Measurement of Colour and Reflectance of Paints and Textiles in the Near Infra-Red region using the Cintra10e and the extended Range DRS1150

Traditional integrating spheres employed as colour measurement accessories in UV-Visible spectrometers have a usable wavelength range which is restricted by the choice of the detector.
This particularly limits the upper wavelength range to about 800nm or less.

The DRS1150 Integrating Sphere accessory for the GBC Cintra 10e UV-Visible spectrometer employs an advanced solid state detector.
This technology extends the range of measurement to 1150nm. The measurement of the visual area (what one observes with the naked eye from 400 – 600 nm) and the Near Infra Red (NIR) region (what one observes through passive night vision devices and image intensifiers such as a starlight scope in the region 600 – 800 nm and beyond to 1,150 nm), can now be measured and quantified.

Measurements in the region 800nm to 1150nm are of particular interest for military imaging applications where it is desirable to know the reflectance due to natural light sources and infra-red lasers. To analyse reflectance properties of paints and textiles above 800nm would normally require an expensive NIR spectrometer.

Solid samples such as textile swatches or paint can be easily mounted using the built-in sample holder. There is a 10mm cell holder for turbid liquid samples. The reflectance range of 0.01 to 1.0 means that even weakly reflecting samples may be resolved.

The colour application can be used for quality control or analysis on any surface coatings, the software includes a comprehensive suite of colour models based on CIE tristimulus values that are easy to load and use.

Experimental
Various camouflage Battle Dress Uniforms (BDU's) were evaluated including two colour experimental disruptive urban camouflage uniforms, a three colour disruptive urban camouflage uniform, a monotone grey urban camouflage uniform, an experimental monotone black flight suit, a standard three colour desert camouflage uniform and a standard woodland camouflage uniform.

Method

The analysis is automated using powerful Spectral software.
Figure 1 shows the main software page of the Colour software which enables the standard colour parameters to be chosen.

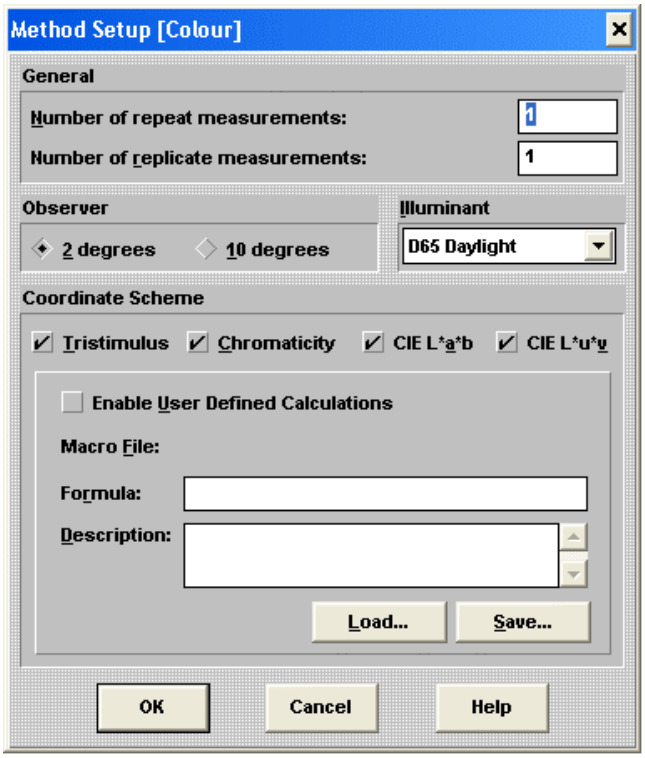

Figure 1: Spectral software allows various standard colour parameters to be chosen

The human colour sensation varies with the standard observer size (angle at which a portion of sample to be observed is visible to the human eye). Spectral software allows a choice of two types of colour matching functions for the standard observer: 2° and 10°.

Spectral software allows a choice of up to 10 standard light sources which serve as illuminants for colour analysis. If required, the analyst can also input a customised illuminant.

