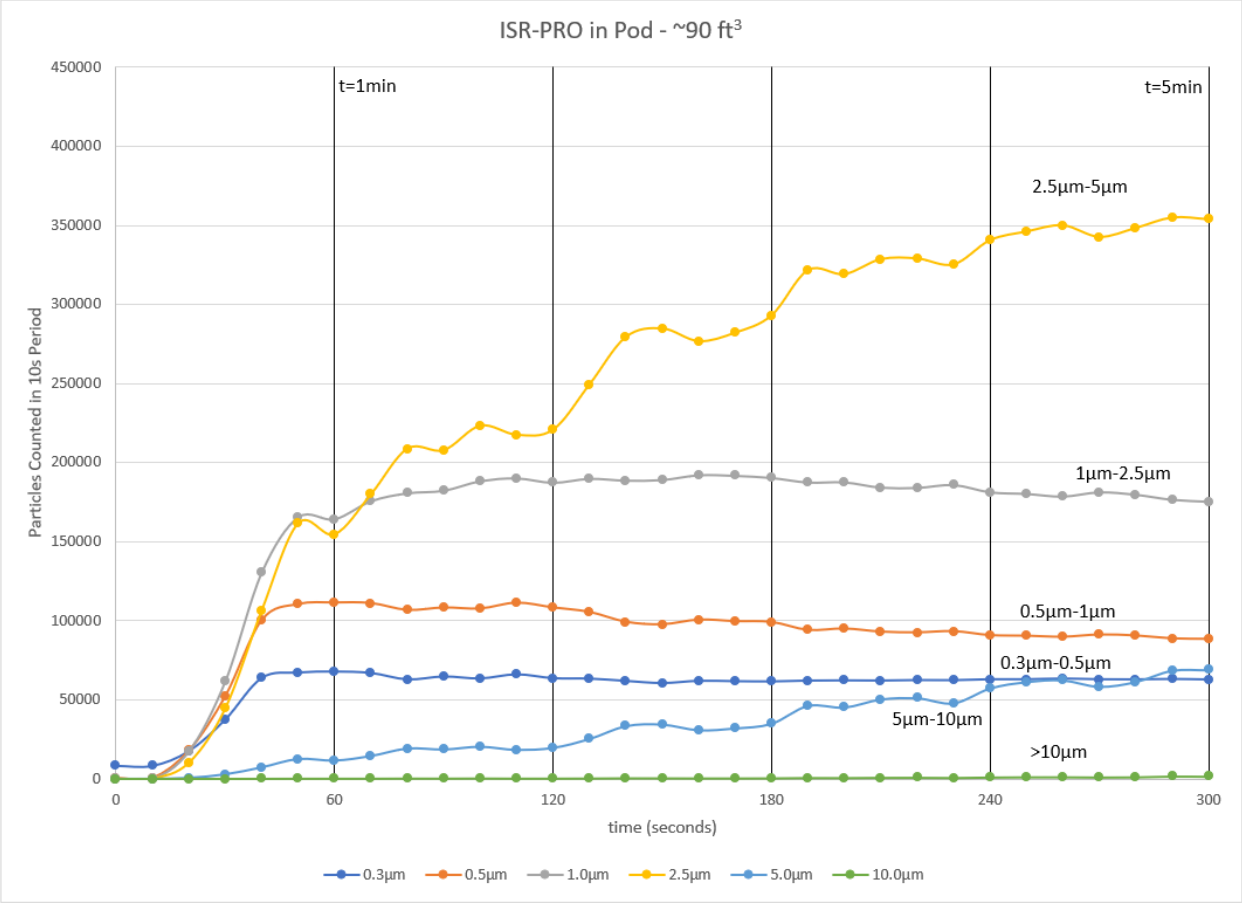
INFINITY
— SALT AIR MACHINE —

How many ISR-PRO units do I need for my spa room?

Summary: The ISR-PRO halotherapy device performance in the lab is extrapolated to the real world to help you decide how many units are needed for larger rooms.

ISR-PRO Particle Math Made Easy – A White Paper

The ISR-PRO consumes about 0.5 grams (500mg) of salt (NaCl) in a 5-minute run. To properly record the salt particle output of the device, it is run in a small, fully enclosed pod. This pod has a volume that is approximately 90ft^3 or 2.54m^3. The results of a typical run are shown below. A 6-channel particle counter uses optics to record the count and size of particles as it draws air into its chamber through a small tube. Dots on the chart represent a count accumulated over 10s, so below are 300 points of data (per size) in time which show the salt output of ISR-PRO over the 5-minute period.



These particles are counted in buckets, so to speak, with the following noted values:

0.3µm, 0.5µm, 1.0µm, 2.5µm, 5.0µm, 10.0µm

The bucket values are minimum particle sizes within each bucket, so each count within the 0.3-micron (µm) bucket is between 0.3 micron and 0.5 micron, for example. Therefore, actual particles are in ranges in those buckets. Note that this data is only useful to determine the approximate percentage breakdown of the particles generated. It cannot be guaranteed that the machine is counting all particles generated.

