SASS® 4000 CONCENTRATOR

The SASS 4000 (patent pending) is a highly efficient, high-volume aerosol concentration device. Many applications require the collection and analysis of aerosol particles, ranging from counter-terrorism to epidemiology, medicine, and agriculture. These applications typically involve the monitoring or collection of airborne plant, animal or human pathogens. But aerosol sample analysis is frequently plagued by three problems:

- The targeted pathogen is present at a very low concentration;
- The collection process involves too small an air sample to be statistically valid; and/or
- Available bioassay methods are not sensitive enough.

In response to these issues, Research International is now offering the SASS 4000, the **highest-capacity portable** aerosol concentrator in production.

Figure 1: SASS 4000 Concentrator.

What is a Concentrator?

A concentrator processes large volumes of ambient air, continuously transferring particulates from this primary air stream to a much smaller secondary airflow (Figure 2). As a result, the secondary flow can reach aerosol concentrations that are 4X to 15X higher than present in the incoming air. The concentrator therefore amplifies the ambient aerosol concentration, while retaining most of the particles that were present in the incoming airflow in the secondary flow.

The concentrator device developed by Research International (Figure 1) has several favorable attributes.

- There are no moving parts, other than the primary fan.
- Maintenance is minimal.
- The operating temperature range is very wide.
- The structure is comparatively clog resistant.
- Sampled air volume is maximized, improving collection statistics.
- It is an ultra-high capacity stand-alone dry sampler when used with RI's proprietary electret filters

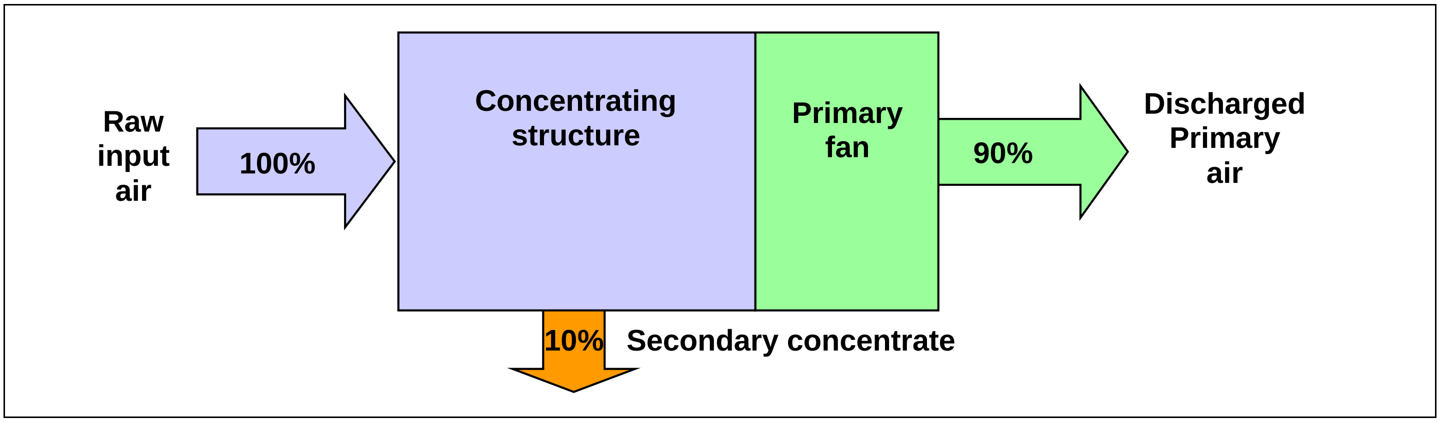

Figure 2: Concentrator flow diagram.

Particles are routed into the secondary flow by forcing primary circuit air to circulate through specially shaped channels where centrifugal force and particle momentum are used to isolate and concentrate the particles. The interior structure has been designed so that the smallest flow cross-section is a channel 0.6 mm wide x 6.35 cm long, providing good resistance to clogging by larger particles. A coarse screened cover with 5.4 mm square openings further restricts the entrance of large debris.

Air Flow Patterns

Airflow patterns are shown schematically in Figure 3. Air flows radially inward into the concentrator through the coarse square-mesh screen previously mentioned. This inward radial flow provides 360 degree sampling of the surrounding aerosol environment. A quick-release tripod that is standard with the product (See Figure 1) allows the concentrator section to be located from about 0.6m to 1.43m above the tripod mounting surface.

