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Project Report: Parametric Assessment of the Original Vortical Aerosol Generator and Its Replica Assembled at PNNL

1. INTRODUCTION

Under the Project PNNL T2-242 "Development of Effective Decontamination Methods and Technology" sponsored by the US DOE Global Initiatives for Proliferation Prevention (GIPP), PNNL and the Institute of Highly Pure Biopreparations (IHPBP, Saint Petersburg, Russia) have developed a non-intrusive method/technology "PAEROSOL" for concurrent decontamination/disinfection of airborne pathogens and pathogens residing on inanimate surfaces (fomites) in contained environments, such as hospitals, transportation units, farms, food processing facilities, and alike. High bactericidal efficacy of PAEROSOL has been demonstrated with significant number of different microbial cells, viruses, microbial, and fungal spores in an aerosol chamber of 100 ft^3 and in the rooms of 2,000 and 3,000 ft^3. PAEROSOL was shown neither toxic, nor corrosive, and no negative impact to sensitive electronics was observed during long-term practicing PAEROSOL protocol in the same room. PAEROSOL requires minimal logistics and leaves virtually no wastes after mission completion.

PAEROSOL comprises two key elements:

<u>1) 0.5% sodium chloride (NaCl) aqueous solution that has been electrochemically activated</u>.
Various apparatus for production of electrochemically activated NaCl solutions are off-the-shelf available, including electrochemical module "STEL" (NPO EKRAN, Moscow, Russia) that has been utilized for PAEROSOL' development and testing.

<u>2) Vortical (Vortex-principle ejectors) Aerosol Generator (VAG) - the device for production of microaerosol</u>

VAG device was designed and handmade (every element) at IHPBP. It was demonstrated that a combination of extraordinary high production capacity (high particles concentration in microaerosol) and size of aerosol particles generated by VAG was crucial for PAEROSOL disinfecting efficacy. Under GIPP Project, IHPBP provided PNNL with one VAG device for its evaluation and to further advance PAEROSOL decontamination technology. In 2012, PNNL copied original VAG to have spare device to perform PAEROSOL protocol and also, to supply VAG device for third party independent evaluation without interruption of the study at PNNL. However, due to budget constrain there was no possibility to completely reproduce the original VAG. Instead, the VAG' replica was assembled from off-the-shelf parts, which significantly varied in size and configuration comparing to the parts in original device. Whether or not the modifications in VAG replica impacted the characteristics of an aerosol was the motivating question in this project. To answer this question, parametric characteristics of original VAG and its replica were investigated and compared in this study.

2. RESULTS

2.2. VAG devices

2.2.1. Original VAG device

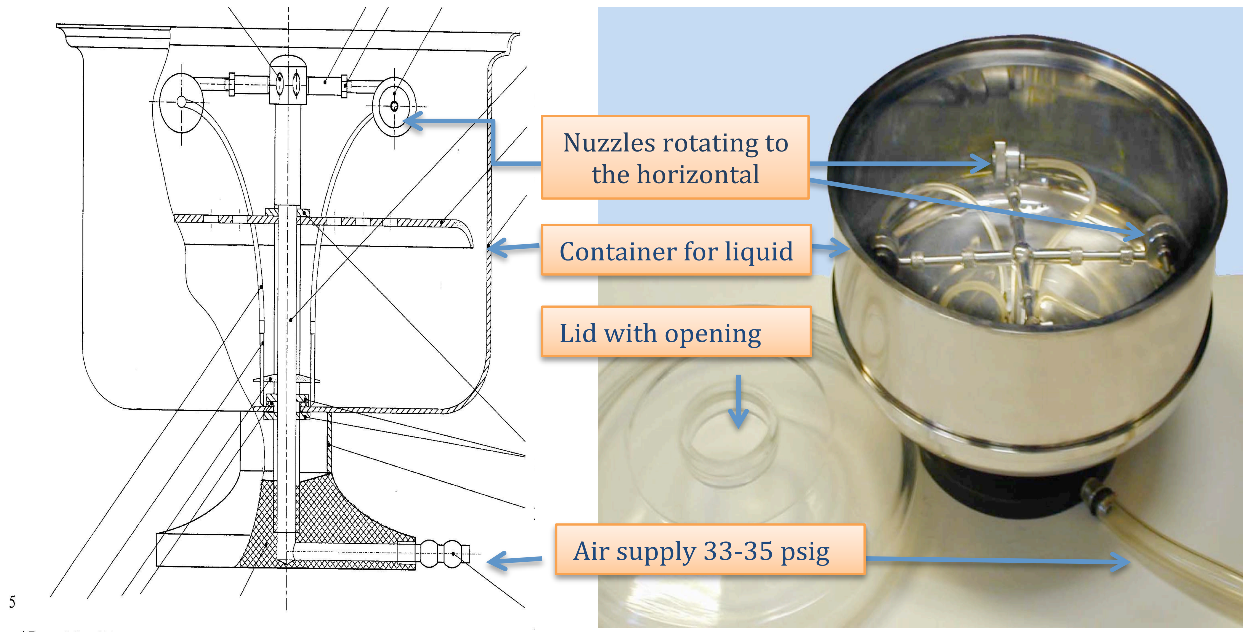
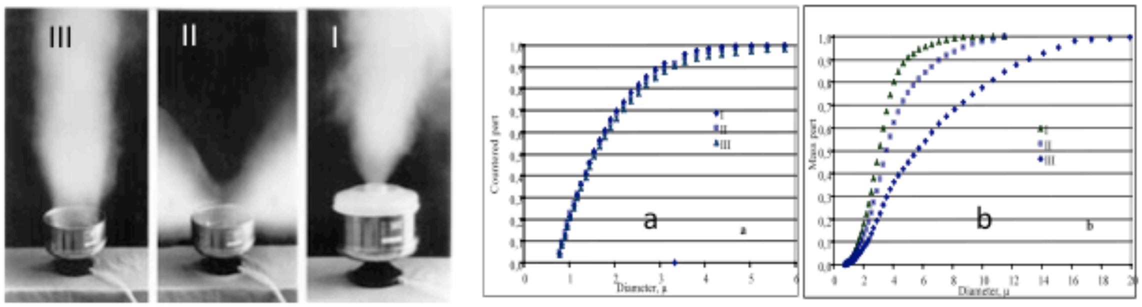