Spectral software allows twenty co ordinate schemes such as chromaticity co-ordinates, CIELAB, CIELUV, Hunter Lab, Whiteness and Yellowness. User defined calculations can also be performed. Spectral can also calculate delta values for each of these co ordinate schemes allowing one scan to be quantitatively compared to a second scan. This is particularly useful in a manufacturing environment where a sample colour must be compared to a “standard” colour and any differences can be quantitatively shown quickly highlighting if more or less of a particular colour dye must be added or reduced in a batch.

Results

The sample is easily placed in the DRS1150 using the spring loaded clamps provided.

The scans are performed and the software calculates the various colour parameters as shown in figure 2.

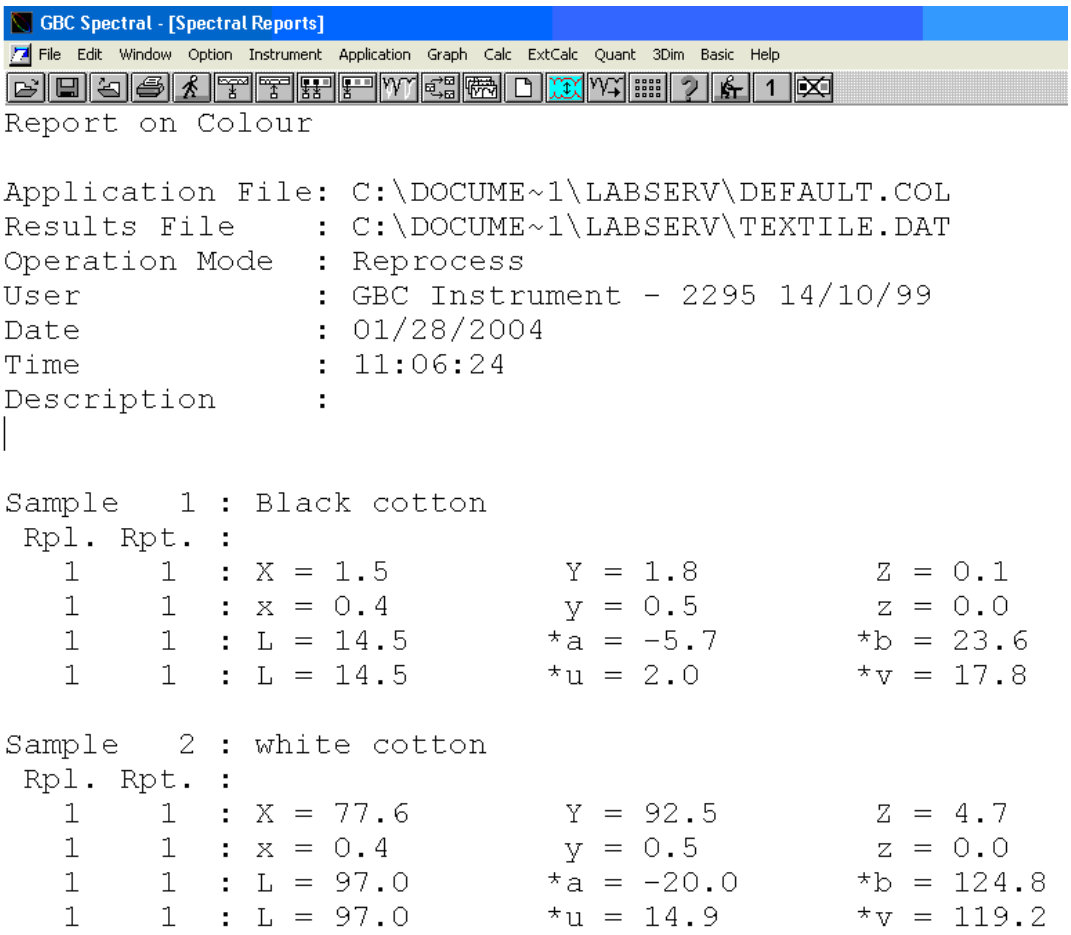

Figure 2: Spectral Report

Various military samples were scanned from 375 to 1,130 nm.
The reflectance of each sample was scanned and the corresponding data analysed.
Figure 3 shows the scans of the various military samples analysed. The intent of the analysis was

1) To determine which sample had the lowest reflectance in both the UV-Vis and the NIR region
2) To determine the reflectivity of each sample at the various laser wavelengths used in infra red targeting or illumination systems used in the military.

