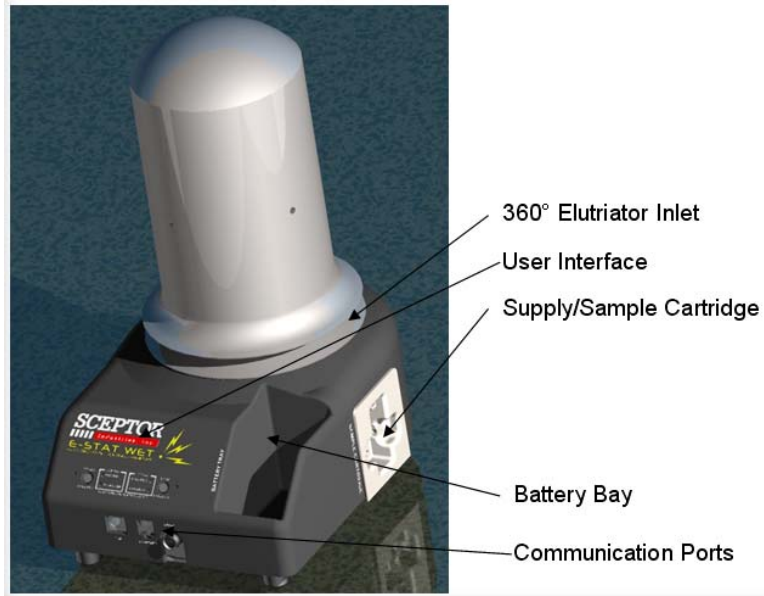




The purpose of the E-Stat Wet technology is to rapidly capture biological particles contained in the air and suspend them in a liquid at high concentration. Essentially the system converts an ambient aerosol to a controlled hydrosol that is amenable for various biological analyses.

The main steps involved in doing this within the E-Stat Wet systems are: aspiration of the ambient aerosol into the system; collection of the particles suspended in the aspirated air onto a collection substrate; and lastly extraction of the collected particles from the collection substrate by re-suspension into a liquid.

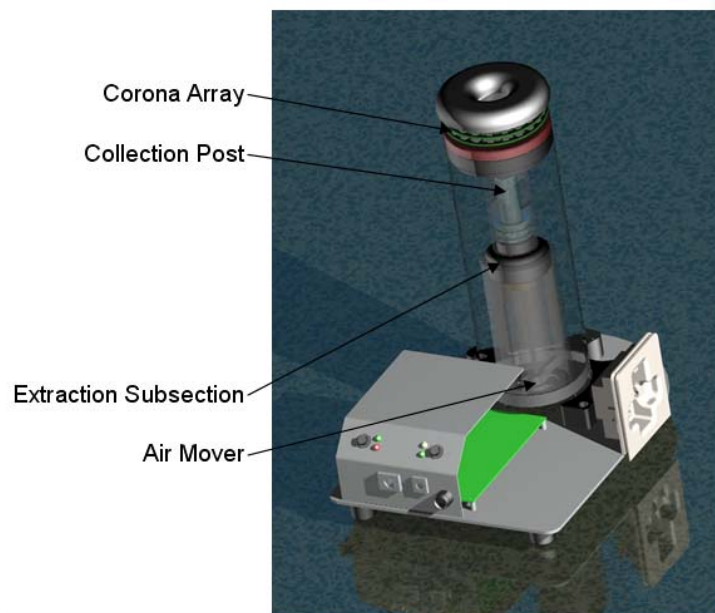
The system is designed to perform all of these items in a batch process once instructed to begin sampling. Liquid sample is only output from the system at the end of a sampling cycle rather than continuously during the collection process.



More detail on each of the sampling steps is described in the following sections.

Aspiration

Aspiration of the ambient aerosol is performed by using a 360° advantageous inlet. This configuration allows air sample to be aspirated into the system equally regardless of the incident wind direction as long as the direction is parallel to the ground. Once the air enters the inlet, 100



liters per minute of airflow is pulled upwards and enters the particle pre-separation region of the system.

This particle pre-separation region is designed as an elutriator, which uses a balance between gravity and particle velocity to effect pre-separation of large particles from the aerosol and prevent them from being passed to the collection zone.

A fine screen is also placed in the inlet elutriation section to help prevent self-mobile or large physical diameter but small aerodynamic diameter materials from entering the collection zone. These materials are normally items like leaves and insects.

The inlet is designed to have an advantageous velocity at the ambient interface. This means that the inward velocity is greater than the free-stream ambient velocity for most conditions. For instances where ambient concentration is desired to be calculated it is preferable to have an iso-kinetic inlet, where the face velocity is the same as the free-stream velocity. However as a sampler that is intended to capture as much ambient particulate as possible, a super-sampling approach is preferred.

