FORS Interim Progress Report: Testing on Preserved and Archaeological Textiles

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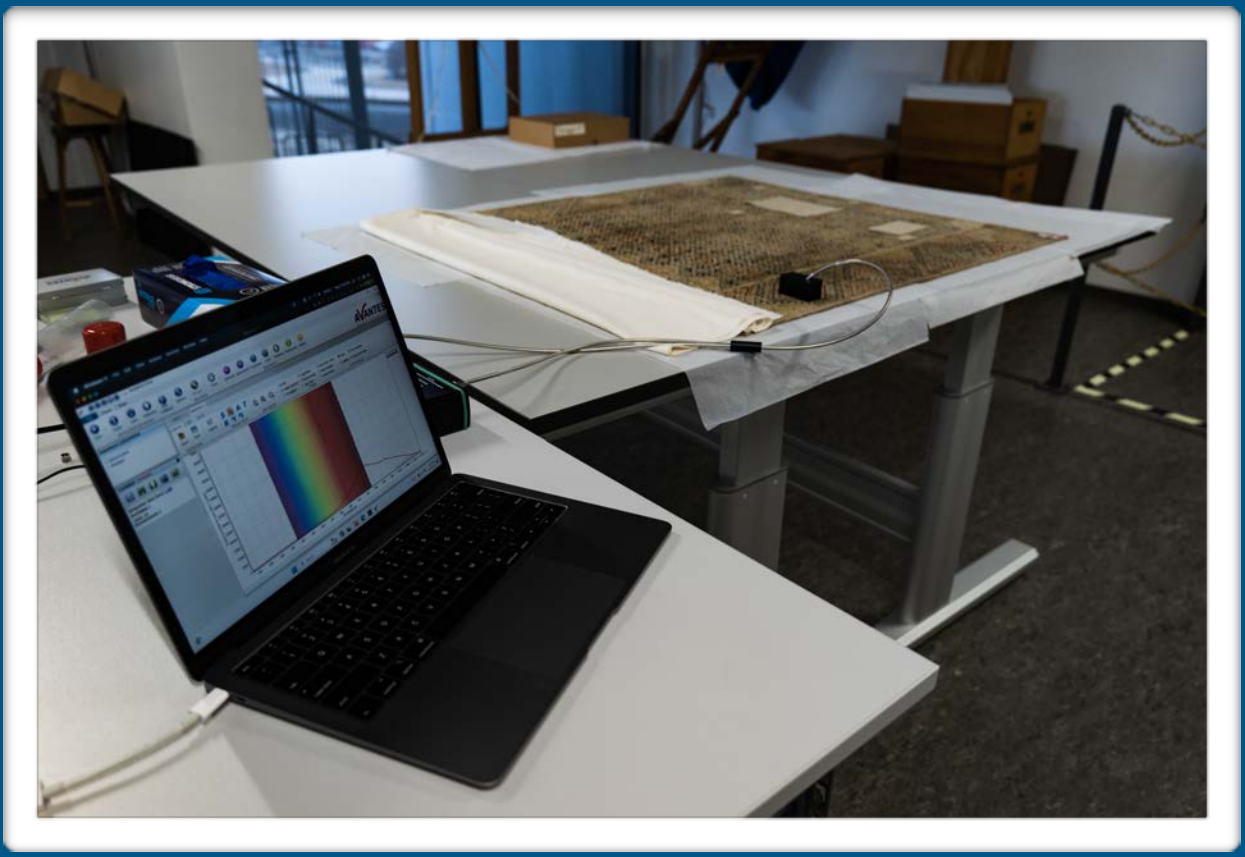
2024



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Introduction

This document is to serve as a brief but thorough presentation of the current results from the Fiber Optic Reflectance Spectroscopy (FORS) testing that was conducted on 32 textiles in the Þjóðminjasafn Íslands collection in 2024. These results are subject to change as new information, testing, and references become available while I complete my master's thesis. However, I will first provide some context to the methodologies and my reference material, report the results from the preserved textiles, and finally report the results for the archaeological textiles. Additionally, I have included three appendices providing all relevant data for the museum's records and possible future use.

