

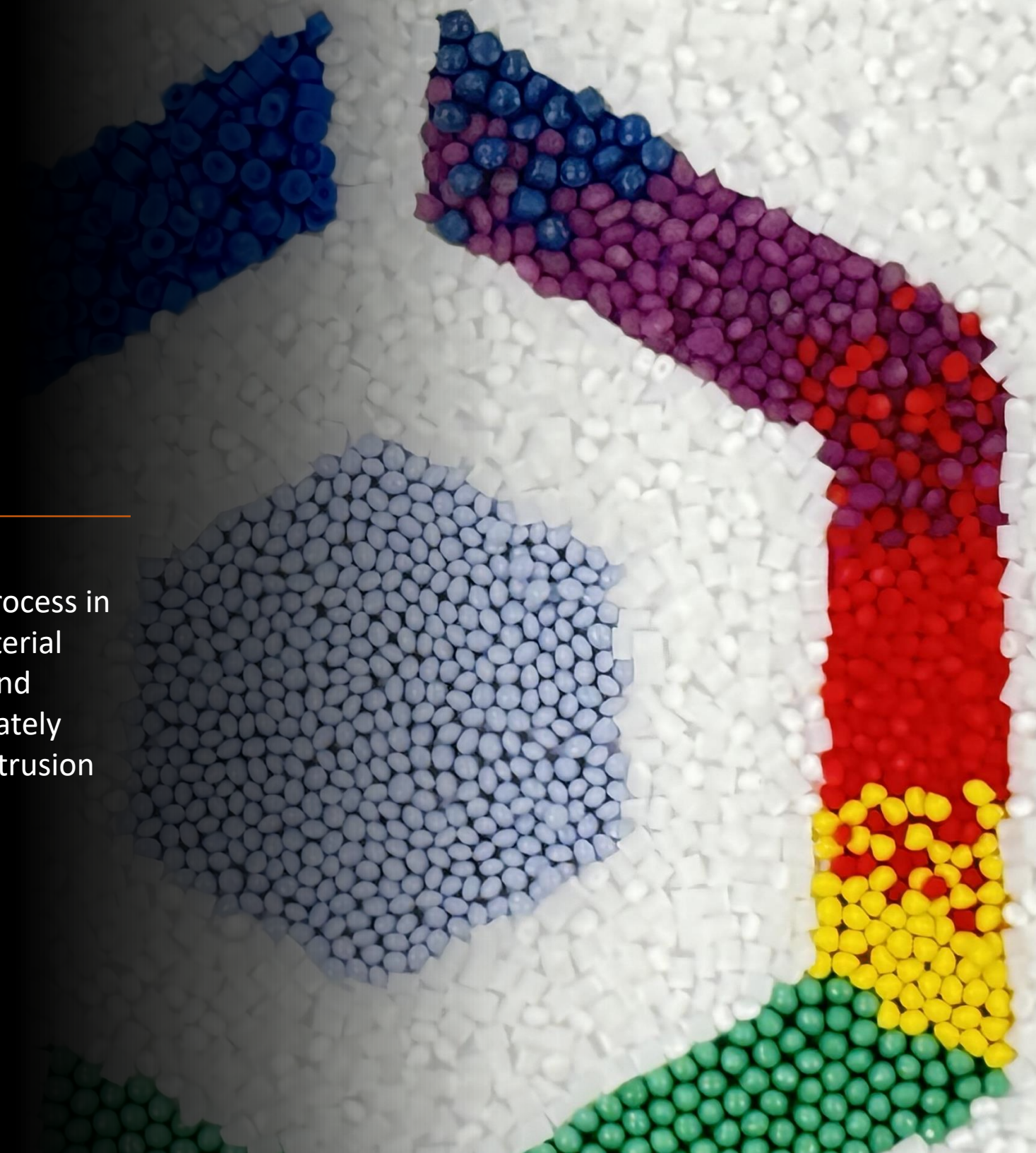
Color Differentiation of Recyclates

Using the Three-range Method in the Visible
Wavelength Range



Color Measurement of Recyclates

Immediately after the extrusion process in the recycling company, during material feeding at the plastics processor and during the dosing process immediately before the injection molding or extrusion process.



