

Attachment 2

RxAir Disinfection Unit

Performance Against Ebola

By Dr. Wladyslaw J. Kowalski, Aerobiological Engineering, LLC

Executive Summary

The RxAir disinfection unit produces a UV dose of 41 J/m^2 in a single pass. Ebola virus (Zaire strain) has an established UV D90 dose of 8.6 J/m^2 . The RxAir disinfection unit is capable of inactivating or destroying 99.9% of the Ebola virus, as per the calculations presented herein.

Ultraviolet Susceptibility of Ebola Virus

The UV sensitivity of Ebola virus has previously been evaluated by Sagripanti and Lytle (2011). The data indicates a two stage decay curve with a resistant fraction of about 3.8%. Based on the published data, the first stage UV rate constant was found to be approximately $0.2846 \text{ m}^2/\text{J}$ and the second stage rate constant was found to be approximately $0.0921 \text{ m}^2/\text{J}$. Figure 1 below shows the results of the clinical testing.

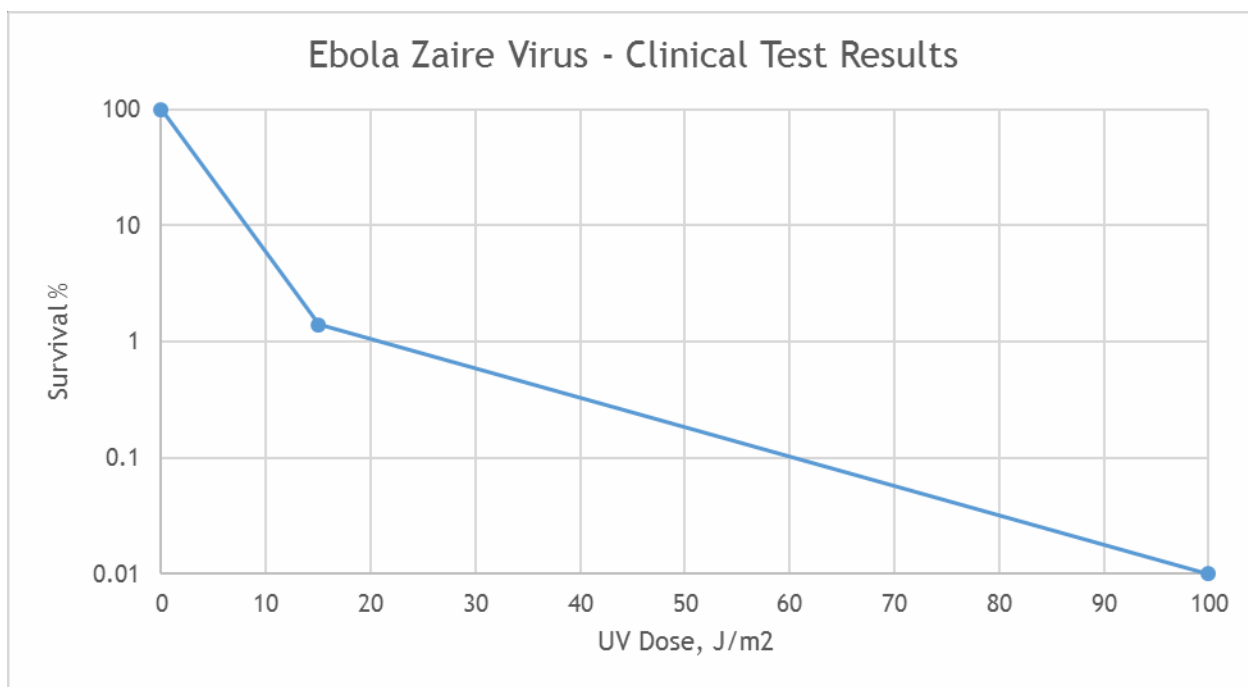


Figure 1: Graph of the clinical test results of the survival of Ebola (Zaire) under UV exposure. Based on data from Sagripanti & Lytle (2011).

The two stage decay model was developed from this published data and is represented by the following equation:

$$S = 0.962e^{(-0.28458D)} + 0.038e^{(-0.092103D)}$$

Where D = UV Dose, J/m²

Based on this equation, the D90, D99, and D99.9 values are computed as follows:

$$D90 = 8.6 \text{ J/m}^2$$

$$D99 = 20.1 \text{ J/m}^2$$

$$D_{99.9} = 35.8 \text{ J/m}^2$$

The two stage decay model is plotted in Figure 2 following.

