Aerosols Transport – Particle Removal Experiment
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1 Placing particles on the slide

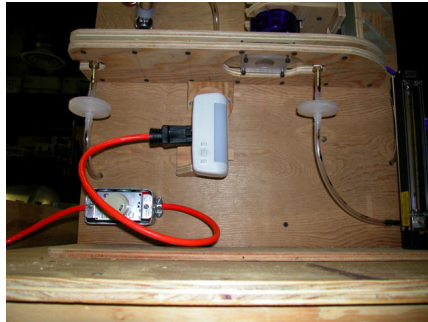## 1.1 Swing the light beneath the test section down and to the left.

Figure 1: Light rotated away from the test section.

1.2 Remove the 4 screws that hold the slide in place.

Figure 2: The four allen head bolts holding the slide to the channel should only be finger tight. These must be removed to access the test section.
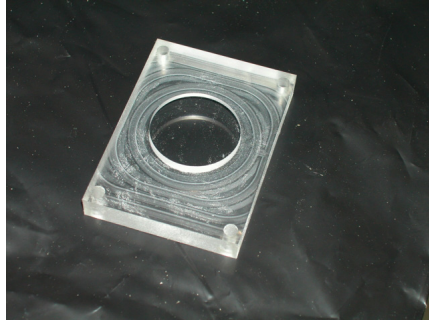
Figure 3: The lower surface of the test section is a plexiglass block. This is the surface upon which the glass particles will be deposited.

1.3   Clean the slide using a little water.

1.4   Dry the slide thoroughly. You may want to consider reinstalling it in the channel and passing some air across the surface to remove any moisture on the surface of the slide.

1.5   Place the slide on the table and carefully dip the pipe cleaner into the bag of particles.

The glass particles are spherical in shape and range from 5 to 40 μm. The average particle is ≈ 20 μm in diameter. For reference purposes, at 200x magnification, the microscope has a resolution of 2.95 $\mu m/px$.

1.6   Tap the shaft of the pipe cleaner on the edge of the slide to shake a small cloud of particles onto the surface of the slide.
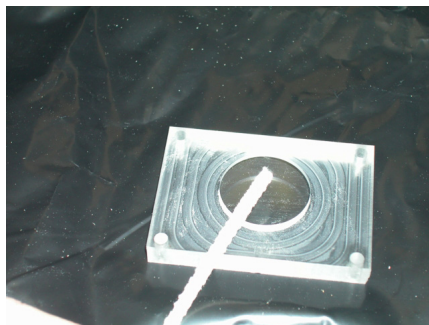

Figure 4: Tap the pipe cleaner on the edge of the slide to deposit the paricles.

Figure 5: This slide probably has too many particles on it. The pipe cleaner can be used to brush a few particles off the surface or to spread the particles more evenly.

1.7 Insert the slide back into the channel and finger tighten the bolts.

1.8 Replace the light beneath the test section.

2 Taking the pictures

2.1 Open the Intel Play QX3 Computer Microscope software.

This is software that was supplied with the microscope. It has a large number of filters and strange photo editing features that apparently appeal to kids but will not be used in this experiment.

2.2 Turn on the light beneath the test section.

Make sure the light is plugged in and then adjust the dimmer switch to full power (clockwise until it stops). The original microscope lamp was powered by the USB bus. This light was not bright enough to illuminate the test section and provided uneven illumination making the images difficult to interpret.

2.3 Set the magnification to 200x by moving the green turning section on the microscope until you see 200x.

At this setting the resolution of the microscope is approximately 2.95 $\mu m/px$.

2.4 Focus the microscope by using the up/down traverse.

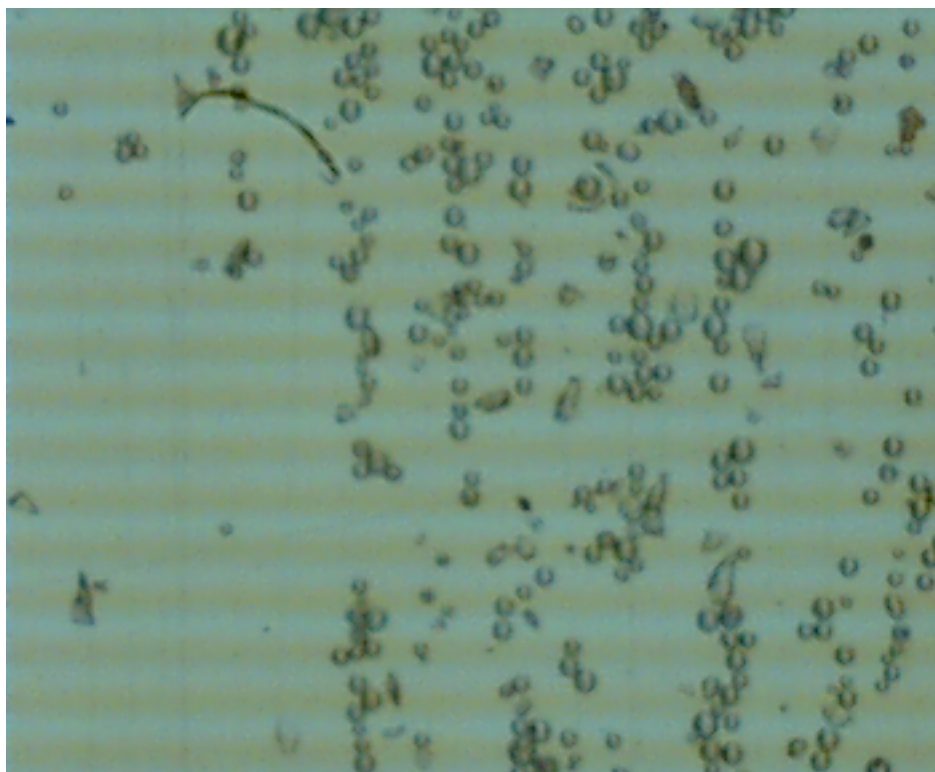The particles will appear as white dots with gray ovals surrounding them.