Increasing Use of Recycled Materials

The increased use of recyclates worldwide is of great importance for several reasons:

- **Environmental protection:** The use of recycled materials reduces the need for new raw materials, which in turn reduces the extraction of natural resources and the associated environmental damage.
- **Reducing waste:** Recyclates help to reduce the amount of plastic waste that ends up in landfills or in the environment.
- **Circular economy:** In a circular economy, materials are kept in the economic cycle for as long as possible.
- **Energy saving:** Manufacturing products from recycled materials requires less energy than production from new raw materials.
- **Legal requirements:** In many regions of the world, requirements are set for the use of recyclates with the aim of promoting sustainability and reducing environmental impact.

Plastics Recycling

- Collecting plastic waste
- Reprocessing plastic waste
- Separating and sorting the coarse fraction
- Shredding the coarse fraction
- Cleaning the fine fraction
- Separating and sorting the fine fraction
- Extruding, filtering and regranulating the fine fraction
- Color control of the recyclate
- Filling and packaging of the recyclate
- Delivery to the plastics processing industry



Color Measurement of Recyclates during Production

In the past, it was sufficient to produce recyclates that could only be used for inferior products (so-called downcycling), but the plastics processing industry and the legislators are increasingly demanding a recyclate quality that comes close to the properties of virgin plastic. Modern recycling approaches aim to keep high-quality materials in the cycle for as long as possible.

The color of the recyclate is an important quality criterion, as it can serve as an indicator of possible contamination. Darker or uneven colors may indicate that the recyclate has not been completely cleaned or that it consists of different types of plastic. A uniform and appealing color is crucial for many end products. Recyclates that have a uniform color improve the appearance of the end product.



Inline Recyclate Color Measurement in a Recycling Plant

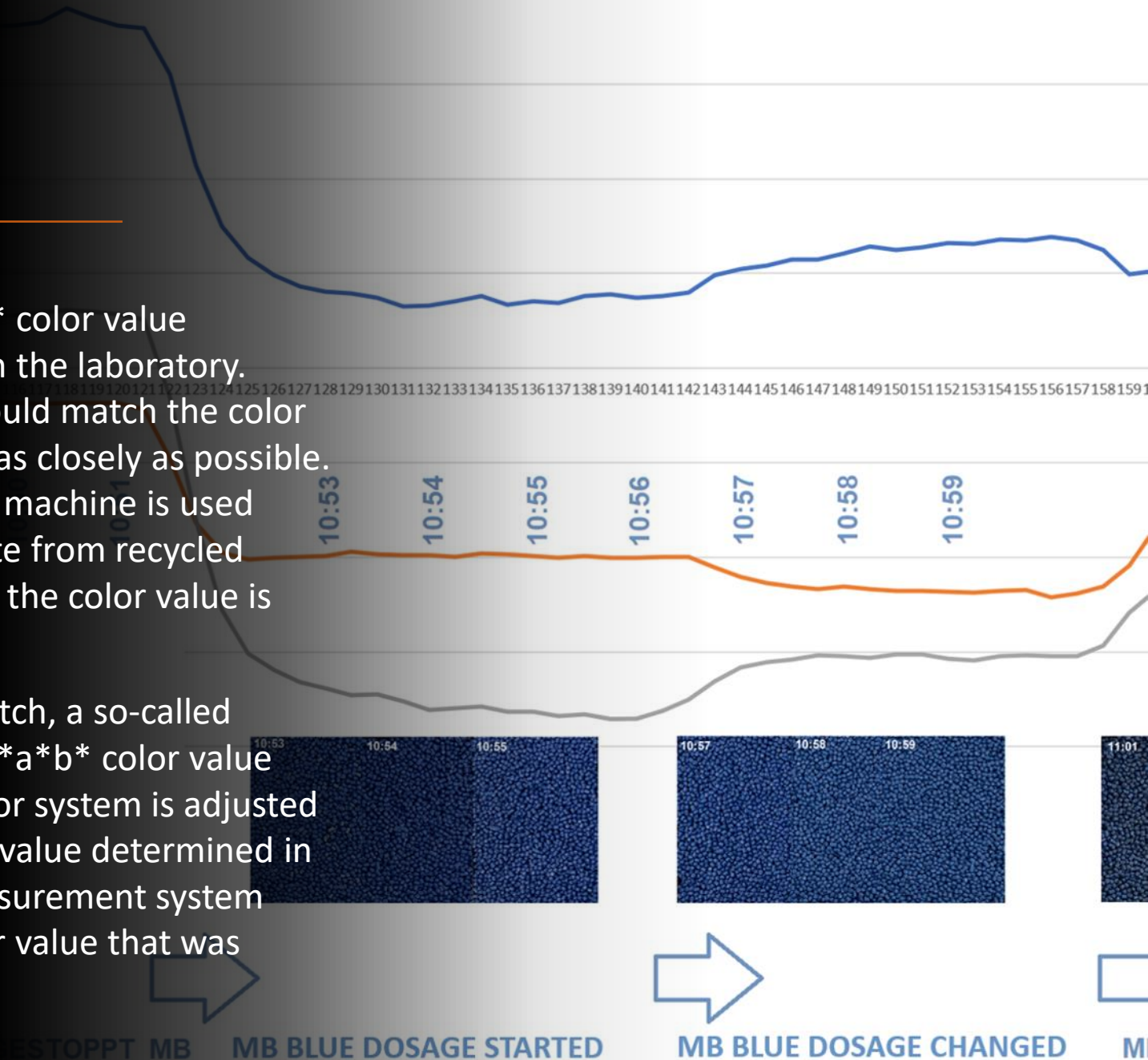
The first way which the color of recyclates can be measured is immediately after the extrusion process. The color sensor system is directed at the recyclate flow conveyed on a vibrating chute. Thanks to the robust design of the sensor system, reliable measurements can be made even at high recyclate temperatures.