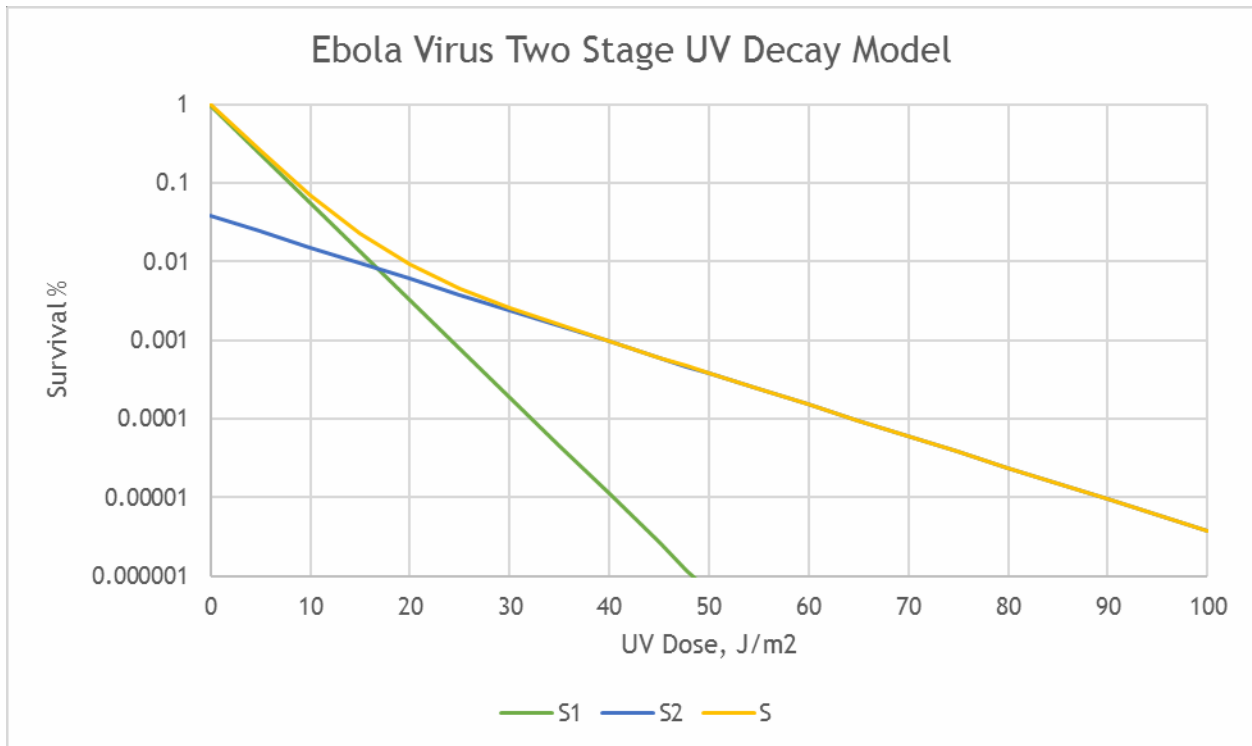


Figure 2: The two stage UV decay model for Ebola (Zaire) virus. Based on data from Sagripanti & Lytle (2011). The yellow line (S) represents the total survival. The first stage (S1) is in green and the second stage (S2) is in blue.

In the previous analysis, the UV D90 for Ebola (Reston) was predicted to be in the range of 12-25 J/m² based on genomic modeling, and the value recommended for use was 25 J/m² (Kowalski 2011). The data presented by Sagripanti and Lytle offers good corroboration of the model predictions but adds information on the second stage. It is recommended that the two stage decay model be used for predicting the effectiveness of sanitizing equipment.

The RxAir unit produces a UV dose of 41 J/m², based on previous analysis. It can be seen in Table 1 on the following page that at 41 J/m² the inactivation rate of Ebola virus is 99.9%. It can also be observed from Figure 2 that 41 J/m² is well into the second stage of the decay curve, and that the two stage model is the appropriate model to use in this case.

Table 1: Ebola Decay under UV Exposure

UV Dose J/m ²	1st stage S1	2nd stage S2	Total S	Total IR, %	
0	0.962	0.038	1	0	
5	0.231856	0.023976	0.255832	74.41679	
10	0.055881	0.015128	0.071009	92.89914	
15	0.013468	0.009545	0.023013	97.69868	
20	0.003246	0.006023	0.009269	99.07314	
25	0.000782	0.0038	0.004582	99.54177	
30	0.000189	0.002398	0.002586	99.74138	
35	4.54E-05	0.001513	0.001558	99.84417	
40	1.1E-05	0.000955	0.000965	99.90345	D99
41	8.24E-06	0.000871	0.000879	99.91212	RxAir
45	2.64E-06	0.000602	0.000605	99.93951	
50	6.36E-07	0.00038	0.000381	99.96194	
55	1.53E-07	0.00024	0.00024	99.97601	
60	3.7E-08	0.000151	0.000151	99.98487	D99.9
65	8.91E-09	9.55E-05	9.55E-05	99.99045	
70	2.15E-09	6.02E-05	6.02E-05	99.99398	
75	5.17E-10	0.000038	3.8E-05	99.9962	
80	1.25E-10	2.4E-05	2.4E-05	99.9976	
85	3.01E-11	1.51E-05	1.51E-05	99.99849	
90	7.24E-12	9.55E-06	9.55E-06	99.99905	
100	4.21E-13	3.8E-06	3.8E-06	99.99962	

References

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