Transmittance of Theatrical Lighting Filters

The lighting on a performance stage can be tricky considering the many colors, fabrics, and surfaces that the stage lighting will illuminate. To prevent glare and present the colors onstage in their true hues, stage lighting is controlled by placing colored filters in front of the light sources.

These lighting filters are nicknamed “gels”, the name by which professionals in design and production work refer to these colored sheets of polycarbonate or polyester. Long, long ago, when the Rolling Stones were but strapping lads with visions of fame and fortune dancing in their heads, lighting filters were made from gelatin, thus the nickname gels.

In this experiment, you will use a Vernier Spectrometer (V-SPEC) to measure the amounts and wavelengths of light that are transmitted through various lighting filters. Different filters transmit different wavelengths, which can be seen in the information that accompanies each filter. You will measure % transmittance over the 380 – 950 nm range and compare the resulting graphs with the information supplied for the filters.

OBJECTIVES

In this experiment, you will

- Measure and analyze the visible light transmittance spectrum of various samples of theatrical lighting filters.
- Compare and contrast the spectra of lighting filters with the published information.

MATERIALS

Vernier Spectrometer	light filter samples, cut to fit into a cuvette
computer	tissues (preferably lint free)
one cuvette	

PROCEDURE

1. Use a USB cable to connect a Vernier Spectrometer to your computer.
2. Start Logger *Pro* 3.4.6 on your computer.
3. Select a set of lighting filter samples to test and record the proper information about each sample in your data table.
4. To set up the Vernier Spectrometer, open the Experiment menu and select Connect Interface → Spectrometer → Scan for Spectrometers.
5. Calibrate the spectrometer.
   a. Obtain an empty cuvette. Wipe the clear sides of the cuvette clean with a lint free tissue.
   b. Open the Experiment menu and select Calibrate → (Spectrometer). The following message appears in the Calibrate dialog box: “Waiting … seconds for the device to warm up.” After 60 seconds, the message changes to: “Warmup complete.”

c. Place the empty cuvette in the spectrometer. Align the cuvette so that the clear sides are facing the light source of the spectrometer. Click "Finish Calibration", and then click OK. Leave the cuvette in the Spectrometer.

6. Analyze the light transmittance of a lighting filter sample.
   a. Open the Experiment menu and select Change Units → Spectrometer: 1 → Transmittance.
   b. Place the lighting filter in the cuvette so that the filter is "blocking" the path of the light source. Keep in mind that your goal is to measure how the filter affects light as it passes from one place to another.
   c. Click ▶ Collect. A full spectrum graph of the filter sample will be displayed.
   d. Examine the graph, noting the peak (or peaks) and other distinguishing features.
   e. Open the Experiment menu and select Store Latest Run to save the results of this test.

7. Repeat Step 6 with the remaining light filter samples. Optional: place two filter samples in the cuvette and measure the transmittance of light; you may see some interesting results depending on the filters that you use.

8. At the behest of your instructor, print a copy of the graph of each filter sample. Proceed to the Data Table and Data Analysis sections and take care of your obligations there before exiting the Logger *Pro* 3.4.6 program. The chances are pretty good that you will need to consult your data to answer the questions at the end of this write-up.

9. (Optional) Save and/or print a copy of your test results. Select Save As… from the File menu and save your experiment file.

10. Select Exit from the File menu to close down Logger *Pro* 3.4.6.

DATA TABLE

Trial	Lighting Filter Sample	Peaks or unique features of the graph
1		
2		
3		
4		

DATA ANALYSIS

1. Describe, in detail, the graph of each light filter sample. Emphasize the features of each graph that distinguishes it from the other samples.

2. Identify the wavelengths and absorbance values of every peak in the graph of each filter.

3. Compare the graphs of each light filter sample with the published information about that sample. Discuss how well your test results match the published information.

Teacher Information

1. There are many reliable sources of theatrical lighting filters. One such source is Lee Filters (www.leefilters.com). The advantage of using filters from a company such as Lee Filters is that the filter comes with a transmittance graph and a description of the specific color of the filter (Pale Violet, Mallard Green, and Flesh Pink, for example).

2. If you cannot obtain theatrical lighting filters, colored acetate report covers will work.

3. The procedure instructs the student to place a rectangular piece of filter in a cuvette. We have found an empty cuvette to be an efficient holder for strips of filters. Using a cuvette also makes it easy to test 2 or more filters at once.

4. It is good lab technique for the student to place the filters in the same place in the cuvette from test to test. However, because the light path of the spectrometer is very narrowly focused, the positioning of the filter strips does not significantly affect the resulting graphs.

5. An interesting extension for this experiment is to test two filters separately, and then prepare a new calculated column that combines the % transmittance of the two filters. Follow that by placing both filter strips in a cuvette and measuring their combined % transmittance. You can then compare the calculated/predicted results with the actual results.

6. We included a few questions in the Data Analysis section of the student version as a generic starting point. Please feel free to edit or replace these questions as best fits the needs of your experiment.

7. As a good way to become familiar with this experiment, you should plan to keep a set of sample data as well as develop an answer key. It is our experience that data can vary, based on many factors, and the sample data that we have collected in testing this experiment may not be representative of your students' results.