Figure 6: Sample image of the slide with particles. The flow through the channel would be from bottom to top and the lines in the images are caused by the 120Hz flickering of the florescent light.

2.5 Take a picture by clicking on snapshot button in the software.

Multiple pictures can be acquired at at flow rate or different flow rates prior to saving the data. It may be a good idea to save the data as it is acquired to avoid confusion later.

2.6 After taking the picture click on the arrow in the bottom left hand corner of the screen.

This will take you to another screen. Your image should be showing on the screen.

2.7 Click on the export button to save the image.

This should allow you to save the picture. Name the image such that if you lose your notes you can infer the flow rate and run number from the filename. **Note: a .jpg extension will be added to the end of the filename you choose.**

2.8 Click the microscope in the bottom right hand corner of the screen to return to the microscope image.

If you have finished the experiment, click the red stop sign icon in the upper right hand corner of the page.

3 Increasing the flow rate

3.1 Make sure the flow meter is turned off.

The knob at the bottom of the flow meter is turned all the way to the left.

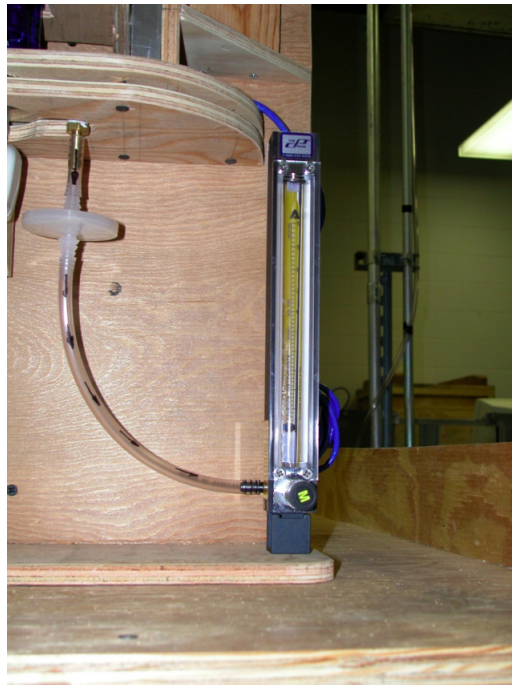Figure 7: The flow meter used is a basic rotameter with units of liters per minute.

3.2 Attach the pressure line to the pressure regulator.

The pressure line should be connected before you arrive. You can visually verify that the air hose is attached.

3.3 The pressure regulator will be set, prior to beginning the experiment.

Please do not touch the regulator. The adjustment knob is very coarse and too much or too little pressure could have adverse affects on the experiment.

3.4 Take a picture with no flow through the channel

This is going to serve as the baseline from which you'll compute the percentage of particles removed at each of the increasing flow rates.

3.5 Increase the flow meter by turning it slowly to the right.

The flow meter is very sensitive so turn it very slowly. You can determine the number of data points needed for the experiment.

3.6 Allow the flow rate to stabilize and acquire an image.

The flow rate should stabilize fairly quickly.

3.7 Rinse, wash, repeat for additional flow rates or runs.

4 Particle counting

The particle counting software uses the machine vision toolbox included with LabVIEW.

4.1 Launch "measure.vi"

The icon should be on the desktop.

4.2 Click the RUN arrow in the upper left hand portion of the toolbar.

When the VI (Virtual Instrument) is running the arrow will be black. Otherwise it will be white.

4.3 Click the "Load File" button.

This should open a dialog box. Navigate to the directory containing your images and select one of them. It might be a good idea to pick an image at a higher flow rate with fewer particles.

4.4 Use the mouse to draw a yellow rectangle around a single particle.

Click and hold the mouse button above and to the left of a particle. Drag the mouse below and to the right. This will draw the yellow rectangle.

4.5 Click the "Learn Template" button.

The yellow rectangle defines a region of interest that the code will extract from the image. This region will tell the code what to look for in the rest of the images.

4.6 Type the path to the directory containing your images, or...

Click the button with the little yellow folder on it. This will open a dialog box. navigate to the folder containing your images and click on one of the images. It does not matter which image you select.

4.7 Highlight the images to be processed in the ring list menu box.

Shift-Click on the files that you'd like to process. The code will load them one at a time, count the particles, display the count, and then write the data to a file.

4.8 Click the "Begin Processing" button.

This will begin the processing loop.

4.9 Read the name of the file to be processed, enter the flow rate associated with the image, and click "Process this Image"

Doing this will do a few things. A series of red rectangles should appear on the image shown in the window (note: this is the image you are processing in the window!), the particle count and flow rate will be entered into a data array for future storage, and the data will be plotted on a graph.

4.10   Click the "Move to Next Image" button.

This will load a new image file. Check the file name, enter the associated flow rate information, and process. This will continue until you've processed all the highlight files.

4.11   The data will be saved upon completion of the processing.

The file path for the output path may be typed or selected with a dialog box. If the filename is not changed between runs the data from the second run will be appended to the end of the data from the first run. This may be a convenient way to keep track of all your data.