Measurement Accuracy and Comparability of Color Values

In many recycling plants, the $L^*a^*b^*$ color value of a recyclete is already measured in the laboratory. The color value measured inline should match the color value determined in the laboratory as closely as possible. In many cases, an injection molding machine is used to produce an injection-molded plate from recycled material taken from production and the color value is then determined.

To ensure that both color values match, a so-called user calibration is carried out. The $L^*a^*b^*$ color value determined by the inline color sensor system is adjusted accordingly after entering the color value determined in the laboratory. The inline color measurement system then displays the same $L^*a^*b^*$ color value that was measured in the laboratory.



Display and Recording of the Color Values Determined Inline

The DOCAL Windows® software is used to display the $L^*a^*b^*$ color values numerically and graphically, as well as their deviation $dL^*da^*db^*$ from the target value. At the same time, the data is stored in a file on the panel PC and the data can also be transmitted via fieldbus (ProfiNet) or Ethernet.



Calibration of the Inline Color Sensor On Site

Calibration of the inline color sensor is extremely simple and does not require the system to be dismantled. A white plastic card (RAL) only needs to be placed in front of the sensor system at the prescribed distance for the white balance.

Calibration (UCAL) to the respective product is carried out using recycled material and the measurement data from the laboratory. After a one-off calibration to the respective recyclate type, the calibration data can be easily imported from the respective file.



Determining the Recyclate Color Values Using a Mobile Color Measurement System

The mobile color measurement system can be used to obtain color measurement data more quickly than in the laboratory, even without an installed color sensor system. A recyclate sample can be taken on site from production and fed into the mobile unit (hopper capacity: 11 liters). The mobile color measurement system is calibrated in the same way as the inline unit.