Figure 1. Sketch (left) and photograph (right) of original Vortex-type aerosol generator VAG

The original, 4-ejectors-VAG is the stainless steel (every part), lightweight (~5-pound), portable device (∅-8.5-in.; H-8.5-in.) that has neither electronic, nor disposable parts. VAG consists of a cylindrical container for decontaminating solution and four nozzles (ejectors), which are mounted inside the container above the liquid surface, so as to direct generated aerosol flow by chord to the container wall. The nozzles are flexibly assembled and might be turning to the horizontal. The device is operated by compressed air supplied through the standard hose (optimal pressure of 33-35 psig; airflow 300L-500L/min), at any humidity and temperature (where water is liquid), and requires virtually no maintenance and no special skills to operate. VAG generates 300-500 L of microaerosol per min, which contains ~$5x10^9$ particles per liter with the particles size mainly in the range of 0.5-10μ. First (but not complete) separation of coarse aerosol particles (bigger than 10 μ) is achieved inside ejector and second- inside the container when aerosol flow hits the container wall. Additional separation of coarse particles can be achieved by covering a container with the lid having an opening. It was previously observed that at constant air pressure/airflow, size and concentration of aerosol particles produced by VAG depends on ejectors orientation to the horizontal and a presence of the lid (Fig 2). The combination of the elements and original design of the nozzle makes VAG a unique atomizer.



Cumulative particle distributions by size (a) and by mass (b) in different VAG operating regimes

Regime	Productivity, ml/min (volume of liquid blended with air)	d_g, μ	D_{c95}, μ	d_{med}, μ	d_{m95}, μ
I	5±0.1	1.5±0.1	3.4±0.2	3.0±0.2	6.2±0.3
II	100±10	1.5±0.2	3.8±0.2	3.6±0.2	8.8±0.4
III	300±34	1.6±0.3	4.0±0.6	6.0±0.5	16.8±0.8

d_g - counted median diameter of the particles
d_{c95} - maximum diameter of the particles (95% of the total number of the particles)
d_{mmd} - mass median diameter of the particles
d_{m95} - maximum diameter of the particles (95% of the total particles by mass)

Figure 2. Different modes of VAG operation: I – triple separation of coarse droplets (minimal productivity); II - double separation of coarse particles (high productivity); III – single separation of coarse particles (maximal productivity).

2.2.2 VAG replica

The sketches of original VAG and the original device itself were used to make its replica. The photo of VAG prototype is depicted on Fig. 3. The device was assembled from the off-the-shelf parts, which significantly differed in size and configuration comparing to handmade parts in original device. One can see that while liquid supplying tubes and ejectors are miniature parts occupying minimal volume inside original VAG container (Fig 1), these elements are bulky in the replica (Fig 3). While height to width ratio in original VAG (container) is 6:8.5, the replica has reverse proportion of 10.5:7.5. While the parts of original VAG ejectors have been handmade using precise turning lathe and other machinery, for VAG replica the of-the-shelf parts were slightly altered to make similar ejectors (not shown). In addition, three insignificant new elements were added to the VAG replica to advance its usability:

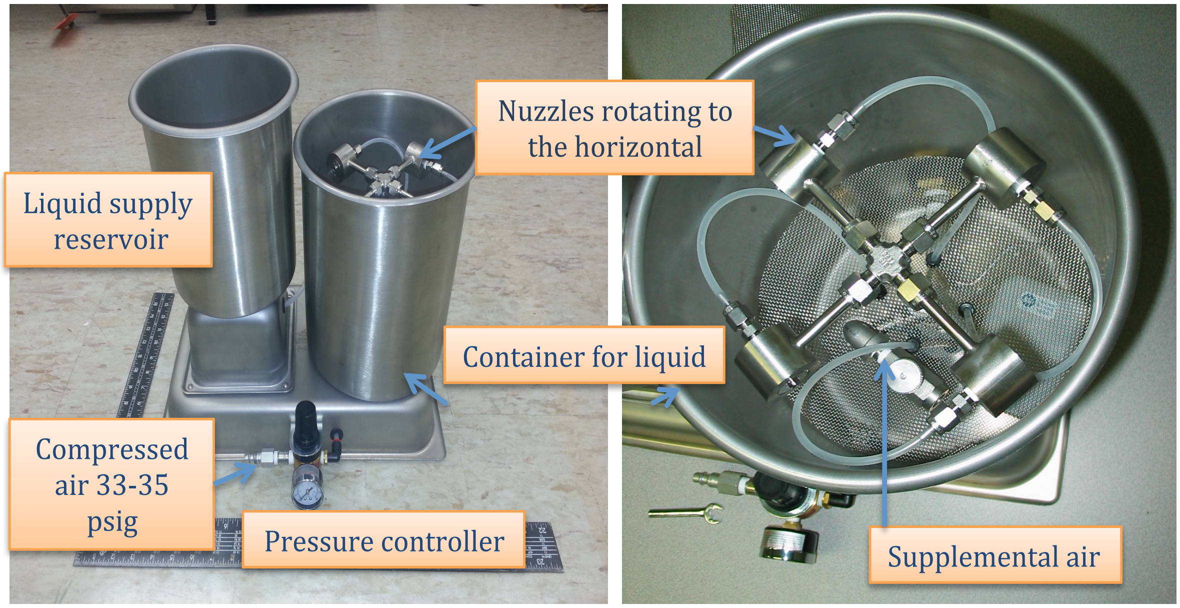


Figure 3. Photograph of the replica of the VAG (PNNL)

1) *A liquid supply reservoir for VAG automatic refill.*

The original VAG device holds up to two liters of liquid. This volume of electrolyzed solution allows disinfecting a room of approximately 2,000-2,500 ft^3 (average size of a hospital ward). To disinfect bigger facility, an operator (e.g. janitor) needs to open the door, enter the room filled with dense fog (bad visibility), and to manually add the solution to the VAG container. All together, it interrupts the process, increase the duration of the protocol, and requires operator's time. Automatic VAG refill will allow decontaminating facility of any size without operator.

