Triplex Cyclone (SCC 1.062) -- (PM)1, (PM)2.5 & Respirable

Applications
With growing interest and concern over diesel "soot", the need has arisen for a "PM1" personal sampler to investigate this fraction in the workplace\(^1\)\(^2\). Additionally, with PM2.5 firmly established the measurement of choice for Ambient and Indoor Air Quality, there is interest in what fraction of PM2.5 may be (PM)\(^1\)\(^2\).

Historical
A series of papers has been carefully building models of several types of ambient and personal cyclones for the diverse measurements of the size cut (D50) performance, of use to a variety of investigators\(^4\)\(^5\). These D50's include PM2.5, Respirable, PM10 and Thoracic. These papers have also firmly established the concept of referring to the "slope" of a Size Selective Inlets (SSI) penetration curve by an approximation of the Geometric Standard Deviation (GSD). Introduced by Peters et al\(^6\), this measurement is now referred to as "sharpness" to avoid confusion with the GSD. It is calculated from the penetration curve as:

\[
S = \left( \frac{D_{16}}{D_{84}} \right)^{0.5}
\]

Where: 
- \(S\) = Sharpness
- \(D_{16}\) = 16% penetration
- \(D_{84}\) = 84% penetration

Lower sharpness number (1.15-1.25) are associated with SSI's for ambient investigations. Larger numbers, up to 1.4 are related to SSI's for occupational monitoring. Overlaps can be observed where IAQ devices are employed.

Flow Rates/Design
The Triplex Cyclone was designed to solve the problem of achieving a high flow rate personal sampler for (PM)1 applications combined with a well defined, sharp penetration curve at a flow rate of 3.5 lpm.

Further investigation revealed a good fit to the EPA curve for PM2.5\(^6\) at 1.5 Lpm. A D50 cut of 4µm was also found at 1.05 Lpm which was sharper then the respirable curve and should be more properly referred to as PM(4).

<table>
<thead>
<tr>
<th>D50 µm</th>
<th>Flow Rate Lpm</th>
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<tbody>
<tr>
<td>1</td>
<td>3.5</td>
</tr>
<tr>
<td>2.5</td>
<td>1.5</td>
</tr>
<tr>
<td>4.0</td>
<td>1.05</td>
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The technical report on the development of this SSI may be viewed and downloaded by clicking at the top of this page. A graph of the penetration curves, at the three significant flow rates may be seen to the left, as well as a D50 vs. flow rate graph.

In order to enhance the omni-directionality of this cyclone, it has been given a "shrouded" inlet, first introduced by Higgins and Dewell\(^7\) for their original respirable cyclone. While this type of entry lacks the convenience, when performing an air flow calibration, of a single point inlet, it should be more forgiving of drafty environments. A press-on calibration chamber has been created for convenient use.

References