Display of Color Values Using DOCAL Software

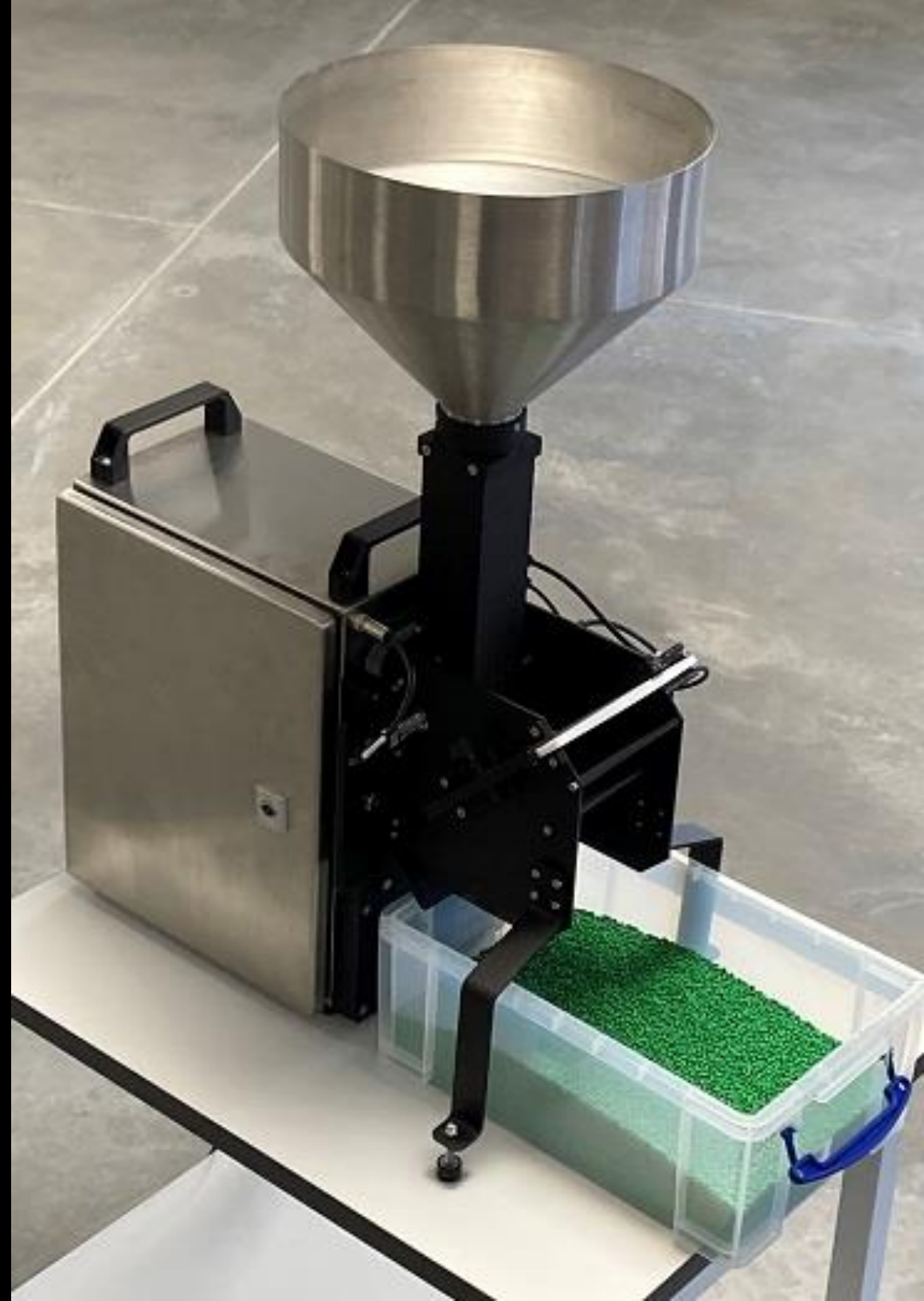
Software that enables both simple calibration and convenient display of the color measurement values in both numerical and graphical form. Furthermore, the tolerances of a reference sample can be individually defined and called up as required.

