

Ionization and Filter Enhancement in Coastal Environments

GPS Air Opti-Lok™ System Captures 100% More Aerosolized Sea Salt Particles than MERV 8 Filters at the Same Static Pressure

Coastal air, impregnated with higher concentrations of salt, (NaCl), is known to be corrosive to HVAC equipment and fittings. It is virtually impossible to ventilate coastal buildings without salt ingress from the incoming air stream. Three strategies help lower the NaCl intensity on HVAC equipment:

1. Reduce overall outdoor airflow by applying the indoor air quality procedure (IAQP),
2. Apply cost-effective and higher performing filtration,
3. Do both 1 and 2 simultaneously to achieve the lowest concentrations

Sea salt aerosols, one of the most common aerosols in the environment, are naturally occurring due to the interaction of waves and wind. Analysis reveals that sea salt aerosol sizes form a normal distribution over the range of 0.5 μm and 10 μm with the mean being $\sim 4.0 \mu\text{m}$. (Approximately 50% of the particles will be smaller than 4 μm and 50% will be larger) [1]. Since aerosols range in size it is helpful to understand filtration performance across the particle size spectrum.

Filtration Ratings & Particle Bins

ANSI/AHSRAE Standard 52.2 rates filters based on their ability to remove particles from the air stream considering various particle sizes [2]. There are 12 particle size ranges sorted into 3 bins E1, E2, and E3. For aerosolized sea salt and filtration effectiveness, the following distribution is expected:

- 10% of particles are in the E1 bin
- 35% of particles are in the E2 bin
- 55% of particles are in the E3 bin

Table 1 shows aerosolized sea salt particles sizes sorted by ANSI/ASHRAE bins to support analysis. Aerosolized sea salt is highly common, particularly in coastal regions, and the smallest sizes in the E1 bin. Sub micro particles (E1 bin) are the most difficult to capture via passive filtration. Common MERV 8 filters have 0% removal rate for these particle sizes. In addition, the ultra fine particles may linger in air streams for over 1 week [3]

Both MERV 8 and Opti-Lok M14 filters are compared in their aerosolized sea salt particle removal performance. Opti-Lok M14 was selected because it is compatible with most equipment in the field. It has been tested against 100% outdoor air for over a year, resulting in operating static pressure less than 1.0" wg. This pressure drop is comparable with industry standard MERV 8 filters and moreover means that M14 filter is compatible with most DOAS/RTU systems without in-field modifications.

ANSI/ASHRAE 52.2			Sea Salt Particles
Range	Size (μm)	Bin	
1	0.3 - 0.4	E1	10%
2	0.4 - 0.55		
3	0.55 - 0.7		
4	0.7 - 1.0		
5	1.0 - 1.3	E2	35%
6	1.3 - 1.6		
7	1.6 - 2.2		
8	2.2 - 3.0		
9	3.4 - 4.0	E3	55%
10	4.0 - 5.5		
11	5.5 - 7.0		
12	7.0 - 10.0		

Table 1

Common Filtration Approach

It is the industry norm to apply MERV 8 filtration for outdoor air in DOAS/RTU systems. As shown in Table 2 MERV 8 filters will remove 0% of the smallest particles (E1), less than or equal to 20% of the medium sized particles (E2) and less than or equal to 70% of the larger particles (E3). When performance tested for efficacy against aerosolized sea salt particles, a standard MERV 8 filter system was seen to achieve an overall 45% removal rate, as shown in Table 3.

average particle size removal efficiency standard filters			
MERV Rating	Range 1 (0.3 - 1.0 µm)	Range 2 (1.0- 3.0 µm)	Range 3 (3.0 - 10.0 µm)
8	n/a	20 ≤ E2	70 ≤ E3
9	n/a	50 ≤ E2 < 60	75 ≤ E3
10	n/a	50 ≤ E2 < 65	80 ≤ E3
11	20 ≤ E1	65 ≤ E2 < 80	85 ≤ E3
12	35 ≤ E1	80 ≤ E2	90 ≤ E3
13	50 ≤ E1	85 ≤ E2	90 ≤ E3

Table 2

Bin	Sea Salt Particles (a)	Filter Removal (b)	Results (a * b)
E1	10%	0%	0%
E2	35%	19%	7%
E3	55%	69%	38%
MERV8 Removal Rate for Aerosolized Sea Salt:			45%

Table 3

Opti-Lok M14 Approach

When the same aerosolized sea salt test is conducted with a system utilizing Opti-Lok M14 filters, removal rate increases to --% (see Table 5), with static pressure not exceeding the MERV 8 sample. **This is 100% better than the MERV 8 filter, allowing only 8% of the particles to penetrate the HVAC System vs 55% with MERV 8.**

average particle size removal efficiency of select filters			
MERV Rating	Range 1 (0.3 - 1.0 µm)	Range 2 (1.0- 3.0 µm)	Range 3 (3.0 - 10.0 µm)
8	n/a	20 ≤ E2	70 ≤ E3
11	20 ≤ E1	65 ≤ E2 < 80	85 ≤ E3
13	50 ≤ E1	85 ≤ E2	90 ≤ E3
M14	95 < E1	95 ≤ E2	90 ≤ E3

Table 4

Bin	Sea Salt Particles (a)	Filter Removal (b)	Results (a * b)
E1	10%	95%	9.5%
E2	35%	95%	33%
E3	55%	90%	49.5%
Opti-Lok M14 Removal Rate for Aerosolized Sea Salt:			92%

Table 5

REFERENCES

- [1] Katherline L. Ackerman, Alison D. Nugent, and Chung Taing, "Mechanisms controlling giant sea salt aerosol size distributions along a tropical orographic coastline" *Atmospheric Chemistry and Physics*, Volume 23, 2023
- [2] Lynn M. Russell, Richard H. Moore, Susannah M. Burrows, Patricia K. Quinn, "Ocean flux of salt, sulfate, and organic components to atmospheric aerosol", *Earth-Science Reviews*, Volume 239, 2023
- [3] ANSI/ASHRAE Standard 52.2-2017 "Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size"