Collection

As the aspirated and pre-separated aerosol is transferred to the collection area, it encounters a corona charging zone. The corona, through various charge transfer mechanisms, causes the remaining suspended particulate to become very highly charged. In the E-Stat design the charge is negative rather than positive as biological organisms can generally withstand a higher negative charge without becoming damaged.

Also within this corona charging zone is a combination ground electrode and collection substrate. The collection substrate / ground electrode is in the form of a post located along the center axis of the charging zone which is also axial to the airflow. Through electrostatic phenomena, the highly charged suspended particulate is attracted to the collection substrate where it attaches and is able to discharge its accumulated charge to the electrical ground. This process is analogous to a powder-coating process used to apply paint.



Using the ground electrode as the collection substrate enhances collection due to the ionic wind generated by the flow of ions from the corona pins to the ground electrode.

All the while this charging and collection process is occurring; the air in the system continues to flow axially along the post within the collection region. The charge created on the particles essentially causes the particles to follow a

different trajectory than the air in the system. Once the air exits the collection zone it passes through the system fan and is expelled from the bottom of the system.

It is important to note that one of the keys to good efficiency within the system is to ensure that either the airflow is slow enough such that the particles have time to migrate to the collection zone, or that the collection zone is long enough such that the same can occur. Due to this need, increasing the system flow rate without affecting the collection performance is about as easy as simply lengthening the collection zone. Therefore this type of collection system is amenable to scaling for the intended application.

Extraction

After the particles are removed from the aspirated airflow and attached to the post they are available to be extracted. As indicated in the above sections, the collection must be ceased to perform the extraction since the collection post must be moved from the collection zone into an extraction cup.

The extraction cup is a small cavity in the system in which the post is retracted to permit controlled extraction of the collected particulate into a liquid. O-rings on the far top and bottom of the collection post permit the cavity to be sealed when the collection post is in place. This configuration creates a closed environment for the extraction liquid; permits the system to operate in many orientations other than just vertical; and also permits the fluid to be isolated from the environmental temperature should heating be required to enable low temperature operation.

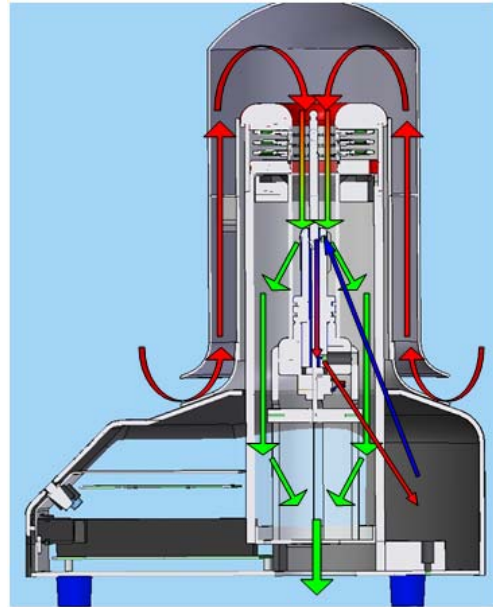
Two ports in the extraction cup are used to transfer sampling liquid to and from the annular void created between the collection post, the extraction cup, and the o-ring seals. The gap between the collection post and walls of the extraction cup are about .030" all around.

To remove the particulate from the collection post, a PBS-Triton solution (Phosphate Buffered Saline with .01% Triton X-100) is injected into the top liquid port in the extraction cup. The fluid first reaches a weir, which assists the fluid in distributing evenly around the diameter of the collection post, and then travels down the post in the annular void, extracting particles from the post as it travels.



Once the injected fluid reaches the lower liquid port in the extraction cup it is carrying a significant amount of the collected particulate. The fluid is then transferred out of the lower port, through the system fluidics, and into a waiting sample cartridge. After the liquid sample is transferred to the cartridge, the cycle ends and the system enters an idle state where a new collection can be commanded.

To enhance extraction the post had been automatically pre-coated with PBS-Triton residue before collection occurred either from an initial coating step or as part of a previously performed extraction. This minimal coating helps to mitigate the various forces that cause particles to attach to a surface such as Van-der-Waals and static forces and liquid surface tension created by moisture in the particles or air. Essentially the system is able to wash away the collection surface, which is actually the PBS-Triton residue, instead of attempting to separate the particles from the stainless-steel surface of the collection post. The collection post is also highly polished in order to avoid trapping particles in areas away from the flowing extraction fluid.



At the end of the cycle the sample is present in a leak resistant sample container, and awaiting removal for analysis. This self contained sample cartridge, and Sceptor's implementation of sound user interface design and automated collect, and sample production, make the Evogen E-Stat Wet biological collection system easy to use, even for the novice user.