Background and Reference

At its simplest, Fiber Optic Reflectance Spectroscopy works using a three-part machine: a light source, a spectrometer, and a fiber optic cable connecting them. The light source emits light with a known spectrum through the fiber optic cable and onto the material that is being tested. This light is fed back through the cable and collected inside the spectrometer using a series of mirrors and a light sensor. This is then processed within the software, presenting us with a graph such as the one in Figure 1, which shows us the wavelengths of light that are both reflected and absorbed by the measured material. Here, we are using the “Reflectance” measurement mode as it allows us to see what is known as absorbance features, described in more detail below.

Figure 1 uses the reflectance spectra of our reference Indigo as an example. The yellow area highlights the wavelengths that pertain to the visible light spectrum, while wavelengths <380nm fall in the Ultraviolet Spectrum and >780 are in the Infrared Spectrum. Valleys or minima, such as the one at wavelength 663nm, represent the wavelengths not reflected and, therefore, absorbed by the material. These are our absorbance features and can be used to distinguish between similarly colored dyes. Meanwhile, peaks or maxima, such as the one at 460nm, indicate the color light the material is actually reflecting.

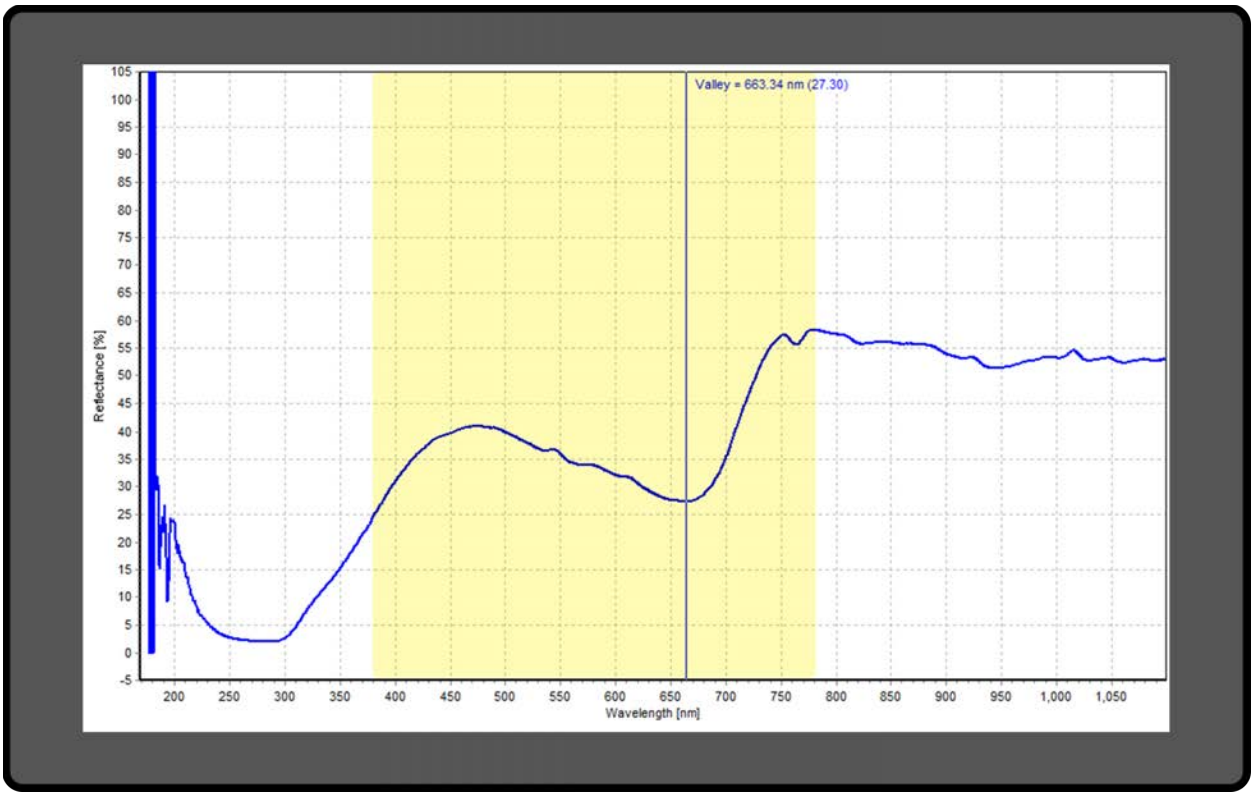


Figure 1. Reflectance Spectra with Absorbance Feature

These features allow us to distinguish the dyestuffs used, as many have distinct features. As with any methodology, there are limitations to the power of the FORS machine. Most notably, yellow and brown colors appear to have no absorbance features to distinguish between dyes. Additionally, if a color is too dark, the absorbance feature may be lost as the surrounding wavelengths are also absorbed. For these reasons, the FORS approach may be best understood as an important, non-destructive first step in identifying these dyes. However, if more information is needed, for yellow dyes, for example, the researcher may need to proceed with a more destructive methodology like RAMAN analysis. That said, I believe this report and its forthcoming updates offer valuable information made possible by FORS.

Since the initial test on textile #1997 in early April of this year, I have worked with Noemi Cubas Martin to create a collection of dyed wool. The reflectance spectra of this collection produced by the FORS machine will be used as a reference in comparisons against the measurements taken on the museum's textiles. This process is intended to identify or at least eliminate possible dyestuffs used in creating these textiles. In Table 1 (see below), I have

