



Spreadsheets to Dye for:

Using Excel to Teach and Facilitate the Fiber-Reactive Dyeing Process

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Creative dyeing has hit every segment of the apparel market, thus increasing career opportunities in the textile and apparel arts. However, professional dyeing with consistent results requires considerable calculations, which many design students find challenging. By using Excel—one of the programs that employers request most frequently—students can streamline and increase the accuracy of the mixing process by creating spreadsheets that make all of the calculations for them. Accurate formulae are extremely important when using fiber-reactive dyes, because the formula must be correct before the goods are added. Whereas one can see the final color and tweak it by adding more dye during the acid-dyeing process, one cannot see the final color until the end of the process when using fiber-reactive dyes.

In the Creative Design Techniques course, which includes knitting and embroidery, students learn various dyeing techniques and apply them to fabrics and yarns composed of cellulosic, modified cellulosic, protein, and nylon fibers. To assure the anticipated results when using fiber-reactive dyes, this professor selected the dyeing methods developed by Carol Soderlund and taught in her New Color Mixing for Dyers- Part 1, course at ProChemical and Dye in Fall River, MA. During the workshop, the professor created a notebook with more than 1,000 fabric swatches, which show the results of using various dye combinations. Soderlund's methods are extremely accurate, because they use the metric system and are based upon the weight of the dye and of the goods. This method also uses only dyes in the three primary colors to produce more than 350 hues, which saves both money and storage space. For this experiment, the professor purchased three red, three yellow, and three blue pure primary dyes in warm and cool variations. Different combinations of these primary dyes can produce thousands of colors.

The 16 students were divided into three groups, each of which worked with a different family of primary colors. After learning safety procedures, equipment use, and information about fiber-reactive dyes, the students used calculators to perform the calculations required to prepare 1.0% stock dye solutions. They then used Procion MX dyes to create the primary stock solutions. Students then learned to create an Excel form, which contained the formulae for creating a 5.0% stock solution. They used the calculations from this spreadsheet to mix 5.0% stock solutions in their respective primary colors.

Whereas creating stock dye solutions requires a few calculations, creating different colors from various percentages of primary colors requires many formulae and calculations. One must consider the stock concentration; the desired depth of shade (DOS); the weight of goods (WOG); the proportion of each primary; and the required amounts of water, soda ash, and salt. Each student selected three colors from the sample notebook and used Soderlund's charts and

worksheets to calculate the formulae by hand. They then learned how to create a spreadsheet that would perform all calculations and display the required amounts of each primary and of water, soda ash, and salt. Students selected different colors from the notebook to dye and then used their spreadsheets to make the calculations. To check the accuracy of the spreadsheets, students checked the calculations by hand before mixing the dyes. All dyed samples were also compared to the swatches in the notebook.

After the initial exercises, students used their spreadsheets to mix dyes of different concentrations for various fabrics, including silks, cottons, and woolens. They practiced both vat dyeing and low-water immersion techniques and compared the results.

Students reported that they enjoyed the dyeing process and the wide variety of colors that they could produce. Some combined fiber-reactive dyeing with fabric painting and eco-dyeing with rust and plant materials to achieve special effects. They said that they appreciated the speed and accuracy with which the spreadsheets calculated the dye formulae as well as the ability to achieve the desired color. Students also enjoyed the surprising, unexpected results of low-water immersion dyeing, during which the dye molecules attached themselves to the fabric at different speeds to form several shades and colors on one fabric.

This experiment is valuable because it enables students to see how they can utilize Excel for applications that differ from those that they learn in most merchandising courses. In consideration of the success of this exercise and of the growing importance of dyeing and fabric embellishment, a separate dyeing course will be developed. It will include natural, acid, and eco-dyeing as well as fiber-reactive dyeing. Students will learn to develop the above spreadsheets as well as more complex sheets that can calculate formulae for dyes of different values (light to dark) and for over dyeing fabrics of one color to create a different color.

#### References

Soderlund, C. (2013). *Color Mixing for Dyers*. (Available from Carol Soderlund, 664 Castle Street, Geneva, NY 14456)