L^*	92.75	dL^*	-0.56
a^*	-1.05	da^*	-0.58
b^*	1.62	db^*	0.62
		dE	1.04

Determination of the Recyclate Color Values in the Laboratory

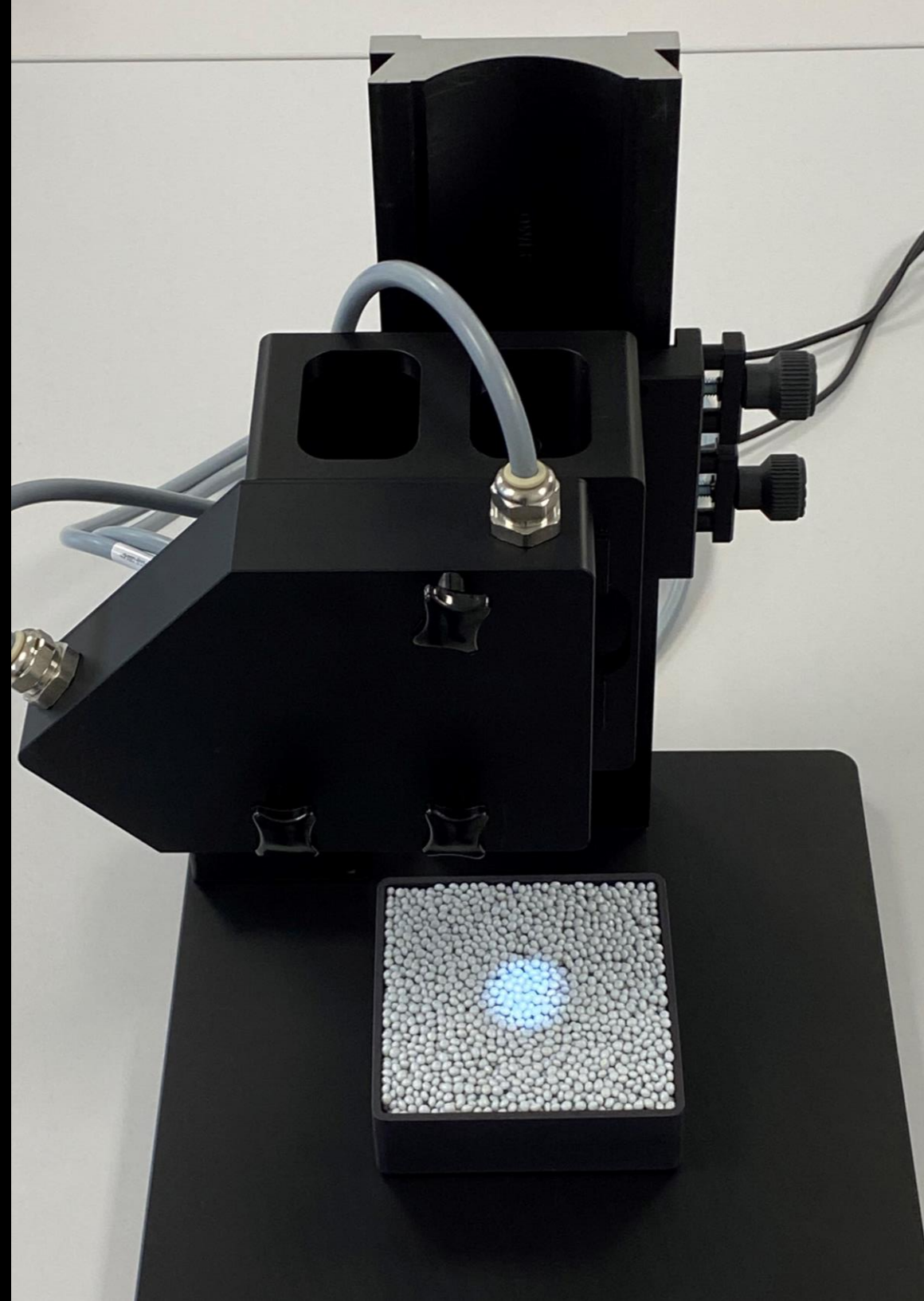
The $L^*a^*b^*$ color value of a recyclate sample can also be determined with high accuracy ($dE < 0.3$) using the color laboratory device, without the need to first produce an injection-molded plate from recyclate at great expense.

The high color accuracy is achieved by measuring the recyclate flow and continuously averaging the measured values. This eliminates the influence of the random position of the individual granules in the light spot of the measuring device.