provided the list of our current reference collection and, when applicable, the wavelength of its absorbance feature. Please see Appendix A if you wish to view the spectra in detail. Of the 22 dyed yarns in our reference collection, 16 have some identifiable Absorbance feature, while 6 have none. However, 8 of these dyed yarns were created using a combination of two dyes, meaning there are 14 unique dyes, 6 of which present no discernible features. The combination dyes usually contain absorbance features of both dyes used, but they can be shifted slightly. After conferring with Dr. Maurizio Aceto, I am considering absorbance features within +/-10nm from our reference spectra to be within an acceptable range. Expanding and improving this reference list is the top priority as we move forward, allowing further refinement in the selection of possible dyes used.

Table 1. Absorbance Features of Reference Collection

Dye(s) Used	Absorbance Feature Y/N	Minima
Birch Leaves	N	-
Brazilwood	Y	520
Cochineal	Y	540
Cosmos	N	-
Indian Madder	Y	500
Indigo	Y	660
Lichen Parmecia Saxaticis	N	-
Liguen Iolite	N	-
Logwood	Y	610
Lupin	N	-
Madwood	Y	495 or 560
Marigold	Y	430
Mulberry	Y	640
Osage Orange	N	-
Logwood + Indigo	Y	600

Dye(s) Used	Absorbance Feature Y/N	Minima
Lupin + Indigo	Y	660
Madder + Cochineal	Y	375?, 510
Madder + Indigo	Y	500, 660
Marigold + Cosmos	Y	405
Marigold + Indigo	Y	430, 670
Marigold + Madder	Y	430, 530?
Osage Orange + Indigo	Y	660

Preserved Textiles

We will now go through the results of each preserved textile included in this study in the order in which they were tested. In total, I measured 22 preserved textiles, and an additional textile was measured by Maurizio Aceto. As we take each textile in turn, I will briefly describe the textile, address any particularities or things of note when considering the FORS approach, and then discuss the Identifiable and unidentifiable colors thus far. While examining many of these textiles, I distinguished between Light and Dark tones of the same color, either because the two tones were consistently kept separate throughout the piece, indicating that color difference may be due to more than just fading, or because the dark areas may not reflect enough light to

Figure 2. Textile 1997 Back

secure a good reading. Additionally, I endeavored always to sample the ground fabric in case some bygone color was no longer apparent. See Appendix B for the full reflectance spectra.