The primary fan and a curved air shroud are mounted above the concentrator, channeling exhaust air into a vertical stream away from the input air areas. The secondary concentrate air is available at a hose barb fitting designed nominally for 3.8 cm ID hose. This allows the discharged aerosol concentrate to be delivered, with minimum tubing length, to an assay system or wet collector that is on the ground under the concentrator. We recommend that the aerosol concentrate be delivered to its destination using a smooth-surfaced tube of not less than 3.5 cm ID and length not to exceed 3 meters- 2 meters is preferable.

Any sudden change in the aerosol concentrate tube's cross-section is to be avoided to minimize particle loss to the tube wall, and excessive pressure drop. Tube bend radii should also be of the maximum possible radius to minimize secondary circulation patterns and particle collisions with the tube wall.

Collection Blades

The particulate concentration process is primarily performed within 20 rectangular collection 'blades' that slip into radial slots in the main structure (Figure 4). These blades are precisely formed to the desired shape using state-of-the-art CNC machining centers at Research International. This manufacturing method assures that air moves as intended within the interior channels and minimizes particle loss through wall collisions, while also minimizing the overall pressure difference required to push air through the device.

Performance

Figure 5 shows typical data for concentration factor as a function of particle size for a primary airflow of about 3000 LPM and secondary air flow of 300 LPM. This Figure is based on tests that used polystyrene microspheres (density=1.05 g/cc) and fragments thereof, as test particles. Concentration factors were determined from multiple test runs using a Met One 200L laser particle counter.

Figure 3: Airflow patterns for the SASS 4000 Concentrator.

Figure 4: SASS 4000 Concentrator blade.

