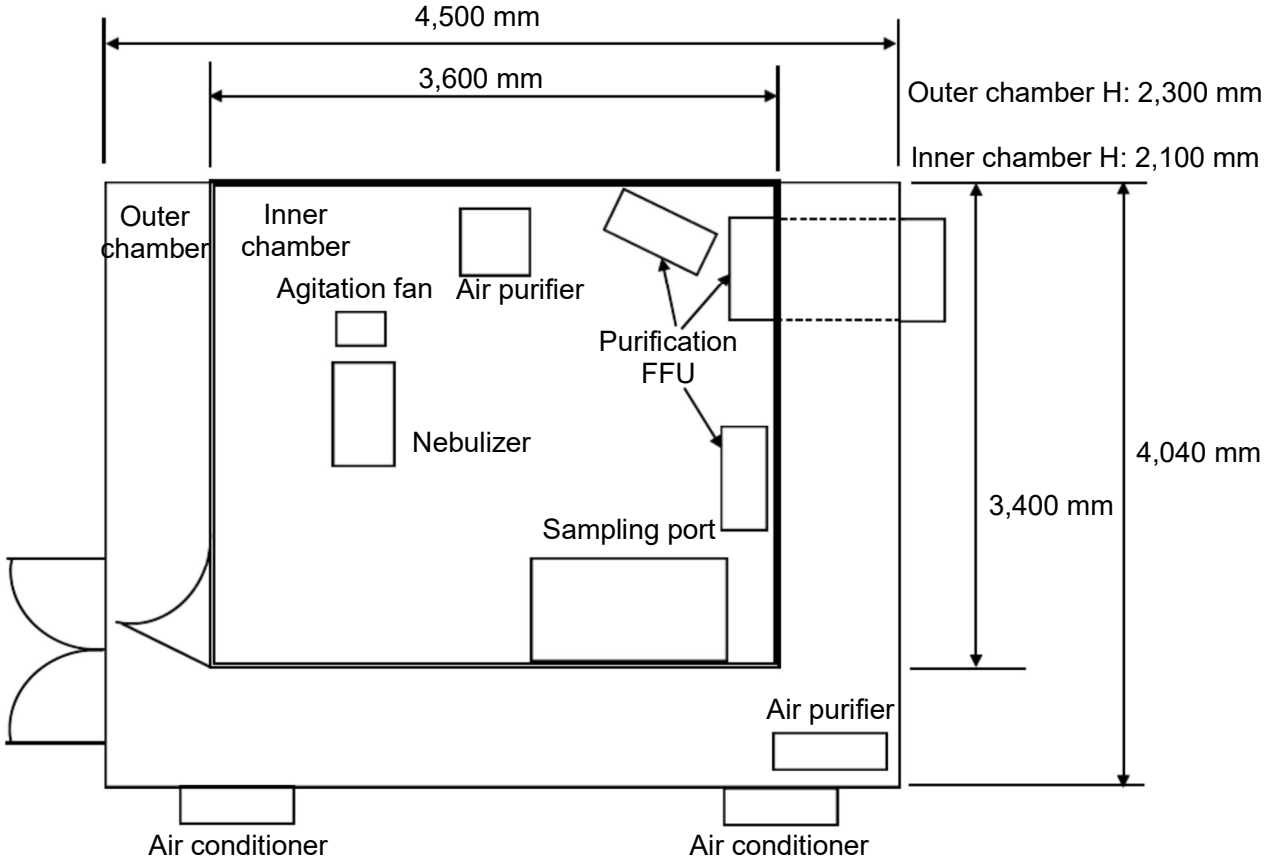

Fig. 1 Test chamber and condition of installation of various devices

Fig. 2 Condition of installation of home air purifier MA-E100J

4) Virus quantitation

A solution prepared by dissolving a gelatin filter in MEM (Minimum Essential Medium) was used as a sample stock solution, and a 10-fold serial dilution was prepared in MEM. The sample stock solution or the diluted solution is inoculated into MDCK (Madin-Darby canine kidney) cells. After culturing in a carbon dioxide incubator at 34 °C for 1 hour, MEM containing agar was added. It was then cultured at 37 °C for 24 hours; the agar was removed; fixed staining was performed with methanol-crystal violet solution; and viral infectivity was calculated by counting the number of plaques.

6. Test results

The test results are shown in Fig. 3. The graph shown in Fig. 3 is the result of tests performed two time around for both natural decay and when using the air purifier. The first round is filled in and the second round is outlined.