These measurements were taken using an AvaSpec ULS2048CL-RS-EVO spectrometer and the AvaLight DHc deuterium and halogen light source. All measurements were processed on Avasoft 8.15. The Reflectance Probe was kept at a 45º angle for measurements. A slit size of 200µm was chosen for maximum light. In order to compensate for the added noise from this slit size, 10 measurements were averaged per sample, and a pixel averaging of 10 was chosen. Integration times of between 500 and 600ms were achieved, meaning each sample took between 5 and 6 seconds in total.

1997

This was the first cloth I sampled, so my methodology varied slightly from the rest, but the results remain comparable. The 10 colors sampled were Dark and Light Blue, Dark and Light Green, Dark and Light Yellow, Dark and Light Red, Orange and the Ground Cloth. I sampled the same colors from the central section, the attached sides, and the more vibrant backside for this textile. Four colors had no absorbance features, including Light Green, Yellows, and the Ground Cloth. Both Blue sections and the dark green exhibited a minimum of between 650 and 660nm, indicating the use of an indigo dye, likely in combination with an unknown yellow dye in the green's case. Both Dark and Light Red spectra had a minimum of around 500nm, indicating the use of a madder dye. Finally, the Orange dye's spectrum had an absorbance feature at the 550nm wavelength, which closely matches the spectrum of Madwood in our reference collection. However, Madwood is an imperfect match, which could change as we expand the reference collection.

5445

This is the first textile using the consistent methodological procedure described above. It is estimated to have originated in the 1600s. I sampled eight colors: Light and Dark Green, Yellow, Light and Dark Blue, White, Brown, and the Ground Cloth. All four Green and Blue

Figure 3. Textile 5445 Sample Sites

spectra contained minima between the wavelengths of 650-660nm, indicating indigo dye. The real mystery for this cloth was in the Yellow areas, which also contained a depression around 650nm. As you can see in Figure 3, the yellow areas are broad enough that there was no danger of "missing" and accidentally sampling a blue or green area. This warrants further investigation as either indigo is present in the yellow area through intention or contamination in the textile's

production, or the unlikely possibility of yellow dye with a similar feature. As expected, the White, Brown, and Ground Cloth spectra contained no distinguishable absorbance features.

1945

Figure 4. Textile 1945 Sample Sites

This textile was selected due to its date of 1695 and description of floral designs. However, it only contained four distinct fabric colors: Dark Blue, Gold, Silver, and some undyed areas. The metallic areas proved to be too reflective to provide distinguishable spectra, and the

undyed areas contained no absorbance features. The Dark Blue area did present an absorbance feature between 660 and 670nm, indicating an Indigo dye.

