Spectrophotometers have revolutionized the way product color is measured across numerous industries, from maxillofacial plastics to maple syrup. By allowing for full spectrum analysis of both reflected and transmitted light, spectrophotometers offer the most advanced method of objectively quantifying chromatic information possible today and give customers virtually endless options for obtaining accurate color measurements. However, not all spectrophotometers are created equal; recent technological advances have expanded the versatility of optical configurations and understanding your options is critical when choosing the right instrument for your purposes.

Single Beam Systems

The first spectrophotometers were based on a single beam configuration that is still in use today. The light source in this type of configuration is concentrated in a single beam, requiring discrete measurements of each object. In practice, this means calibrating the machine prior to each test by measuring a reference standard and making any necessary corrections to compensate for light source changes during the standardization process. Single beam instruments have historically suffered from deteriorating accuracy over time and unpredictable repeatability, primarily due to the instability of light sources. With advances in tungsten halogen lamp stability, single beam configurations have enjoyed increased reliability in recent years. However, standardization every 4-8 hours is still recommended to ensure accuracy, impeding efficacy and making measurements vulnerable to human error.

The Advantages of Double Beam Systems

The shortcomings of single beam instruments led to the development of a double beam spectrophotometric configuration, also known as split beam or dual beam. Double beam instruments split the light source in two using a static device such as a partially-transmitting mirror, or through the use of dynamic optical and mechanical components. The beams may then be recombined prior to reaching a single monochromator, although some instruments use two monochromators. The dual beam allows for simultaneous illumination of the reference standard and the sample, resulting in faster and less labor-intensive measurement.[1] The simultaneous measurements are automatically analyzed to detect and compensate for light source variation, removing the need for constant calibration, eliminating vulnerability to human error, and offering more reliable and repeatable results. These advantages led double-beam spectrophotometers to quickly become the instrument of choice across industries looking for higher accuracy, flexibility, and efficacy.[2]

Despite their advantages, double beam instruments suffered from one major drawback: they were complicated. The creation of the light paths and recombination of light beams in these sophisticated instruments required precise engineering and a higher standard of design to ensure optimal functionality. Their increased complexity translated to more potential points of failure and higher maintenance costs; if the system uses mirrors, for example, they must be installed or replaced in pairs because the coatings must be identical. Because the instruments required more pieces, they were also larger than single-beam instruments, taking up more space, increasing weight, and limiting flexibility.

A Move Toward Increased Flexibility

In recent years, technological advances in double beam spectrophotometry have led to simplified designs that eliminate many of the potential downsides to this remarkable technology. By minimizing the number of parts, double beam spectrophotometers can now be manufactured with significantly smaller footprints and lower servicing costs, making them more attractive to buyers in a range of industries. HunterLab has led the way in harnessing the possibilities of the reduced size and complexity of these instruments; while double beam technology is still only available in benchtop instruments from most manufacturers, HunterLab

integrates double beam configuration in even its range of lightweight, portable spectrophotometers to optimize accuracy and ease of use. Not only are reliability and repeatability improved, but so too is operator friendliness, as measurements can be taken with a single touch. The result is unprecedented precision and flexibility in even challenging measurement environments outside the lab, from the production floor to shipping areas to sample analysis in the field.

Full article with photos available here:

https://www.hunterlab.com/blog/color-measurement-2/expanding-flexibility-and-color-measurement-potential-with-double-beam-spectrophotometers/