2) *Extra airflow inside a container to prevent aerosol particles collision.*

High VAG productivity results in extra high concentration of small aerosol particles above nuzzles. This inevitably leads to a collision of small particles - formation of the particles bigger than 10μ. Most of the particles with a diameter bigger than 10μ fail to remain entrained in the air and either drop down to the container with liquid, or slope downward in close proximity to aerosol generator. This results in reduced productivity and in undesirable excess of the liquid on the surfaces were big droplets deposit. It was proposed that extra airflow arranged inside VAG device container might rarefy aerosol and thus, minimize small particles colliding.

3) *A regulator to control the pressure of operating air.*

Addition of a pressure-regulating unit advances VAG autonomy.

VAG replica is significantly bigger and heavier than the original device. However, the size and weight of the VAG prototype are unimportant factors at this point.

While the characteristics of aerosols generated by original VAG were extensively studied at IHPBP (e.g. Fig. 3), the characteristics of aerosols generated by VAG replica assembled at PNNL were not examined yet.

2.3. **VAG device productivity**

Surprisingly, neither in scholar articles, nor in the information provided by manufacturers one can find clear definition of aerosol generators' production capacity. Vagueness and often controversy in the clarification of this mostly important parameter make it difficult to compare characteristics of different aerosol generators. Because we have already identified the parameters of an aerosol important for PAEROSOL efficacy, here we suggest to consider a production capacity of VAG as the parameter, which includes all four measurable values: 1) volume of liquid atomized per minute; 2) volume of aerosol generated per minute; 3) size distribution of atomized particles (0.5 – 10μ), and 4) concentration of such particles in produced aerosol. While this definition might be not important for aerosol generators in general, it includes every parameter that dictates PAEROSOL disinfecting efficacy. Technical parameters influencing productivity of original VAG device have been extensively studied at IHPBP and reported under collaborative GIPP Project completed in 2009. However, it has never been studied at PNNL. In this project we conducted limited parametric assessment of the original VAG device and VAG replica in identical conditions.

The study consisted of two short phases. During the first phase, the volume of water atomized per minute was assessed as the function of ejectors orientation to the horizontal and a pressure of compressed air /airflow rate. The size distribution of aerosol particles was not analyzed during this phase. During the second phase, both devices were operated at optimal conditions selected during the first phase, and aerosol particle size distribution and concentration were analyzed.

2.3.1 Phase I. Assessment of the volume of atomized water as a function of ejectors orientation to the horizontal and air pressure.

Both devices have been assessed in natural conditions in the Laboratory 184 (High Bay) of PNNL's Applied Process and Engineering Laboratory (APEL). Pure water was used as a surrogate of electrochemically activated solution (EAS), because EAS consists of 99.5% of water. Because low volume of pure water was aerosolized in large open space during each test, the experiments were conducted without precautions. No extra moisture was left after the tests and no noticeable humidity variation were observed in the High Bay.

In-house compressed air was supplied to the VAGs through standard hose. Air pressure was controlled with standard manometers assembled in line. Known volume of water was placed into VAG container. Stopwatch was used to record the time. After the test completion, the rest of water (non-atomized) was removed from the container and measured. Limited parameters, such as the position of the ejectors to the horizontal, air pressure, and aerosol generating time were varied.

2.3.1.1. Phase 1 assessment of the original VAG device

Table 1. Row experimental data collected during the experiments with original VAG device.

Conditions	Original VAG device								
Liquid in the container	2000	2000	2000	2000	2000	2000	2000	2000	2000
Liquid remained in the container after experiment (V_2), ml	1490	1675	1575	1300	700	1760	1600	1600	1600
Volume of aerosolized liquid ($V=V_1-V_2$), ml	510	325	425	700	1300	240	400	400	400
Operation time (T), min	2	5	5	8	15	3	5	5	5
Productivity (V/T), ml/min	255	65	85	87	87	80	80	80	80
Nozzle position to the horizontal	+90˚	+10˚	+10˚	-10˚	-10˚	-13˚	-13˚	-15˚	-15˚
Air pressure, psig	35	25	35	35	35	35	40	40	33
Number of ejectors	FOUR								
Observation	All surfaces around VAG, including floor, became very wet	The surfaces of a table around VAG became wet	The surfaces of a table around VAG became wet	Almost no wetting of the surfaces was observed, except a few drops of liquid, which fell down from the container edge.					

The results presented in the Table 1 fully confirmed the data previously received by PNNL's partners at IHPBP. An orientation of aerosol ejectors to the horizontal (orientation toward container wall) was confirmed as the factor dictating the volume of atomized liquid per minute.

When all ejectors were at +90˚ to the horizontal (fully upward, single separation of coarse particles inside ejectors), VAG atomized 255 ml/min (compare with Fig 2, regime III). Being operated with upward ejectors, VAG produced an aerosol containing significant number of course particles with a diameter bigger than 10μ. These coarse particles where not entrained by air and dropped down to all surfaces around the VAG device. This resulted in significant liquid deposit on surfaces in the lab, which is highly undesirable factor in decontamination protocol. Also, it significantly reduces "useful volume of decontaminant" – the volume of aerosolized decontaminant that fills the confined environment like a gas.

At the ejectors orientation at +10˚ to the horizontal, VAG atomized 85 ml/min that was very significant reduction comparing to 255 ml/min atomized with the ejectors oriented upward. This reduction is explained by second separation of course particles due to an aerosol contact with the container wall. A part of aerosol (mostly consisted of coarse particles) that hit the wall became a liquid and dropped down to the container. However, liquid was observed on the surfaces around VAG operated with the ejectors at this position, which meant that some particles bigger than 10 μ escaped generator.