Conversely some applications may require the reverse to be true where the desired result is to have a highly reflective surface. Super sonic jets which fly in the earth's stratosphere require a highly reflective surface to reflect the intense solar radiation which occurs there.

As can be clearly seen from the scans performed, that various samples show very different reflective properties.

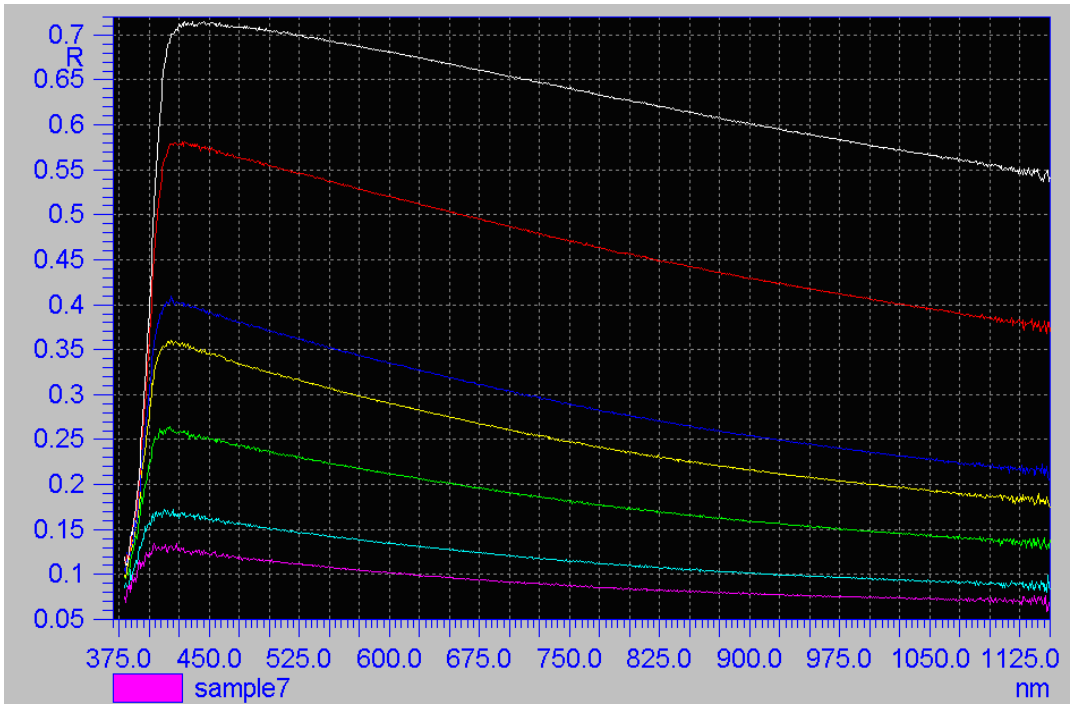

Figure 3: Actual Military Cloth designed to camouflage in NIR region and at key laser wavelengths.

Conclusion

The Cintra 10e with the extended range DRS1150 allows reflectance analysis from the visual region all the way up to 1,150 nm. This application has been used in various military institutions for some time using the GBC Cintra 10e with Spectral software successfully to assist them in the research and development of BDU's which is invisible to night vision devices and infra red lasers.

GBC wishes to thank these users for their valuable contribution into this new area of analysis both from a product development and application development standpoint.

N.B. Due to the very sensitive nature of this analysis and research being undertaken into the field of the design of low reflectance material and the manufacture of BDU's much of the analysis information, information about how the material is treated or indeed the actual calculations and method actually used are highly confidential and been suppressed in the interests of National Security and Defence.

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