Raw, solid limestone and loose powder samples can be challenging to test for color consistency because the texture of the sample is often uneven. Image Source: Shutterstock user photolike

Limestone plays a major role in a number of industries and products, from building materials to cosmetics—limestone is even a key ingredient in certain pharmaceuticals and toothpastes. However, while limestone is a popular material with many diverse uses, it can also present significant challenges when it comes to the color measurement process. This is because the rough texture of raw limestone can make accurate color analysis far more difficult than with a uniformly textured sample; raw limestone typically consists of deep cracks, jagged edges, and dirt deposits that will make the material appear either lighter or darker than it actually is.

This is why you need to implement a dependable color quality control method when testing your limestone samples. By standardizing your color quality control protocols using a highly reliable spectrophotometer and state-of-the-art color measurement software, you can ensure accuracy and precision of color analysis. This, in turn, will improve the overall appearance of your products, as well as the quality of the raw ingredients you use to create them.

Why Color Quality Control is Essential for Limestone

Whether you use limestone as a key ingredient in your cosmetic, pharmaceutical, or processed food products, testing this material for color consistency is vital. For example, limestone is an important ingredient in baking soda, as it helps regulate the pH of the product. However, baking soda manufacturers need to ensure that the powdered limestone in the product is consistent in color from batch to batch, as a lack of consistency could make the final product appear contaminated.[1] Meanwhile, in construction, limestone is highly valued in large part for its aesthetic qualities, and this material is frequently used in cement or floor filler owing to its beautiful finish. In order to ensure that these limestone building materials are as aesthetically pleasing as possible, you need to use materials that are consistent in color; significant variations in color could negatively

affect the overall appearance of the finished construction project. This is also true in the toothpaste industry, as limestone is often used to make the product appear more white, an important aesthetic quality in many toothpaste products. To achieve this level of color consistency in limestone ingredients, you need to use consistent color measurement protocols.

Raw limestone often varies significantly in color, as contaminants and texture can affect the appearance of the material. Image Source: Shutterstock user Cezara Tudosa

Addressing the Challenges in Testing Limestone for Color Consistency

The primary challenge that manufacturers face when they test limestone for color consistency is that this material unevenness of texture, as highly textured samples are typically difficult to test for color consistency without proper sample preparation. For example, limestone in its raw, sedimentary rock form usually has to be ground into a fine powder prior to testing. This is because the rough edges of the raw rock sample will make the rock appear darker in some areas, but lighter in others. Although some spectrophotometers are specifically designed to measure the color of textured products like this, the extreme texture variation in some limestone samples can still preclude accurate analysis. As a result, your spectrophotometer may flag the sample for color inconsistency, even if the sample actually falls within color tolerance standards.

To solve this problem, you can use one of two methods. First, you can test your samples using the Aeros non-contact spectrophotometer, which is able to measure the color of highly textured samples using a wide area of view, rotating sample platform, and a sensor head that automatically adjusts for sample height. In order to use the Aeros to test the color quality of your limestone products, you can simply break your sample into small pieces and place these pieces into a metal sample dish and then place the dish on the Aeros' large sample platform. This may be an option for manufacturers of products such as limestone gravel because the final product is already comprised of relatively small pieces.

Once you've placed your pieces on the sample platform, the instrument will take a number of measurements of the sample, and will rotate the platform automatically in order to measure a large surface area of the sample. The Aeros then averages these measurements to get an overall color measurement result for the entire batch. The benefit of the Aeros is that you won't have to grind your limestone sample into a fine powder first, as the instrument is capable of testing the color of textured samples, such as small, roughly-chopped pieces of limestone. The Aeros sample handling platform is perfect for testing sedimentary rock with jagged edges.