When ejectors were oriented at the angle in the range between -10˚ to -15˚ to the horizontal, VAG atomized almost the same volume of liquid per minute that was observed at the ejectors oriented at +10˚ to the horizontal; however, only very light moisture was observed on a table surface in close proximity to VAG device, and this means that most of coarse aerosol particles were separated when the ejectors were oriented at the angle in the range between -10˚ to -15˚ to the horizontal.

Dependence of VAG productivity on compressed air pressure was observed at the pressure below 35 psig. VAG atomized 65 ml of water per min and 85 ml/min at air pressure of 25 psig and 35 psig, correspondingly. Air pressure increased above 35 psig did not affect the volume of liquid atomized by VAG. Previously, air pressure in the range of 33-35 psig was shown optimal for operating original VAG device. This is very positive factor for wide usability of VAG device because neither specific precautions to work with VAG, nor specific training for operators are required. It was also observed that at constant air pressure the volume of atomized liquid per minute did not depend on an operation time.

2.3.1.2 Phase 1 assessment of the VAG's replica

Table 2 summaries row data received throughout the experiments with VAG replica and briefly outlines the measures taken to improve the device productivity. Additionally, visual observation of VAG replica at operation is provided, which is indeed, not scientifically correct, but seems to be important for better reproducing original VAG. Due to extremely limited budget, only insignificant modification to VAG's replica were made during this project.

With four ejectors turned upward, replica atomized approximately 75 ml/min that was about 3 times less than that of original VAG, and very significant liquid deposit was observed on the surfaces. It was shown that with 3 ejectors operated, VAG replica atomized proportionally lower volume of water than that with replica operating 4 ejectors (~57 ml and 77 ml, correspondingly).

Table 2. Row experimental data collected during the experiments with the replica of VAG device.

Conditions	Prototype of VAG													
Liquid in the container before experiment (V_1), ml	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	3000	3000
Liquid remained in the container after experiment (V_2), ml	1725	1700	1600	500	1650	1900	1890	1860	1150	1400	1620	1700	1790	1800
Volume of aerosolized liquid ($V=V_1-V_2$), ml	275	300	400	1500	350	100	110	140	850	600	380	300	1210	1200
Operation time (T), min	5	5	5	20	5	5	5	5	40	29	5	5	20	20
Productivity (V/T), ml/min	55	60	80	75	70	20	22	28	21	21	76	60	60	60
Nozzle position to the horizontal	90˚	90˚	90˚	90	90	10˚	-10˚	-8˚	-8˚	-8˚	-8˚	-12˚	-12˚	-12˚
Air pressure, psig	33	35	35	35	35	35	35	35	35	35	40	40	40	40
Suppl. air	n/a	n/a	n/a	+	n/a	n/a	n/a	n/a	n/a	+	40	40	40	33
Number of ejectors	3	3	4	4	4	4	4	4	4	4	4	4	4	4
Observation	Much of water all around. No aerosol flow on short distance from VAG was observed.						Significant wetting of the surfaces							
Action	To meet productivity vertical liquid feeding tube was shorten for 5/6 and then to 5/32”								To meet productivity the container for liquid supply was shorten (Fig 4) and liquid feeding tubes inside ejectors were moved toward the ejectors openings					

The comparison of two VAG devices showed that at the ejectors oriented at +10˚ to the horizontal and air pressure of 35 psig, original VAG atomized 85 ml/min, replica - 20 ml/min; at the ejectors orientated at -

10˚ to the horizontal, the atomized volumes were 87 ml/min and 20 ml/min for original VAG and for replica, correspondingly. At this point of the assessment, the replica' elements were slightly modified: 1) the liquid supplying reservoir was shorten (Fig 4) because aerosol flow from two out of four ejectors hit the wall of the liquid supplying reservoir that was higher than the main container with the ejectors (Fig 3) 2) vertical liquid supplying tube (which supports the ejectors) was shorten and the ejectors position in the container became lower as compared to original replica; this reduced direct contact between aerosol flow and the container edge; 3) liquid feeding tubes inside ejectors were moved toward the ejectors openings for 0.14-inch.

As follows from the Table 2, these modifications resulted in increased volume of liquid atomized by replica and in reduced liquid deposit on the surfaces. Seemingly, replica atomized more liquid at the pressure 40 psig that at 35psig. However, several replica' details were changed simultaneously and therefore, it was hard to conclude whether or not replica atomized more water at 40 psig that at 35 psig. Also, it appeared impossible to understand the value of additional air supply introduced to the replica. Nonetheless, limited modifications made to replica throughout the project allowed to increase replica productivity to 60-76 ml/min that was well comparable with optimal productivity of the original VAG (80 ml/min).

Figure 4. VAG replica with shorten liquid supplying reservoir (see Fig 2 for comparison)

It was observed that at any ejectors' orientation to the horizontal, except upward, aerosol flow from each ejector "knockout" every element inside the containers, including massive surface of the other ejectors, liquid supply tubes, container walls, and the edge of the container. This resulted in reduction of the atomized volume and in very wet surfaces around the generator.

It has been already mentioned that the orientation of the ejectors to the horizontal dictated both, total volume of atomized liquid per time and the size of aerosol droplets. However, a volume of atomized liquid itself doesn't provide the information about the size of the particles in resultant aerosol. As follows from the results presented in the Table 1, the original VAG atomized almost identical volume of water when the ejectors where positioned at +10˚ and -15˚ to the horizontal. However, at the ejectors position at +10˚ the surfaces around VAG became very wet (assumingly poor separation of coarse particles), while almost no moisture was observed when original VAG operated with ejectors positioned at the range between -10˚ - 15˚ to the horizontal (good separation of coarse particles).

