

Test Report

– Evaluation Test of the Influenza Virus A Removal Capability of the Space Cleaning System with Virus Washer –

**Kitasato Institute
Kitasato Institute Medical Center Hospital
Research Center for Medical Environment**

Title: Evaluation test of the virus removal capability for the Space Cleaning System with virus washer, using influenza virus A as the test index

Purpose: Evaluate the virus removal capability of the Space Cleaning System with electrolyzed water treatment mechanism, developed by Sanyo Electric Co., Ltd. The test was performed in an enclosed space using a test tent, and evaluated the removal of influenza virus A.

Test contractor

Name: Sanyo Electric Co., Ltd.
Commercial Solutions Group / Commercial Solutions Company
Commercial Airconditioners Control BU / Packaged Airconditioners Development BU

Location: 1-1-1 Sakata, Oizumi-machi, Oura-gun, Gunma-ken

Test agency

Name: Kitasato Institute
Kitasato Institute Medical Center Hospital – Research Center for Medical Environment

Location: 5-9-1 Shirogane, Minato-ku, Tokyo

Test facility

Name: Kitasato Institute – Kitasato Institute Medical Center Hospital, Infection Testing Laboratory (formerly the Canine Laboratory), Biomedical Building 1F

Test director: Noritada Kobayashi

Test staff: Noritada Kobayashi
Takayuki Uematsu
Masataka Otsuka

Director of testing: Tatsuo Suzuki

Test period: December 15, 2005 – March 6, 2006 (including virus cultivation time)

Date that test report was created: March 6, 2006

Date that final test report was created: March 8, 2006

Date that final test report was approved: March 10, 2006

Methodology:

1. Materials

1.1 Test machine

Name: Space Cleaning System
Code No.: VW-VF8A
Remarks: Air purification machine with virus washer
(α electrolyzed water air purification system)

1.2 Virus strain used

Name: Influenza virus A
Strain: PR8

1.3 Cells strain used

Name: MDCK cells
Strain: RCB0995
Remarks: Canine (female Cocker Spaniel) kidney epithelial cells

Results:

Following are the results from the virus removal tests of the Space Cleaning System with virus washer, using influenza virus A as the index.

a. When tap water was used

The infectious strengths of the recovered influenza virus A (IFVA) in the test tent when the Space Cleaning System was operated using tap water were the following.

0 minutes after virus spray ended: $10^{4.43 - 4.55}$ TCID₅₀/mL
10 minutes after virus spray ended: $10^{3.91 - 4.11}$ TCID₅₀/mL
20 minutes after virus spray ended: $10^{3.39 - 3.43}$ TCID₅₀/mL
30 minutes after virus spray ended: $10^{2.58 - 2.65}$ TCID₅₀/mL
40 minutes after virus spray ended: $10^{<2.17 - <2.41}$ TCID₅₀/mL
50 minutes after virus spray ended: $10^{<1.27 - <1.42}$ TCID₅₀/mL

b. When ultrapure water was used (test control)

The infectious strengths of the recovered IFVA in the test tent when the Space Cleaning System was operated using ultrapure water instead of tap water were the following.

0 minutes after virus spray ended: $10^{4.58 - 4.62}$ TCID₅₀/mL
10 minutes after virus spray ended: $10^{4.30 - 4.40}$ TCID₅₀/mL
20 minutes after virus spray ended: $10^{4.20 - 4.28}$ TCID₅₀/mL
30 minutes after virus spray ended: $10^{3.95 - 4.00}$ TCID₅₀/mL
40 minutes after virus spray ended: $10^{3.51 - 3.61}$ TCID₅₀/mL
50 minutes after virus spray ended: $10^{<3.11 - <3.16}$ TCID₅₀/mL

c. Decrease in virus infectious strength

Using as the base the average infectious strength of the recovered viruses when ultrapure water was used, the decreases in the IFVA infectious strength were found from the average infectious strength of the recovered viruses when tap water was used. The decreases in IFVA infectious strength after electrolyzed water treatment were the following.

Immediately after virus spray ended: 22.97%
10 minutes after virus spray ended: 51.40%
20 minutes after virus spray ended: 85.09%
30 minutes after virus spray ended: 95.63%
40 minutes after virus spray ended: 94.50% or greater
50 minutes after virus spray ended: 98.28% or greater

Observations:

This evaluation test of the virus removal capability for the Space Cleaning System with virus washer (α electrolyzed water air purification system) was conducted using influenza virus A (IFVA, strain PR8). The air purification machine used in the test was a system developed by Sanyo Electric, and is intended to reduce the infectious strength of airborne viruses by passing them through an element onto which hypochlorous acid (α electrolyzed water) is dripped. The hypochlorous acid is generated from the chlorine ions resulting from electrolysis of tap water.

