1) I have finished the particle injection and decay experiment. However, I have not anaysis the data yet. I am going to work on them today.

A documentation attached in this email to show the ions concentration in the most recently test and outside chamber. The background concentration in the chamber is around ~300 ions/cm3. Also, I have test the ionis concentration outside the chamber at two position, one is at sampling tube position and another one is next to the AHU unit. The ion concentration is higher than I expect, ~350 ions/cm3 at sampling position and ~670 ions/cm3 next to AHU unit.

2) I averaged the inside and outside number concentration over those 20 minutes and then calculate a single I/O ratio. Updated on PM1,PM2.5 and PM10 mass concentration I/O ratio in the attachment(I calculated all size bin, including three larger size bins of SMPS,205nm,274nm and 365nm.). We can removel them easily.

3)I did not test the reciculationg configuration and just keep the ionizer in the cardbox. If we want to check the mixing assumption with CO2 monitors, we can done it in this week.

Thanks,

Yicheng

On Mon, Nov 2, 2020 at 3:26 PM Brent Stephens <brent@iit.edu> wrote:

Thanks Yicheng and Prashik.

Yicheng: I'm not too worried about the PSD fitting exercise. We can just use the data we have as measured without having to go through this manipulation to try to get it to a curve fit.

Using the data directly, on #1 below, that's interesting. My only concern is that with the SMPS, the biggest size bins are really unreliable. In our past experience anything over the 115 nm size bin is really tricky. You start to get lots of 0's and random changes. Certainly 205 and 274 nm and 365 nm are not trustworthy. 154 *maybe*. You can really see the. Issue in 205 nm here with random drops to 0:

Basically the instrument just doesn't work well — something to do with the radial charging I've heard. In fact, in our original 3d printer emissions paper you'll notice we only reported up to 116 nm with this instrument: http://built-envi.com/publications/stephens_etal_ae_2013_3dprinters.pdf.

So I would suggest just ignoring those bins. If you remove them, it seems I/O ratios are pretty constant (on the SMPS) except for maybe the 115 nm size bin.

Very interesting to see the reduction in larger size particles on the OPS (e.g. 0.5 to 2.5 µm). However, it seems the I/O ratio drops *prior to* the ionizer coming on, no? If the ionizer came on at 15:30, does your point "2" really represent that? Can you see the same drop in the more granular 1-minute interval

data? I also wonder how much of this is driven by weird stuff going on outside the chamber. For example looking at just the 2.1 µm size bin, right before and after the ionizer comes on the 2.1 µm number concentration outside the chamber increases to 18 and 20 (in whatever units that is) and then decreases to 5 and 5 and 6 for the next 3 samples:

So the reduction may have less to do with what's going on in the chamber and more to do with what went on outside?? I would want to see this analyzed in more detail before drawing a conclusion.

Moreover, I still think it's useful to use the data to calculate PM2.5 (and PM1 and PM10) concentrations, summing across the SMPS and OPS, to see if you see an impact there. They are less subject to these weird influences in individual size bins (similar to how total particle counts on the SMPS smooths out these impacts).

I'm also curious to know how you generated your I/O size-resolved estimates. Did you average I/O ratios over the whole interval of 20 minutes? Or did you average concentrations over those 20 minutes and then calculate a single I/O ratio using those averages inside and outside the chamber?

I took a stab at calculating the average (SD) I/O ratio with ionizer off and ionizer on for total particle counts from the SMPS and OPS just to see what that might look like (a simple way of looking at the data), although I calculated them assuming each 1 minute interval indoor concentration matched with a 1 minute interval outdoor concentration measured 20 minutes ago… probably not the best way to approach. Although I then made I/O calculations using your average concentrations in and out on the "chamber ratio PM" spreadsheet (attached) (assuming the indoor/outdoor concentrations on an absolute basis were calculated as an average across each 20 minute time interval, which looks to be the case), and got similar numbers for total I/O # ratio from SMPS and total I/O # ratio from OPS:

So, at these operating conditions, *maybe* a slight reduction in inside/outside PM ratios, but barely, and nothing particularly obvious to me.

I think we should (a) have a call on this soon — later this week? — to synthesize our thoughts, and (b) setup a time early next week to present results to our colleagues also working on this and get their feedback, and (c) start preparing a draft manuscript writing up these various ad hoc experiments.

Some remaining questions on my mind:

1) Yicheng, do you have any more ion concentration measurements from outside he chamber? I just don't recall what our background levels are in the lab… I didn't think they were as high as ~1500 ions/cm3, which is what your data show currently from this one documentation inside the chamber:

2) Yicheng, did you also do a particle injection and decay experiment?

3) I contact STAT Analysis again and they think they can give us more aldehyde results. They said they'll follow up today or tomorrow. Hopefully that becomes more useful.

Thanks,

Brent

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On Nov 2, 2020, at 8:00 AM, Yicheng Zeng <yzeng15@hawk.iit.edu> wrote:

Hey Professor and all,

I have finished the PM elevated and decay experiments this weekend. I have put the ions counter on the table, next to ACH. John can grab it from there.

I have done several preliminary analysis on PM data, I/O ratio, and trying to create the particle size distribution based on our SMPS and OPS data. However, I am confused about the PSD part. Summary excels attached. Please have a look and let me know what you think.

1. For most size bin, except these 3 size bin(0.154um, 0.2054um, and 0.2738um), the I/O ratio decreased after the ionizer turning on. However, on these 3 bins, the value of I/O ratio increased a lot (from 1.1 to 2.1 even 5.8, the highlights in the excel ) after turning the ionizer on, and then i/o ratio decreased again.

2. For larger particle size(OPS part), the trend of the I/O ratio is similar. They all decreased after ionizer on and then increase again. Perhaps the ionizer charged a part of the particles at first, then charged particles coagulate together into larger particles and settled faster. However, its effective time may be relatively short.

3. I am trying to create the PSD every 20 minutes(in and out sampling period), and then trying to compare them to see if there any changes in the particle size distribution. At first, I used Excel to draw "dN/dlogdp vs Dp" figure, then I have a problem on OPS data, especially the 0.3um size bin. The PSD looks so weird.

I tried the second way, using "Multi-Instrument 2.0" software to estimate and fit the distribution. The software can help me get good PSD based on our data. Photo attached. The red line is the PSD before