2.3.2. Phase II. Assessment of aerosol particle size distribution and concentration

In the Phase II, the size distribution and concentration of aerosol particles generated by original VAG and its replica was assessed. The experiments were conducted in the large-scale test chamber built in Laboratory 184 of APEL (Fig 5).

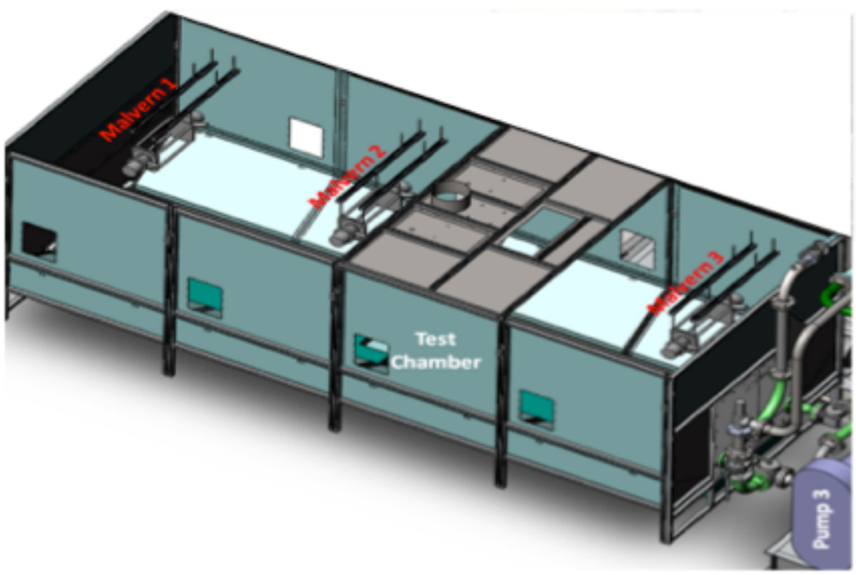


Figure 5. Schematic of the Large-Scale Test Chamber

The chamber was 8-ft wide, 20-ft in length, and 8-ft high with volume of ~28 m^3 (~1,000 ft^3). The size of the chamber was well comparable with the size of the contained space where PAEROSOL protocol was previously implemented (2,000-3,000 ft^3) using original VAG device. The chamber was constructed of stainless steel sheets and included three Aerosol Analyzers (Malvern Insitec-S) (Figs 5, 6). The Malvern Insitec-S functions by continuously monitoring and recording both the intensity of un-deflected laser light striking the central detector relative to the background intensity when no aerosol is present (termed the transmission) and the light scattering pattern generated by scattering of laser light by aerosol in the measuring zone. When an aerosol particle enters the measuring volume, it scatters light in all directions. However, the intensity of scattered light varies as a function of scattering angle and generates a scattered light pattern that is unique to particles of that size and morphology. As the measuring volume of the Malvern Insitec-S is large, the instrument is capable of simultaneously measuring multiple particle scattering events in a single measurement. Using Mie scattering theory and given the nominal optical properties of the aerosol, the scattered light pattern generated by the particle ensemble can be analyzed to determine the size distribution of aerosol particles. Diffraction of the laser beam yields a loss of intensity of the laser beam that strikes the central detector relative to the intensity measured when no aerosol is present (termed the background laser intensity). This decrease in intensity, along with the size distribution estimated from the scattered light pattern, can be used to determine aerosol concentration (Fig 7).

To evaluate VAG devices, airtight heavy panel at the front of the chamber was removed and substituted with tarp (not airtight). Original VAG, or its replica, was positioned on the floor between the first and second Malvern Aerosol Analyzers. Analyzers were spaced evenly through the chamber and were placed 1) near the tarp-covered entrance, 2) at the "middle" of the test chamber, and 3) near the distal wall (Fig 6).

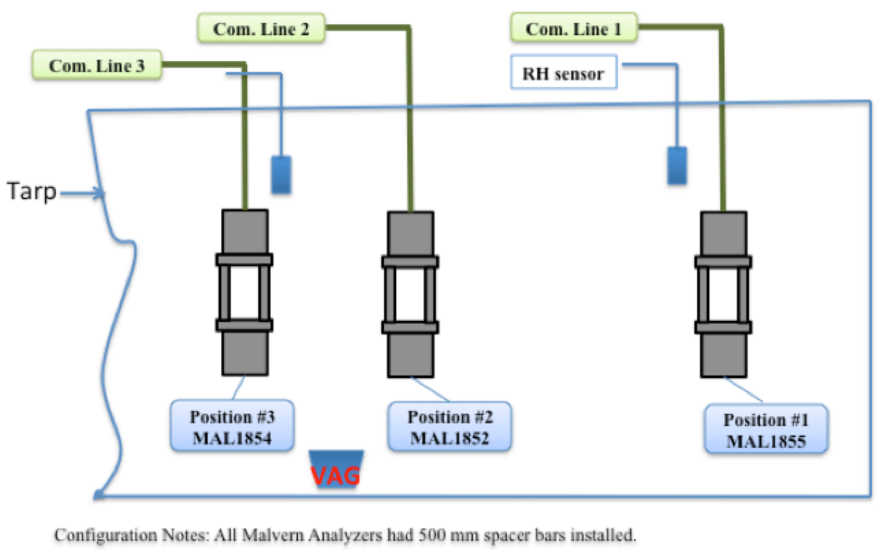


Figure 6. Top View of Malvern Insitec-S Instruments

Two Omega Relative Humidity (RH) sensors model HX93DAC-RPI-F analyzed RH inside the test chamber during each test. Routine checks of all Malvern Insitec-S aerosol analyzers were conducted before the tests to verify acceptable and optimal performance of the instruments. These checks included alignment of the optical components and verification that the detection system and its electrical subcomponents were working properly.