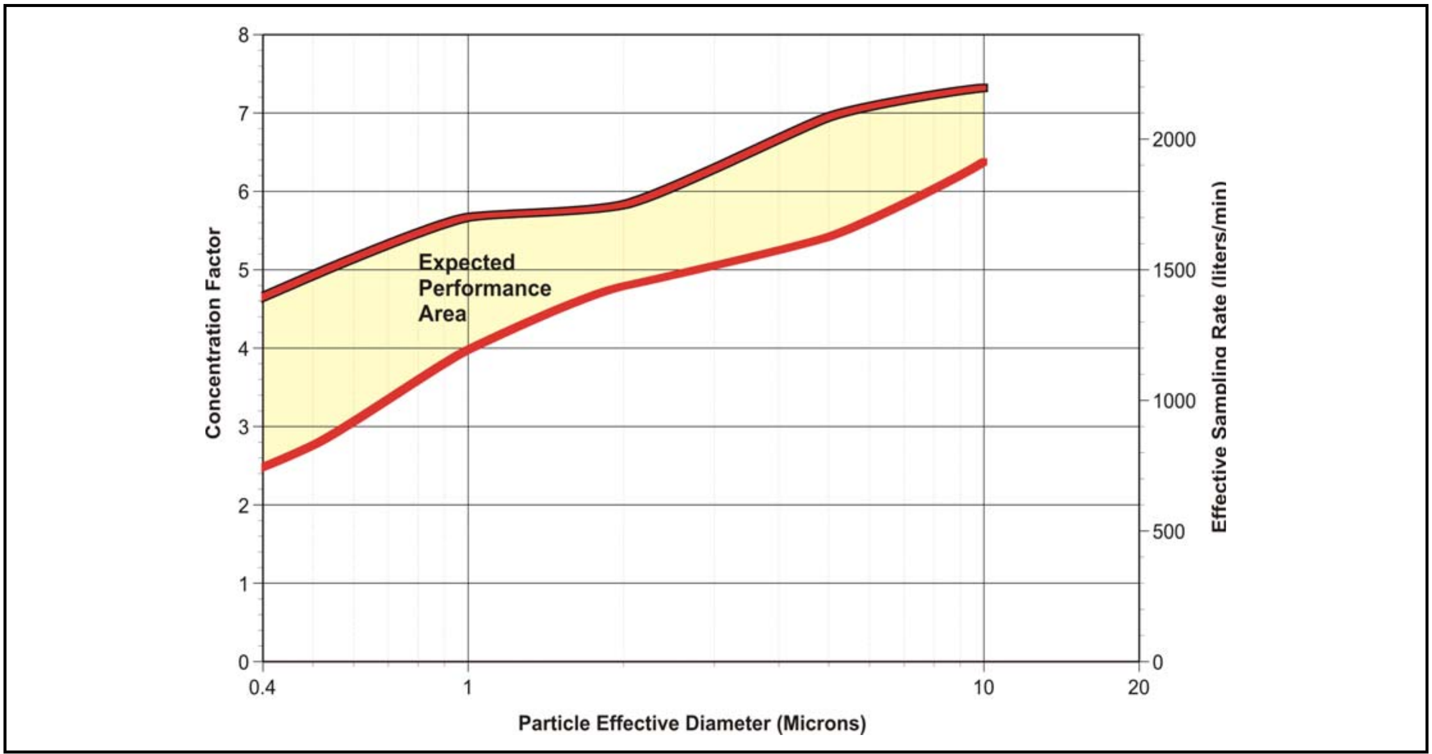

Figure 5: Secondary flow concentration for SASS 4000 Concentrator.

The Figure shows that aerosols of this density and with effective optical diameters in the range of 0.5 to 1.0 microns were concentrated by a factor of 3X to 4X. Particles in the range of 1.0 to 2.0 microns were concentrated by a factor of 4X to 5X, while larger respirable particles were concentrated by a factor of about 6X.

Particle concentrations in the secondary flow can be further enhanced by reducing the secondary airflow, as shown in Figure 6. For example, at a secondary airflow of about 40LPM, the concentration factor is increased by about 3X relative to operation at 300 LPM. However, please note that the total amount of particulate matter collected begins to fall substantially for secondary airflows below about 200 LPM.

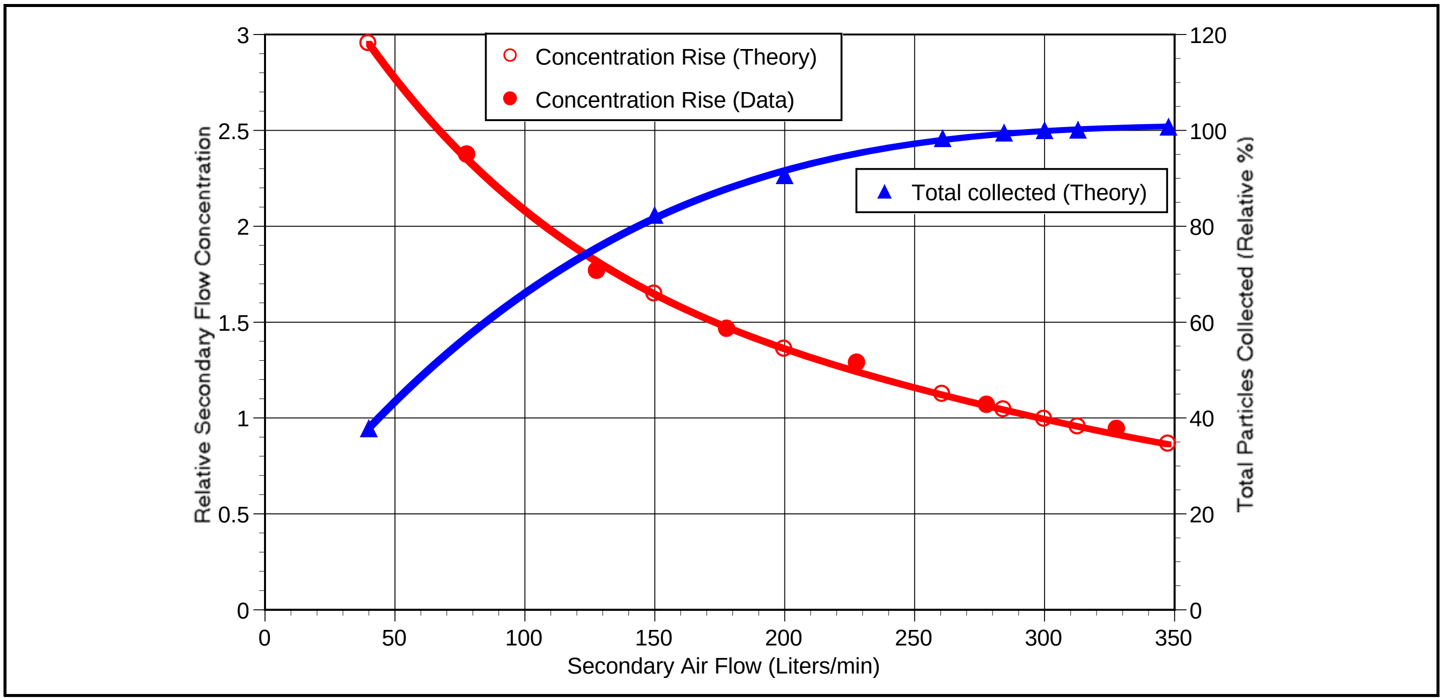

Figure 6: Effect of varying secondary air flow in SASS 4000 Concentrator.