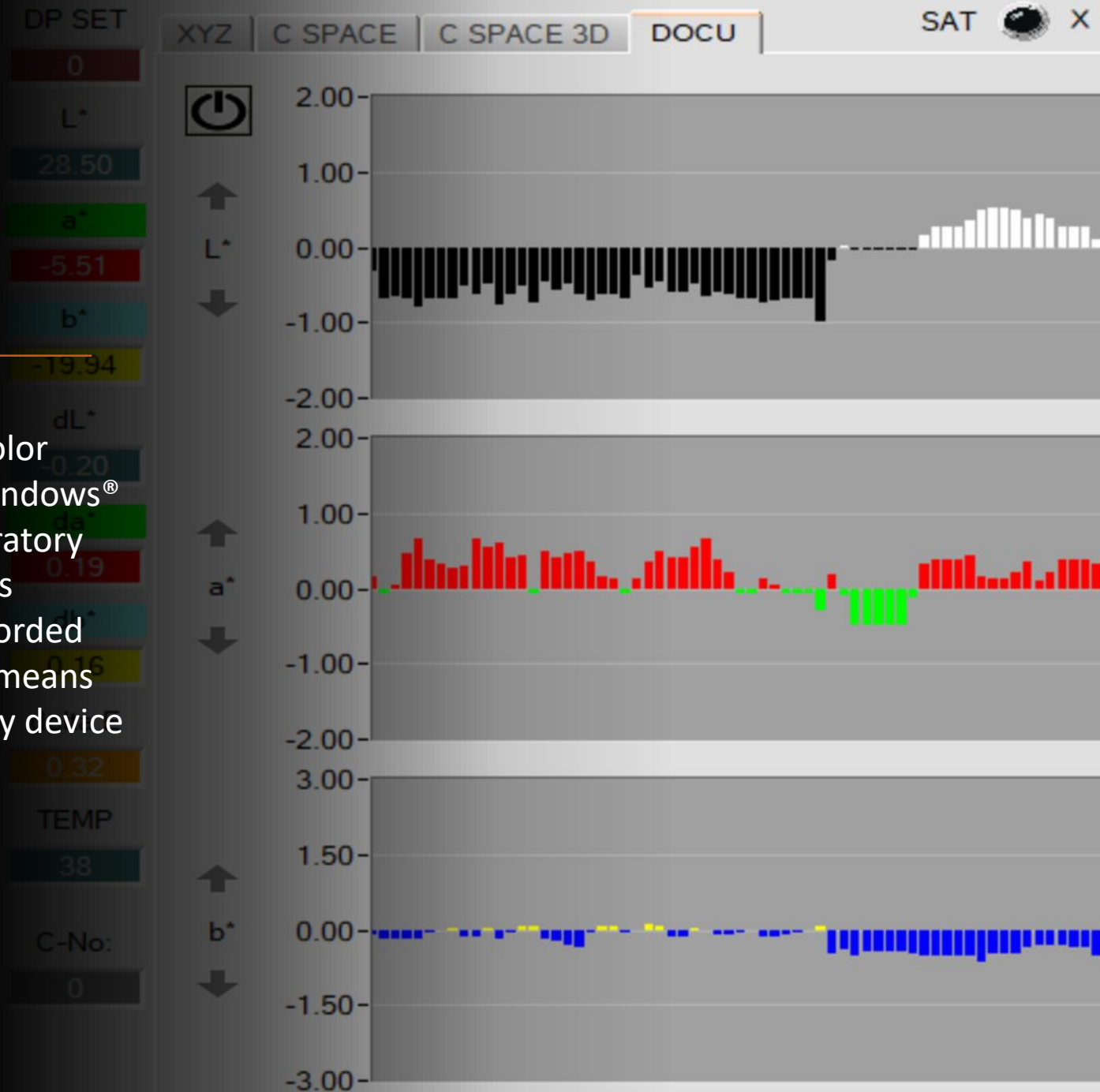
Compact Laboratory System for Measuring the Color of Recyclates

A very compact and inexpensive color measurement system was created using a measuring table top and an optomechanical rail. The recyclate samples are filled into the supplied trays and moved laterally under the light spot in a figure-of-eight movement. This also achieves an accuracy comparable to inline measurement.



DOCAL Software for Laboratory Equipment

In addition to the inline and mobile color measurement systems, the DOCAL Windows[®] software can also be used in the laboratory in the same way. The only difference is that the measurement data is not recorded continuously, but rather triggered by means of additional sensors on the laboratory device or via mouse click.



Plastics Processing

- **Storage of recyclates in silos:** Modern silo systems are equipped with advanced control technology that monitors and controls the operation to ensure a smooth process.
- **Drying the recyclate:** Recyclate can absorb moisture during storage, which can have a negative impact on the material properties.
- **Conveying and dosing the recyclate:** The recyclate is transported from the dryer to the processing machines. Conveying systems such as screw conveyors or pneumatic conveying systems are used for this.
- **Mixing and homogenizing:** To ensure uniform material quality, the recyclate is often mixed with virgin material or other additives.
- **Extrusion:** The mixed material is melted in extruders and pressed through a die to produce new plastic products such as films, profiles or granules.
- **Injection molding:** Alternatively, the recyclate can be processed in injection molding machines to produce complex molded parts. Here, the material is injected into a mold and cooled under pressure.



Color Measurement of Recyclates in the Plastics Processing Industry

Due to the increasing use of recyclates in the processing industry, it is advisable to carry out an incoming inspection in order to prevent any fluctuations in the quality of the recycled material.