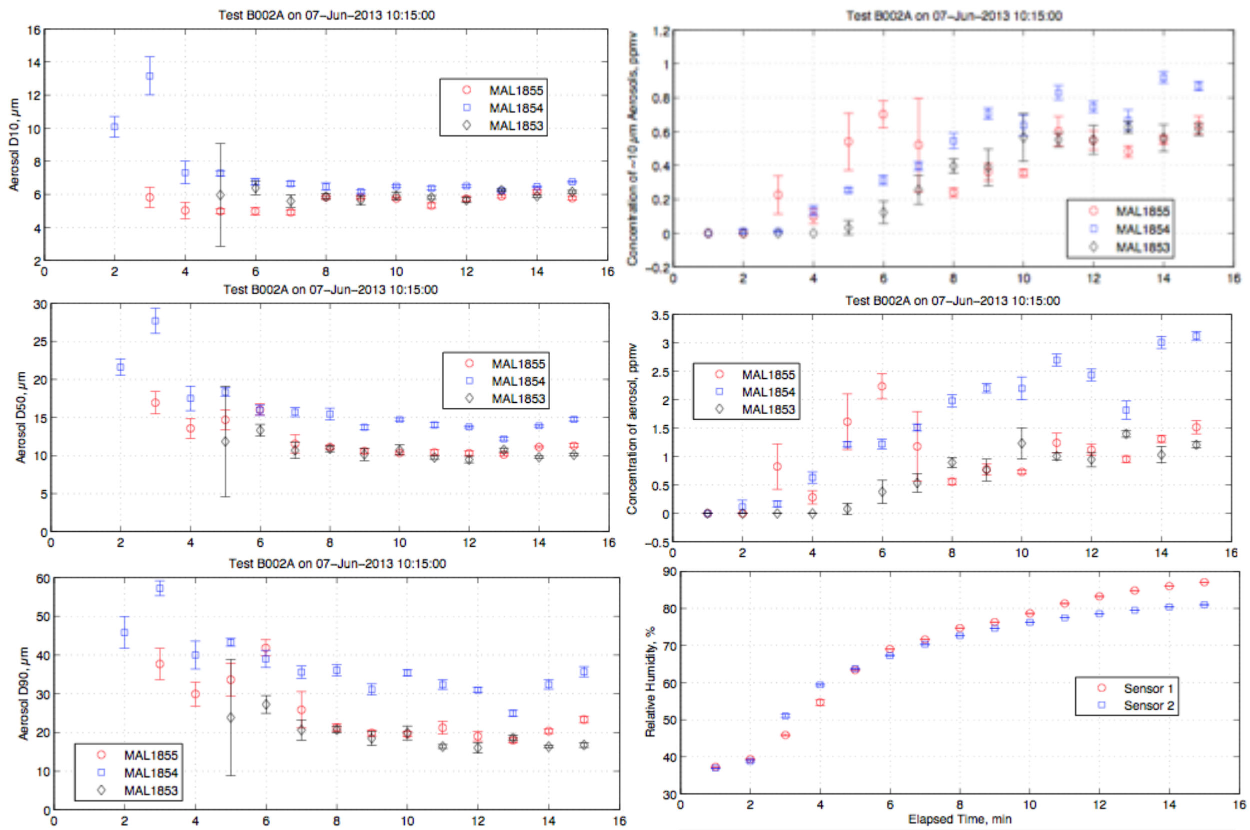
For each test, known volume of pure water was added to the VAG, or VAG replica dispersion container and the device was positioned inside the chamber. The device was connected to in-house compressed air through a hose. The Malvern Insitec-S analyzers were aligned, and baseline measurements of background laser and diffraction intensities were taken to prepare the instrument for measurements. The compressed air and stopwatch were turned on and then off upon test completion. Non-atomized water was taken from the device and measured. Results recorded by Malvern Analyzers were transmitted to the computer through the interface, and interpreted by the Malvern Insitec-S software.

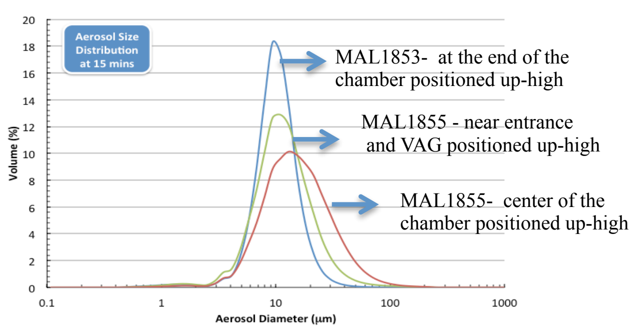
2.3.2.1 Assessment of aerosol particles generated by original VAG

Several tests were conducted with the original VAG device in identical conditions, except the orientation of the ejectors was changed in the range between +9˚ to -15˚ to the horizontal.

At the ejectors oriented at +9˚ to the horizontal, the particles size distribution showed noticeable number of the particles exceeded 10μ (Fig 7). This explains significant liquid deposit on the floor inside the chamber observed after the test completion that is always an evidence of poor separation of coarse particles. Nonetheless, a "quantity" of the particles with a diameter below 10μ was higher than that of bigger particles.