Reduced airflow can be of significant value if the detection method requires small amounts of fluid. For example, Research International's standard air sampler, the SASS 2300, has an airflow of about 300 LPM when connected to the SASS 4000 concentrator, and operates with a water inventory of about 5 ml. The Mini-SASS (SASS 2400), however, which has a nominal airflow of 40 LPM, has a liquid inventory of only about 1 ml. Hence, the Mini-SASS may show a concentration increase of about 15X for this example case, as compared to 5X for the SASS 2300. However, the total amount of particulates collected within a fixed period by the Mini-SASS may be only 40% of that collected with the larger wet sampler. Which overall collection strategy is best will depend on application specifics.

Specifications

As shown in the Table, the 3,600 LPM aerosol sampling rate is obtained with about 90 watts of electrical power applied to the primary fan. There are no other power requirements, apart from power consumed by equipment that will receive the secondary aerosol concentrate. The air pressure drop associated with concentrate withdrawal is quite small- a differential pressure capability of about 4 mm of water is required to withdraw 300 LPM of secondary air from the device.

The operating temperature range is -40°C to 60°C. Let us know if there are any other special conditions such as prolonged high humidity; exposure to corrosive atmospheres; or exposure to aggressive chemicals that will attack type 6061 aluminum.

Table 1: SASS 4000 Concentrator Specifications	
Primary airflow:	3,600+ liters/min is sampled uniformly from around the concentrator's circumference.
Secondary airflow:	30-325 LPM at +0.4 cm of water static head.
Secondary airflow connection:	Hose barb fitting on base surface for nominal 3.8 cm ID hose.
Concentration enhancement:	4 - 15 times, typical, depending on primary/secondary airflow ratio.
Overall size:	38 cm high x 25.4 cm diameter max.
Weight:	6.32 kg (13.9 lbs.)
Operating temperature range:	-40°C to 60°C
Power consumption:	• 90 watts for ECM drive motor. If operated from DC, please specify DC source voltage of 12, 24 or 28 VDC. • 100 to 230 VAC lump-in cord AD/DC converter supplied. Please specify AC voltage range required.
Sound level:	72 db-A @ 1 meter radius on inlet equatorial plane.
Mounting:	Quick-detach tripod legs; 0.53m to 1.46m adjustable height.
Accessories:	• Hard shell carrying case. • Electret sample filter assembly (for stand-alone operation).

Connectivity Options

The SASS 4000 may be directly coupled to Research International's wet sampler, the SASS 2300 (with an airflow of 300 LPM and liquid sample volume of 4-5ml), or Research International's OEM wet sampler, the Mini-SASS (40LPM, 1ml sample volume). Alternatively, any device capable of providing 0.4 cm of water suction pressure at 300 LPM may be connected.

If your application does not require an immediate liquid sample, the SASS 3000 dry sampler with electret filter may also be connected to the 4000's aerosol concentrate output. Alternatively, an optional base-plate assembly may be ordered that allows direct mounting of the SASS 3000's electret filters to the SASS 4000. In that configuration, the SASS 4000's primary fan provides airflow for both the primary and secondary circuits- no additional fans or collection devices are necessary.

The SASS 4000 may be ordered with fans operable on either 115VAC or 220VAC. Call to discuss options for 12, 24 or 48 VDC operation.

Acoustic Behavior

It is difficult if not impossible to process large quantities of air without there being an accompanying acoustic output. The SASS 4000 creates a 75 dB-acoustic signature at 1 meter, measured at the midplane of the concentrator section. Drawing air at large rates from the secondary circuit will create additional acoustic output. In noise-sensitive applications it is recommended that the secondary airflow be limited to about 300 LPM, and in the most noise-sensitive applications, that secondary airflows in the 40-50 LPM range be considered.

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