ISR-PRO Particle Math Made Easy – A White Paper

Relative to the halotherapy device, there are 2 primary elements to an effective treatment. Other variables are controlled by the environment, things like duration of treatment, humidity and temperature in the chamber, etc. However, for the device itself, these primary elements are:

1. Particle Size Distribution
2. Particle Mass Concentration

The Salt Therapy Association, www.salttherapyassociation.org, states that for ideal therapeutic conditions, the "particle size should be between 0.1 and 5 microns."[1] Those are the particles that benefit health the most as the particles are distributed through all levels of the respiratory tract. Furthermore, multiple studies have shown that the most effective halotherapy treatments are accomplished when greater than *80% of the particles generated are less than 5 microns* and *mass concentration ranges are between 1 and 10 mg/m^3*.[2,3]

We can easily calculate the particle size distribution from the particle counter measurements. Here is the cumulative data from the above chart:

Particle Size (µm)	0.3 - 0.5	0.5 -1.0	1.0– 2.5	2.5 – 5.0	5.0 – 10.0	>10.0
Particle Count	1805233	2709720	4802187	7526098	1058630	13155
% Particle Size Distribution	10.1%	15.1%	26.8%	42.0%	5.9%	0.1%
Particle Size % <5µm	**94.0%**					

The ISR-PRO exceeds the minimum particle size distribution noted in scientific studies.

More than 90% of the particles generated by the ISR-PRO are less than 5 microns!

For the particle mass concentration, the question is… how much salt (mg) is emitted? We know that, based on simple before and after weight measurements, the ISR-PRO consumes about 500mg of salt. However, those are for *all* particle sizes. Most important is to determine the mass associated with particles less than 5 microns.

Salt is generally cubic in shape due to the ionic bonds between the Na and Cl atoms; it looks like a box. So, we will assume that a 5-micron salt particle is really a perfect cube measuring 5 microns per side. However, the 6-channel particle counter records the particles in bins with a range of sizes. The 2.5-micron particle count (seen in yellow above) is a sum of all particles between 2.5µm and 5µm. Since we are looking at the worst-case scenario with regards to mass concentration, I will assume that all the particles counted in yellow are exactly 2.5µm. I will do this for every bucket in the chart so we don't overstate the mass concentration for people seeking answers for larger rooms. Therefore, our sizes will be 0.3, 0.5, 1.0, 2.5, 5.0, and 10.0 microns.

The density of NaCl is,

$$2.16 \text{ grams/cm}^3$$

Converting to our common units (mg and µm), that means the density of salt can be written as,

$$2.16 \times 10^{-9} \text{ mg/µm}^3$$

That means the mass of each particle is quite small!

Particle Size (µm)	Volume/Particle (µm^3)	Mass/Particle (mg)
0.3	0.027	5.83E-11
0.5	0.125	2.70E-10
1	1.000	2.16E-09
2.5	15.625	3.38E-08
5	125.000	2.70E-07
10	1000.000	2.16E-06

To keep the math simple, we will use a weighted average calculation to accommodate the fact that the number of particles counted varies so greatly over the range of sizes.

Particle Size (µm)	% Particle Size Distribution	Weighted Average Mass of Particles (mg)	% Weighted Average Mass of Particles	% of Salt <5 microns
0.3	10.1%	5.88E-12	0.02%	
0.5	15.1%	4.08E-11	0.13%	
1	26.8%	5.79E-10	1.79%	
2.5	42.0%	1.42E-08	43.83%	**45.8%**
5	5.9%	1.60E-08	49.33%	
10	0.1%	1.59E-09	4.90%	

This chart says that of the 500mg consumed by the ISR-PRO, 0.02% was associated with 0.3-micron particles, 0.13% was associated with 0.5-micron particles, etc. If we sum the % Weighted Average Mass of Particles for size under 5 microns, we get 45.8%.

45.8% of 500mg = 229mg

The ISR-PRO generates 229mg of salt particles in a 5-minute run that are in the ideal size range for effective halotherapy.

Room Size (ft)	Room Volume (ft^3) *	Salt Particle Mass Concentration (mg/m^3)
Infinity POD	90	92
8x8	512	16
8x10	640	13
10x10	**800**	**10**
10x15	1200	7
15x15	1800	4

* Assumes an 8-foot ceiling

So, what is the maximum room size to maintain the target 10mg/m^3 concentration? **Turns out it is 10x10… if your room is greater than that, you would benefit from placing 2 ISR-PRO units in the room.**

Infinity Salt Air Machine operates out of Charlotte, North Carolina. Check them out at https://infinitysaltair.com/ for more information on the ISR-PRO.

Works Cited

[1] "Dry Salt Therapy (Halotherapy) Reference & Resource Guide" Clinical Studies and Medical Research. Salt Therapy Association, 28 Feb. 2019, p. 6.

[2] Chervinskaya, A.V. "Dry sodium chloride aerosol." 25 May 2018, https://chervinskaya.com/halotherapy_101/dry-sodium-chloride-aerosol-haloaerosol.html.

[3] Endre, László. "A szárazsó-belégzéssel történő kezelés elméleti alapjai és gyakorlati haszna" [Theoretical basis and clinical benefits of dry salt inhalation therapy]. *Orvosi hetilap* vol. 156,41 (2015): 1643-52. doi:10.1556/650.2015.30267