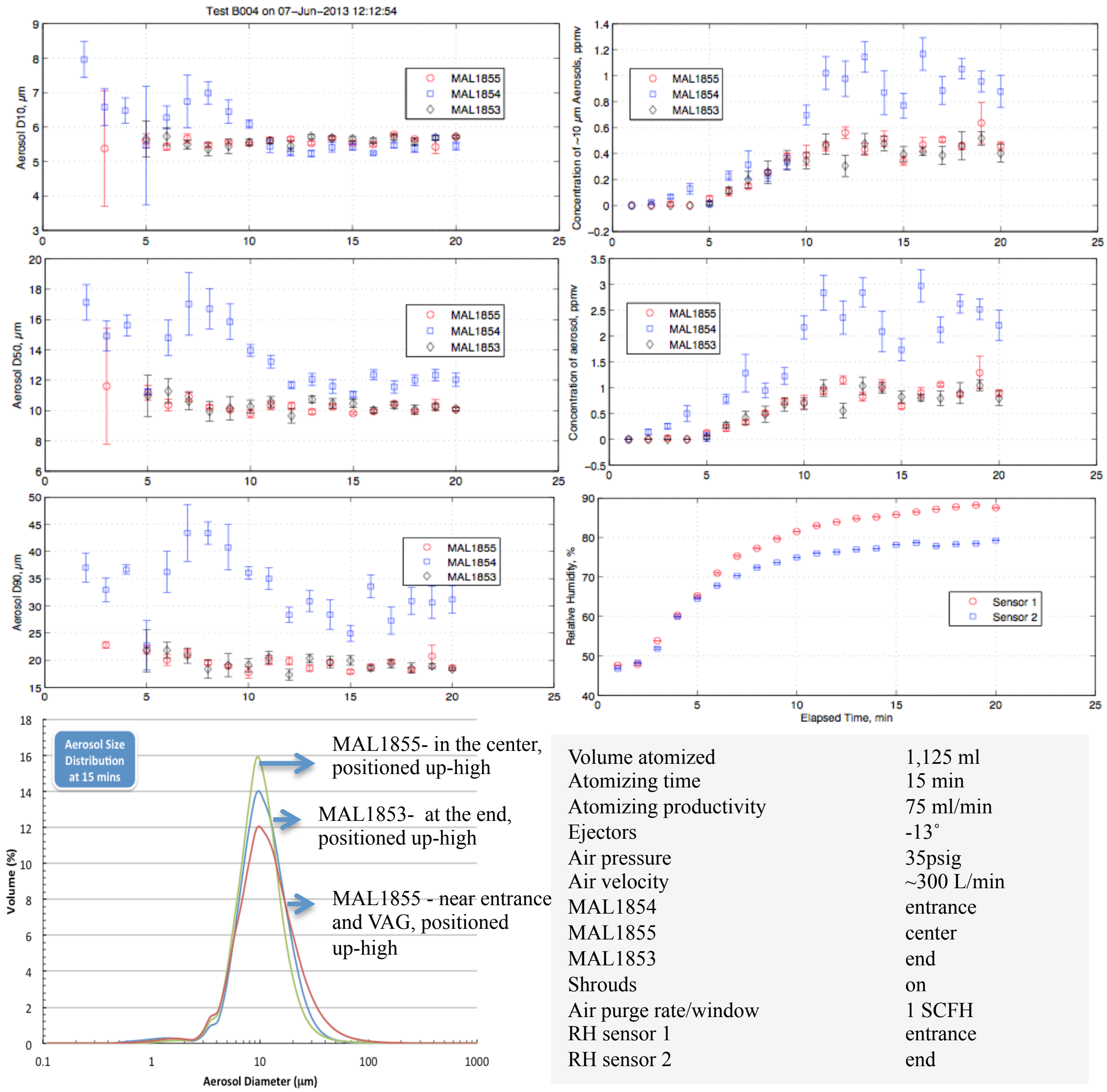
Slight difference in an aerosol particles size distribution and concentration was observed when the ejectors were oriented at -11˚, -13˚, and -15˚. This was consistent with the results previously received at IHPBP. Figure 8 represents typical results of these experiments. One can see that 1,125 ml of water atomized during 15 min increased RH inside the test chamber from 47% to 80%-90%. The difference between the data recorded by two RH sensors is easily explained by the difference in their position, one - close to VAG, and another - on the distance. In the size range below 10 μ, particle size distribution showed that particles of 5-6 μ predominated; in the range below 50μ - particles of 10μ prevailed, though bigger particles were registered by the analyzer that was close to the VAG; and in the range below 90μ - the particles below 20μ were registered by two of three analyzers located in the middle and the end of the chamber. The analyzer near the VAG registered insignificant number of the particles in the range between 20 and 50μ. However, a highest volume of an aerosol fraction was composed of the particles of 10μ (Fig 7). Certain discrepancy between the data registered by three Malvern Analyzers is easily explained by not-controlled conditions in the test chamber, specifically that the chamber was not really "enclosed". Aerosol fraction of the particles bigger than 10 μ could be minimized by precise attenuation of the ejectors position (previously received data). To make a replica, VAG original has been dis-assembled, but no precise attenuation were done after its' re-assembling. This is one of the disadvantageous of handmade devices.





Volume atomized	1,275 ml
Atomizing time	15 min
Atomizing productivity	85 ml/min
Ejectors	+9˚
Air pressure	35psig
Air velocity	~300 L/min
MAL1854	entrance
MAL1855	center
MAL1853	end
Shrouds	on
Air purge rate/window	1 SCFH
RH sensor 1	entrance
RH sensor 2	end

Fig 6. Assessment of an aerosol particles generated by original VAG device at ejectors orientation +9˚ to the horizontal