When the test was conducted using IFVA, which are approximately 1/50 the size of ordinary bacteria, the infectious strength of the IFVA in the test tent decreased with longer operating times of the Space Cleaning System (when tap water was used). These effects became significant when the system had operated for 30 minutes or longer. When ultrapure water (the test control) was used, the infectious strength of the IFVA also decreased with longer operating times of the Space Cleaning System in the same way. However the change was more gradual than when tap water was used. While a decrease in the IFVA infectious strength was also seen when ultrapure water was used, this decrease is thought to be the result of the natural precipitation of airborne viruses caused by moisture in the test tent, rather than the result of the Space Cleaning System operation. With consideration for the natural precipitation of airborne viruses caused by moisture in the test tent, the infectious strength of the recovered viruses with ultrapure water was used as the base in order to find the decrease in the infectious strength of the recovered viruses with tap water. The results showed a decrease in infectious strength of 94% or more when the Space Cleaning System had operated for 30 minutes or longer. When the Space Cleaning System had operated for 50 minutes or longer, and with consideration of the natural precipitation of viruses, a decrease in infectious strength of 98% or more was confirmed.

The above results indicate that the Space Cleaning System with virus washer (α electrolyzed water air purification system) which was used in this test is capable of removing viruses after sufficient electrolyzed water treatment.

Conclusion:

At this performance test of the Space Cleaning System, using the influenza virus as the test index, the Space Cleaning System with virus washer (α electrolyzed water air purification system) which was used in this test was shown to be fully capable of removing viruses.

Reference documents:

Virus Test Studies, primary article, 1973 (National Institute of Infectious Diseases Alumni Association)

Virus Test Studies, sub article, 1973 (National Institute of Infectious Diseases Alumni Association)

Virus Testing Protocols, 1995 (Medical View Co., Ltd.)

Date that test report was created: March 6, 2006

Test report created by: Noritada Kobayashi 小林 亮児

Date that final test report was created: March 8, 2006

Final test report created by: Noritada Kobayashi 小林 亮児

Date that final test report was approved: March 10, 2006

Director of testing: Tatsuo Suzuki 鈴木 達夫

Virus Removal Capability of the Space Cleaning System with Virus Washer with Respect to Influenza Virus A

Time *1 (min)	Infectious strength of recovered viruses (log) TCID ₅₀ /mL		Decrease in virus infectious strength *3 (%)
	Tap water *2	Ultra pure water (test control) *2	
	Average ± Standard deviation	Average ± Standard deviation	
0	4.49 ± 0.06	4.60 ± 0.02	22.97%
10	4.04 ± 0.11	4.35 ± 0.05	51.40%
20	3.42 ± 0.03	4.25 ± 0.04	85.09%
30	2.61 ± 0.04	3.97 ± 0.03	95.63%
40	<2.28 ± 0.12	3.54 ± 0.06	94.50%
50	<1.36 ± 0.08	<3.13 ± 0.03	98.28%

The Space Cleaning System with virus washer was installed in a temporary test tent (Approx. 9.1 m²) in the Infection Testing Laboratory on the first floor of the Biomedical Building at the Kitasato Institute Medical Center Hospital. A nebulizer was used to spray influenza virus A into the tent for 30 minutes, and then an impinger was used to collect the viruses from the air inside the tent for 10 minutes at each of the designated intervals. The virus infectious strength in the collected fluid was then calculated by the TCID method.

*1: The time is the elapsed time after the virus mist spraying was completed.

*2: This indicates the type of water which was used in the Space Cleaning System with virus washer. The conductivity level of the ultrapure water used was 15 MΩ or higher.

*3: Using as the base the infectious strength of the recovered viruses when ultrapure water was used, the decrease in the infectious strength was calculated from the infectious strength of the recovered viruses when tap water was used, by means of the following formula.

$$\text{Decrease in infectious strength (\%)} = \frac{\left(\text{Infectious strength of viruses recovered when ultrapure water was used} \right) - \left(\text{Infectious strength of viruses recovered when tap water was used} \right)}{\text{Infectious strength of viruses recovered when ultrapure water was used}} \times 100$$

Changes in the Infectious Strength of Influenza Virus A Over Time Resulting from Use of the Space Cleaning System with Virus Washer