3438

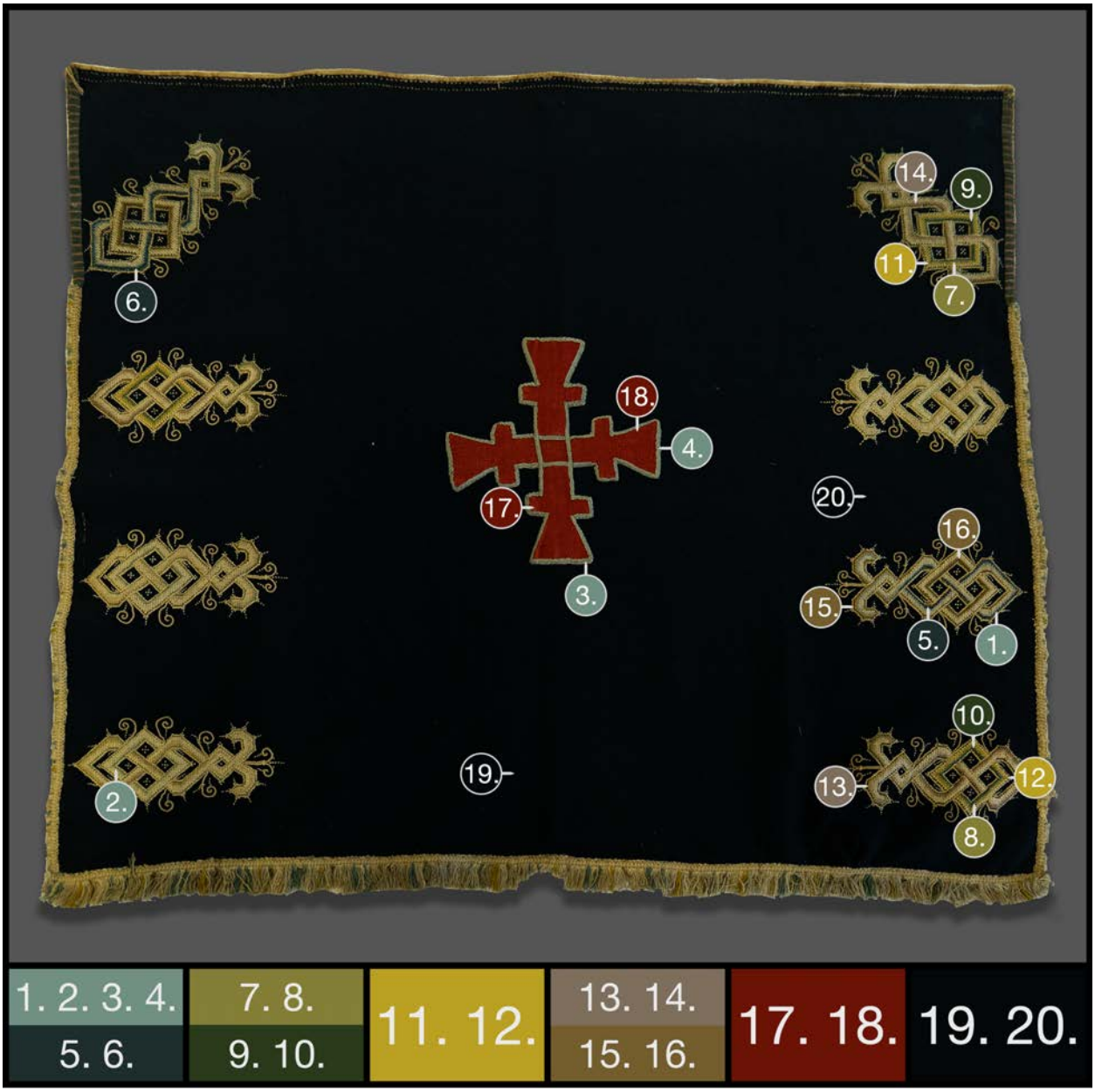


Figure 5. Textile 3438 Sample Sites

This textile is said to be from the 1650s, and while the bulk of the cloth is a black ground fabric, the eight geometric designs along the sides contain several colored stripes, and the border of the red cross in the center contains blue fibers as well. There were nine colors sampled; Dark and Light Blue, Dark and Light Green, Yellow, Rosy Brown, Golden Brown, Red, and the Dark Ground Cloth. The Dark and Light blue from the cross outline and the geometric designs all had minima present between 650-655nm, strongly indicating Indigo dye. The Light green, Rosy Brown, and golden brown spectra contain no discernible features. Once again, the yellow has an absorbance feature present in one of its spectra around 640nm; however, in this case, the possibility of "missing" the yellow section when taking a measurement may account for this. However, I did endeavor to ensure that this was not the case. The Final three colors were very dark, making the absorbance feature hard to detect. First, the dark green also has a valley with a minimum between 630-650nm. The Red color exhibited a minimum of around 530nm, making the most likely candidate a red insect dye such as cochineal. Finally, the black background also hints towards a minimum of around 630nm, which is closest to Mulberry in our reference