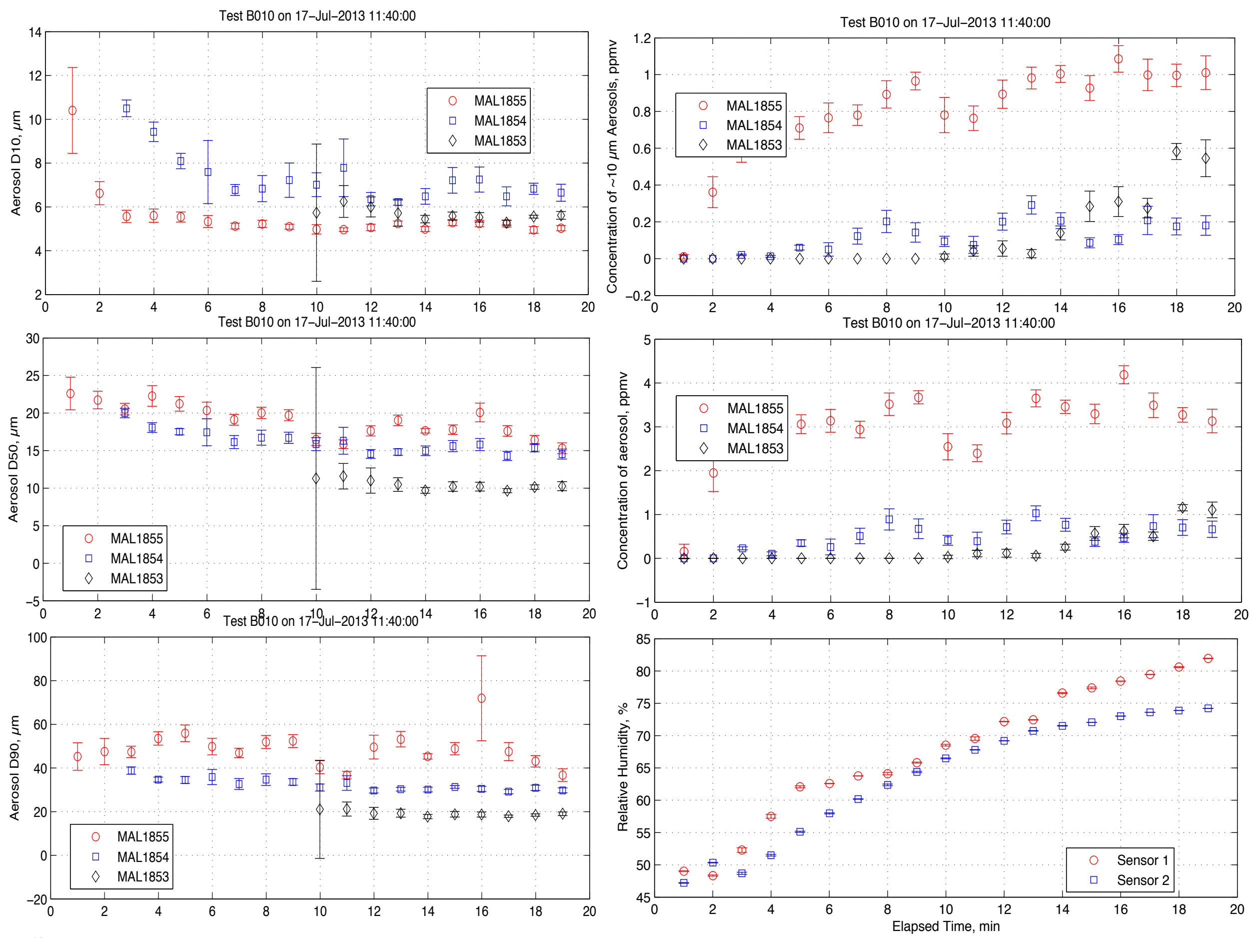


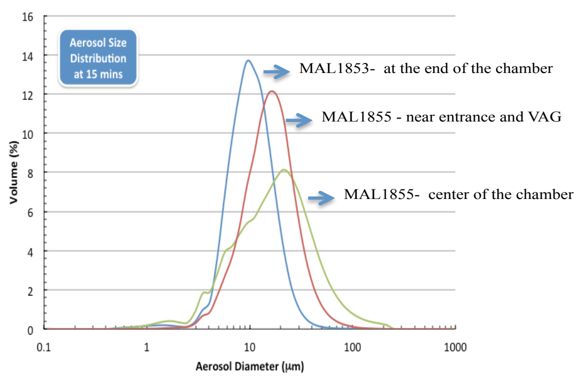
Volume atomized	1,125 ml
Atomizing time	15 min
Atomizing productivity	75 ml/min
Ejectors	-13˚
Air pressure	35psig
Air velocity	~300 L/min
MAL1854	entrance
MAL1855	center
MAL1853	end
Shrouds	on
Air purge rate/window	1 SCFH
RH sensor 1	entrance
RH sensor 2	end

Figure 7. Assessment of an aerosol particles generated by original VAG device at ejectors orientation -13˚ to the horizontal

2.3.2.2 Assessment of aerosol particles generated by VAG replica

The most of the tests conducted with VAG replica in the chamber gave no results because of its low capacity to atomize water, which resulted in desiccation of an aerosol droplets before humidity inside the test chamber was built up. After several modifications described above, atomizing capacity of the replica was increased and achieved 60-75 ml/min at the ejectors oriented at -8˚ and -12˚ to the horizontal. Figure 9 demonstrates the results of VAG replica assessment in the test chamber.





Volume atomized	1,210 ml
Atomizing time	20 min
Atomizing productivity	60 ml/min
Ejectors	-12˚
Air pressure	40sig
Air velocity	~300 L/min
MAL1854	entrance
MAL1855	center
MAL1853	end
Shrouds	no
Air purge rate/window	0.3 SCFH
RH sensor 1	entrance
RH sensor 2	end

Figure 8. Assessment of an aerosol particles generated by VAG replica device at ejectors orientation -12˚ to the horizontal

A comparison of the data presented in Figs. 7 and 8 showed substantial difference in particles size distribution of the aerosols generated by original VAG and its replica. VAG replica generated significantly higher number of the particles exceeded 10μ. Nonetheless, there were significant similarities in the profiles of the aerosols generated by original VAG and VAG replica.

3. Conclusion

1. Despite VAG replica was assembled at PNNL from off the shelf parts, the device demonstrated significant similarities with the original VAG. This is very promising result of the first VAG replication

2. For manufacturing better VAG replica, the proportions and the sizes of the parts of the original VAG device should be fully obeyed

3. Malvern Analyzer Insitec-S appeared to have deficiencies for such study. It was previously shown that aerosol particles remained at the air for hours up until all particles desiccated (time directly depended on RH an T° inside confined environment). These results were received using TSI Aerodynamic Particle Sizer. In this project we also proposed to observe aerosol particles size and concentration distribution after aerosol generator was turned off. However, it appeared to be impossible because for appropriate Malvern functioning, the shrouds should be constantly on and air purge rate per window should be 1SCFH (standard cubic feet per hour) to eliminate moisture accumulation on lenses. Because of this, the concentration of the aerosol particles in measurable volume was below detection limit.