Color Development

Overview
To determine the shrinkage and CIELab color values for ceramic tiles with varying stain concentration, firing temperature, and base body formula. Determining the color values will allow Dal-Tile to accurately match customers’ color requests.

Objectives
Determine the linear shrinkage and CIELab color values of pink, blue, and black color stains at five different concentrations, seven temperatures, and two base base body formulas (EPK and Snobrite).

Approach
● The Dal-Tile manufacturing process was recreated in the lab using a Carver uniaxial press and box furnace.
● The stains (color additives) were mixed at concentrations of 0.25, 0.5, 1, 2, and 4 wt% with the EPK and Snobrite base bodies
● A 0.5 “ diameter die was used to press each pellet at 77.44 MPa pressure
● The box furnace was set at a ramp up and ramp down rate of 13.8˚C/min with a 30 minute hold time.
● The target temperatures for firing the samples were 1149, 1163, 1177, 1191, 1204, 1218, and 1232˚C
● The fired samples were taken to Dal-Tile Gettysburg for analysis using a reflectance spectrophotometer.
● The colors were validated by using the CIELab plot.
● The thickness of each sample was measured before and after firing to determine linear shrinkage

Outcomes
● The color values can be used to match the colors of tiles that customers bring in so that high quality tiles can be made based on the parameters that match the color values
● The quantitative color data can be used to save on the cost of stains for the sponsor by choosing high temperatures instead of high stain concentrations for a pre-determined color value
  ● The shrinkage data was consistent with shrinkage data collected by Dal-Tile
  ● Shrinkage did not change with different stain concentrations or temperatures