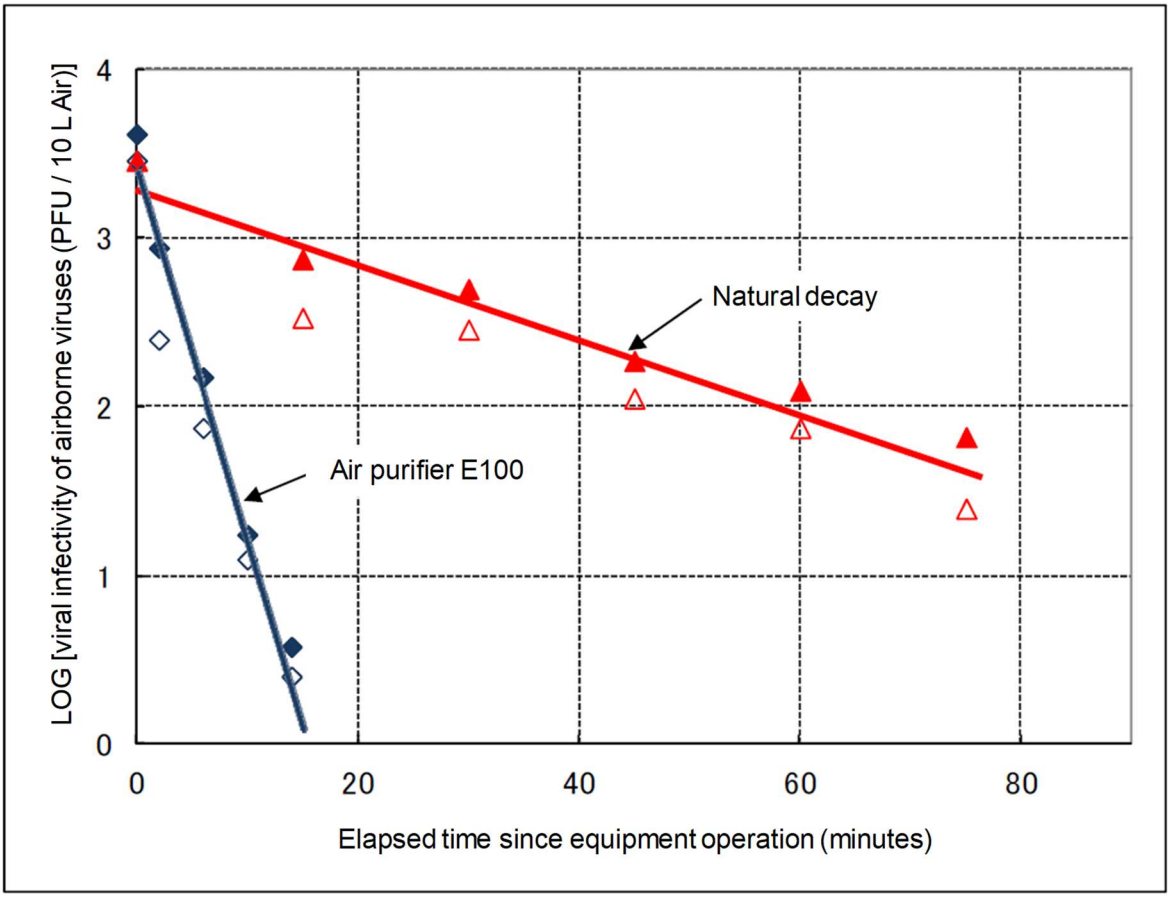

Fig. 3 Results of assessment test for removal of airborne viruses

In Fig. 3, the vertical axis is the logarithmic value of the viral infectivity of the sampled airborne influenza viruses per 10 L of sampling air.

An approximate expression obtained from the graph of Fig. 3 is shown.

Natural decay: $y = -0.0225x + 3.2596$ $R^2 = 0.951$

Air purifier: $y = -0.208x + 3.3089$ $R^2 = 0.9802$

With the air purifier turned on, a significant reduction in airborne influenza viruses was confirmed in comparison to natural decay. The test was performed twice, but almost the same results were obtained for both natural decay and when the air purifier was used.

When the logarithmic value of the viral infectivity of the airborne viruses per 10 L decreased from 3.0 or higher at 00:00, the time required to obtain a reduction of 2.0 or higher in the logarithmic value was 10.8 minutes as the difference between natural decay and when the air purifier was used.

Also, when the one-pass removal rate of the air purifier was calculated from the measurement results this time, it turned out to be about 100%. Therefore, since this air purifier is equipped with a HEPA filter, this result can be judged to be a valid result.