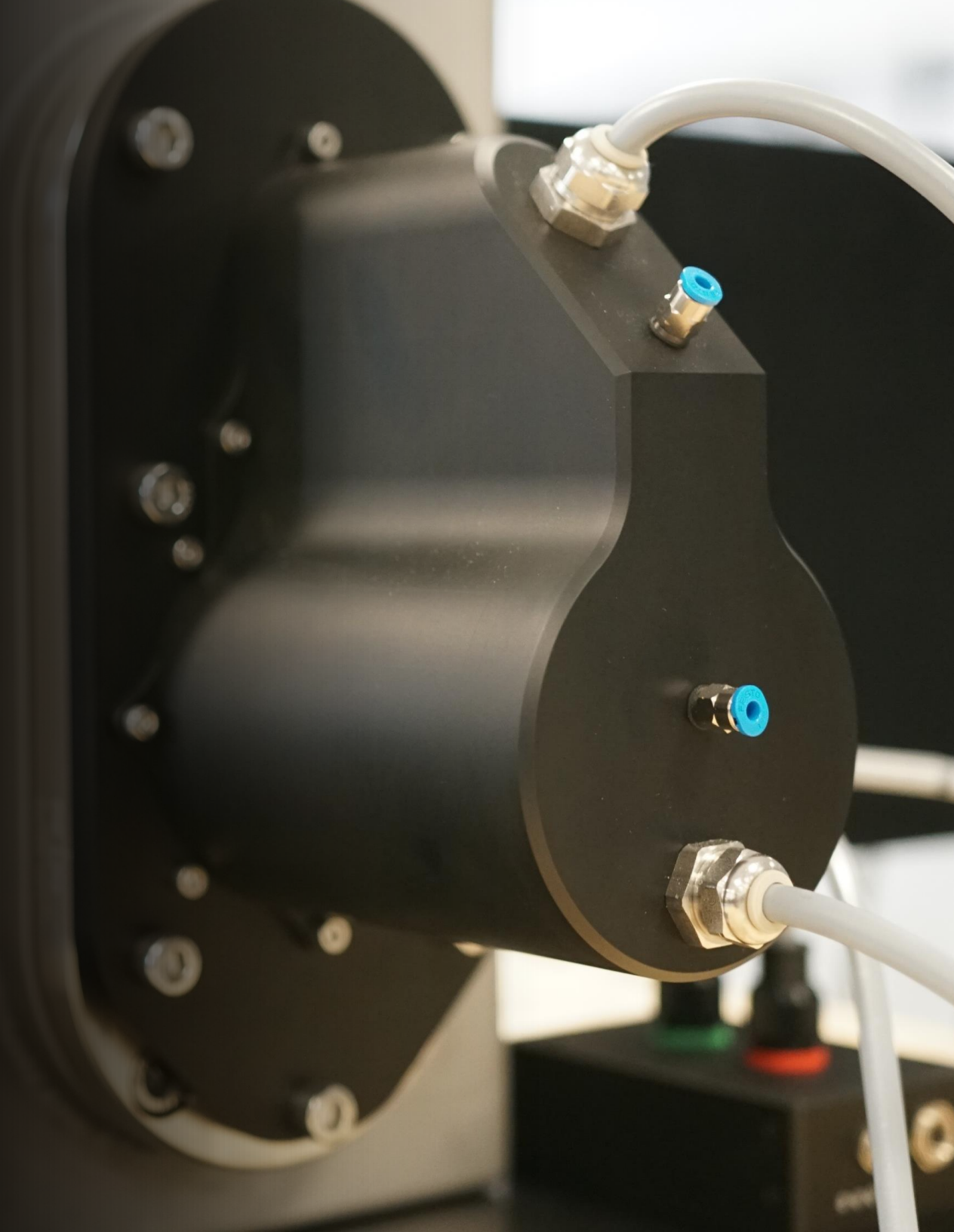
The color of the recyclate can be checked at various points in the process:

- At the silo
- At the material feed container
- At the dosing unit



Recyclate Color Measurement at the Silo

A sight glass is placed at a suitable location on the granulate silo and a suitable color sensor ($0^\circ/45^\circ$ or $d/0^\circ$ method) is then installed. The color values are also evaluated using the DOCAL Windows[®] software.



Recyclate Color Testing during Material Feeding

A recyclate color check can also be carried out at the material feed container. The system operator is informed about the color quality of the recyclate used at an early stage. Furthermore, color measurement data can be transmitted to the quality assurance department in real time.



Color Measurement of Recyclates at the Gravimetric Dosing Unit

The dosing unit offers another option for measuring the color of the recyclate. The color system can be installed after attaching an appropriate sight glass. The color evaluation is carried out using the DOCAL Windows® software.




Clarity about the Recyclate

Detect Color in Pellets and Flakes

Maintain control over color consistency and prevent discrepancies

Our specialists are happy to tell you more about it

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