Alternatively, you can use a standard benchtop spectrophotometer capable of handling loose or pressed powder samples to test the color of your limestone. This is an appropriate color measurement method if you plan on using the limestone as a powder in your final product, such as in toothpaste, baking soda, or powdered cosmetics like eyeshadow. However, this requires more extensive sample preparation. When you use a spectrophotometer other than the Aeros, you need to grind your limestone sample into a fine powder and typically stamp it into a pressed plaque sample holder. Grinding the sample into a powder and pressing it into a plaque improves your color measurement results because the pressed powder plaque will eliminate any minor variations in texture in your sample, which may interfere with the accuracy of your color analysis. With the Aeros, you can grind the sample into a powder and measure as-is. This method allows you to measure the sample directly rather than through glass or plastic petri dishes and a much larger area can be measured than when measured in a smaller petri dish.

Historically the limestone industry used a color scale named Rd,a,b in the direct reading photoelectric colorimeters that were available in the late 1940's through the 1970's. Once your limestone sample is prepared properly, your spectrophotometer will use specialized color spaces, such as the Hunter L, a, b and the CIE L, a, b color space, to analyze the color of the sample. The aRd and bRD are equal to the Hunter a and b values and Rd is equal to the Y Brightness index. These are included in the software of every HunterLab spectrophotometer, and they will objectively analyze the color of each sample, helping you detect color inconsistencies. Generally, a high Rd value and a bRd value of 0 are signs of a high quality, largely contaminant-free sample of limestone, and you should look for these values when you measure your own limestone samples for color quality. You can also use your spectrophotometer to determine whether your limestone sample appears too yellow based on your own tolerance level standards, as yellow coloration is a sign that the limestone could be contaminated with too many trace metals.[2]

Grinding limestone into a powder and creating pressed plaques is typically the most accurate color measurement method. Image Source: Shutterstock user Jenoche

Improvements to Color Quality Control Have a Positive Impact

When you improve your color quality control protocols for your limestone products, these improvements will have a lasting positive impact on your product quality, your process, and your bottom line. Some of the benefits include:

- **Improved product quality:** A reliable spectrophotometer that has both the Hunter L, a, b and the CIE L*, a*, b* color spaces installed can help you achieve better color consistency, ultimately helping your limestone products appear more aesthetically pleasing.
- **Detecting trace metal contaminants:** Testing for yellow tones in your samples could help you detect small traces of metal in your limestone ingredients.[3]
- **Preventing unnecessary product waste and increasing cost savings**: By standardizing your color measurement procedures, you can identify the samples that truly fall outside of color tolerance standards. This allows you to detect unwanted color variation, which in turn could result in less product waste and more cost savings. You won't manufacture faulty products or have to rework any of your products to make them appear more consistent, which could lead to significant savings over time when potential problems are caught early.

A reliable spectrophotometer like the Aeros could make your limestone color measurements far more reliable and repeatable over time, which will prevent you from mistaking variations in texture for actual color variation. The instrument also increases efficiency at your lab or manufacturing facility, as you'll spend less time preparing your limestone samples for the instrument. Alternatively, you can use benchtop spectrophotometers like the ColorFlex EZ, the LabScan XE, or the UltraScan VIS to measure the color of your pressed powder limestone samples. The ColorFlex EZ includes a

glass sample cup accessory that can be used to easily measure the color of powdered samples, while the LabScan XE and the UltraScan VIS instruments both have specialized port insert accessories designed to hold your powdered samples perfectly in place. Using these instruments and accessories in your own lab will have a lasting positive impact on the quality of your future products.

HunterLab Reliability

Are you ready to obtain more reliable limestone color measurements in your lab? Read More about Aeros and contact us today to find out how we can help you solve the color measurement challenges in your industry, helping you create better products and processes.

1. "Limestone in Industry," http://www.bgs.ac.uk/discoveringGeology/geologyOfBritain/limestoneLandscapes/resourcesConflictsSustainability/industry.html
2. "Trace Elements in Illinois Pennsylvanian Limestones", 2012, https://www.ideals.illinois.edu/bitstream/handle/2142/45132/traceelementsini243ostr.pdf?sequence=2
3. "Calcium Carbonate", https://www.tomsofmaine.com/our-promise/ingredients/calcium-carbonate