Standardised measurement of hemispherical light transmission in clear structures

A new era has started for agriculture companies as they are finally able to purchase a standardised measurement solution, allowing simple assessment of complex parameters and be able to compare them to measurements from others. This white paper offers more information about the new measurement solution.

Using greenhouses to grow crops offers a number of benefits, with transparent materials such as structured glass, textiles, plastics and screens and nettings providing protection from the elements when it comes to starting seedlings, overwintering more delicate plants, or growing crops such as tomatoes or peppers. For industrial agriculture in particular this type of protection is essential for businesses to survive and thrive, particularly in countries that experience less sunlight.

More important still is the need for industrial agriculture companies to maximize the use of sunlight and be able to accurately predict the number of kilogrammes of crop that will be harvested and the profit that crop will yield. To do so, they need covering materials and thermal screens with high transmission and the ability to accurately measure their transmittance.

Light transmission measurement techniques

These types of materials are standard characterised by measuring the perpendicular light transmission. However, this method is not ideally suited for horticultural applications, as it is not the most relevant optical characteristic from which to determine the amount of solar radiation or photosynthetic active radiation that enters the greenhouse. For this particular application, measuring the hemispherical light transmission is a much more representative benchmark, especially when measured over a larger area than standard, due to structure size or possible inhomogeneity.

Standards and regulations

The NEN 2675 standard was originally devised for the determination of the light transmission of traditional greenhouse glass. Because of new materials like structured, diffuse and coated glass and the increasing importance of thermal screens it was revised in 2018.

Wageningen University & Research (WUR) in The Netherlands and Netherlands Organisation for Applied Scientific Research (TNO) developed a measurement protocol for determining the light transmittance of greenhouse covering materials in 2010, and in 2012, WUR together with screen manufacturers devised a similar protocol for screens, both of which were used as a basis for the 2018 revision of the standard.

WUR developed its own equipment in order to measure the hemispherical light transmission according to the norm, but there was no commercially available instrument for wider market use.

Standardised measurement

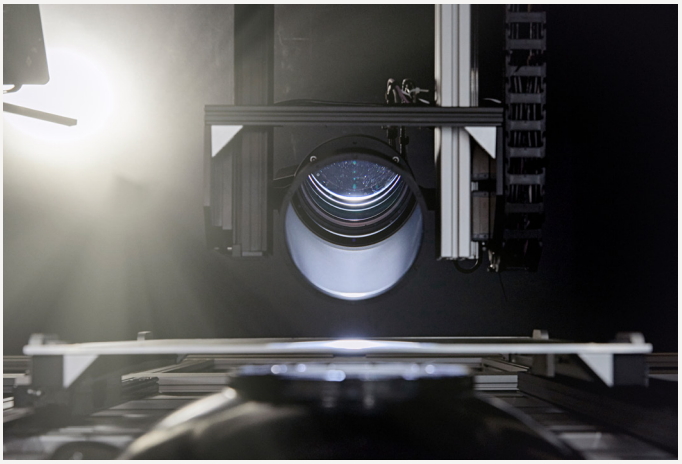
WUR contacted Admesy to help develop such an instrument for commercial use, and, as Admesy already has a variety of commercial products available that can be tailored to individual requirements, the first step was to collaborate and investigate exactly what specifications were required.

Based on the existing measurement setup from WUR and as well the NEN 2675:2018 standard Admesy developed a measurement setup which can be operated by a worker in a glass factory and does not necessarily require a highly skilled operator.

The requirements

In terms of the requirements for such an instrument, high levels of accuracy are key. For crops such as tomatoes, a well-known rule of thumb states that 1% extra light results in 0.7 to 1% extra production, so growers demand a measurement device that can be accurate to a 10th of a percentage – although, conversely, this level of accuracy is not required by the standard, but would serve to ensure that such a device is future-proofed.

A particular challenge when producing a brand new measurement type is a lack of samples to which can be referred. But with WUR's years of experience with different materials, the institute was able to supply a glass sample that could be used as a reference and, crucially, could be trusted and measured to see the differences and the variables based on those differences.



Glass transmission Gonio System

Admesy's solution

The Admesy glass transmission system is a fully enclosed suspended gonio system containing a system enclosure made from high-end item profiles and panels to ensure system closure, block external light and shield the user from moving parts.
The suspended gonio system has four axis suspended gonio movement to move the light bundle in accordance with standard or programmed angles. It contains a broad wavelength LED with collimating lens system to ensure accurate stable lighting and an automated glass mount to load and position the glass sample during testing. An integrating sphere ensures uniform measurement results, while an integrated reference light corrects for in-system glass reflections.

The other elements to the system include the Admesy high-end Neo spectroradiometer, which was developed for hassle free integration in a wide variety of products and processes. The Neo can virtually cover any wavelength range in the 250-1100nm range. Neo has a Czerny-Turner configuration, and the optical bench consists of a slit, a mirror, a grating, a second mirror, a collector lens, a linear variable filter (OSF) and a cooled detector. It offers high-end performance, exceptional ease of use and robustness at a competitive price. The accompanying NEN2675:2017 + R&D software was developed to fulfil the brief of being easy to use, with production and engineering modus and easy-to-read data with full data logging.

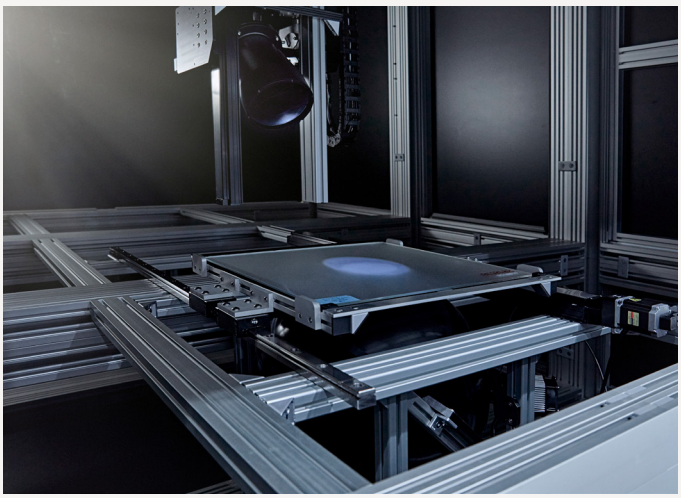
The results

WUR did some measurements with its own in-house system and compared the results achieved using Admesy's system. The results were found to be similar to those achieved using WUR's device and they were well within the required accuracy.

Conclusion

Measuring the hemispherical light transmission is the most representative method for determining the performance of materials used in greenhouses and other horticultural structures related to a maximized use of sunlight. But, until now, there has been no standardized, commercial tool available that is easy to use for the horticultural industry.

Admesy has years of experience in providing customers with test and measurement equipment, based on color and light measurement principles, with a particular focus and passion for industrial applications. The company has used this experience to create an accurate, easy-to-use solution for measuring hemispherical light transmission.
Admesy is currently working with a commercial third party from the glass industry and is in the market validation phase for the solution with potential customers who want to do validations. Based on those validations, there will be a commercially viable system available very soon.



System overview

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