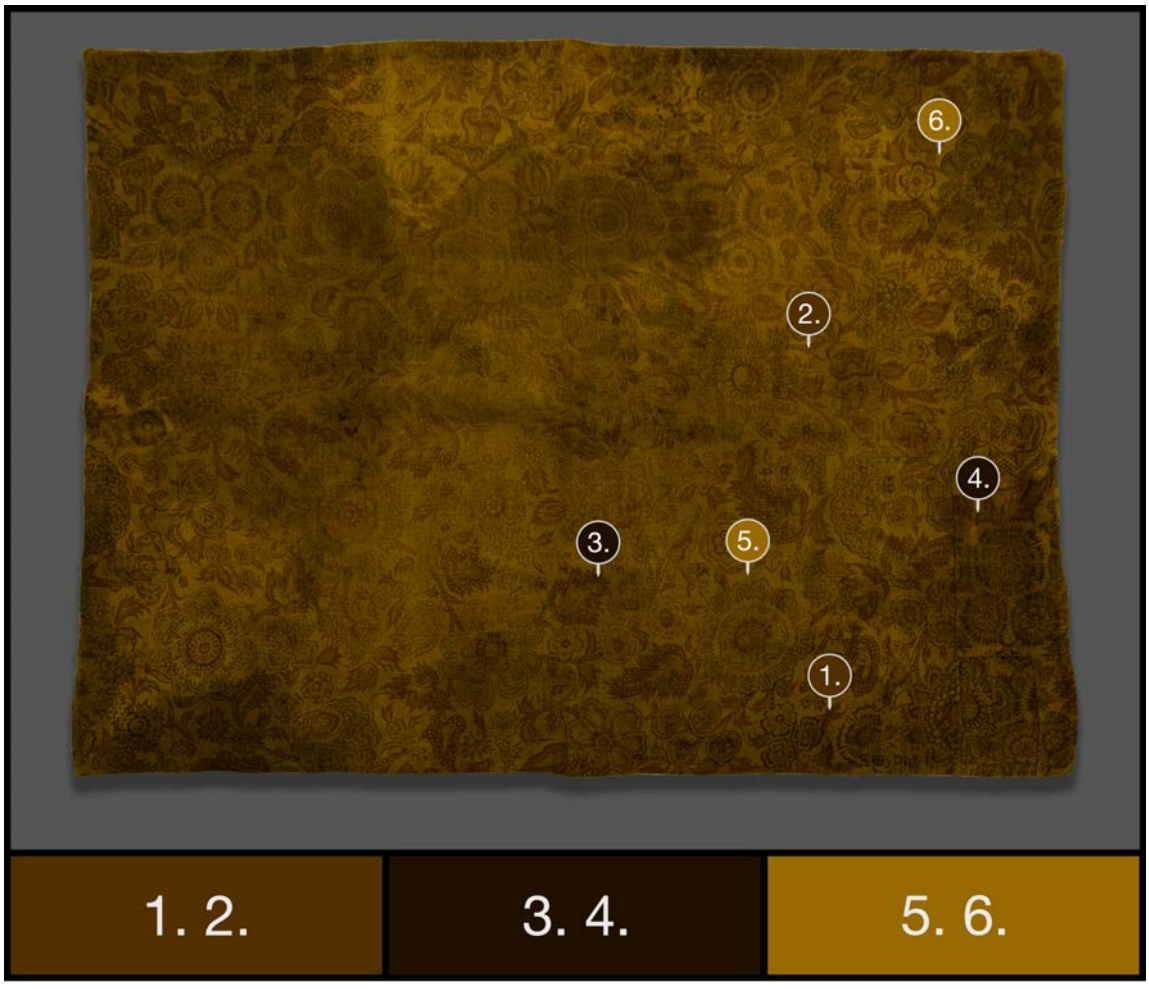


Figure 6. Textile 7955 Sample Sites

collection but could easily be misrepresentative due to the width of this valley feature. Due to the darkness of these three colors, the signal is not strong and must be interpreted cautiously.

7955

This textile exhibits a printed floral design rather than an embroidered one. The only colors present are a Light Brown, a Darker Brown, and a Yellow background. It was my hope that the lighter brown may have been a red color prior to aging and staining and would appear as such in the FORS data. Unfortunately, however, all three colors were absent of any absorbance features.

10952

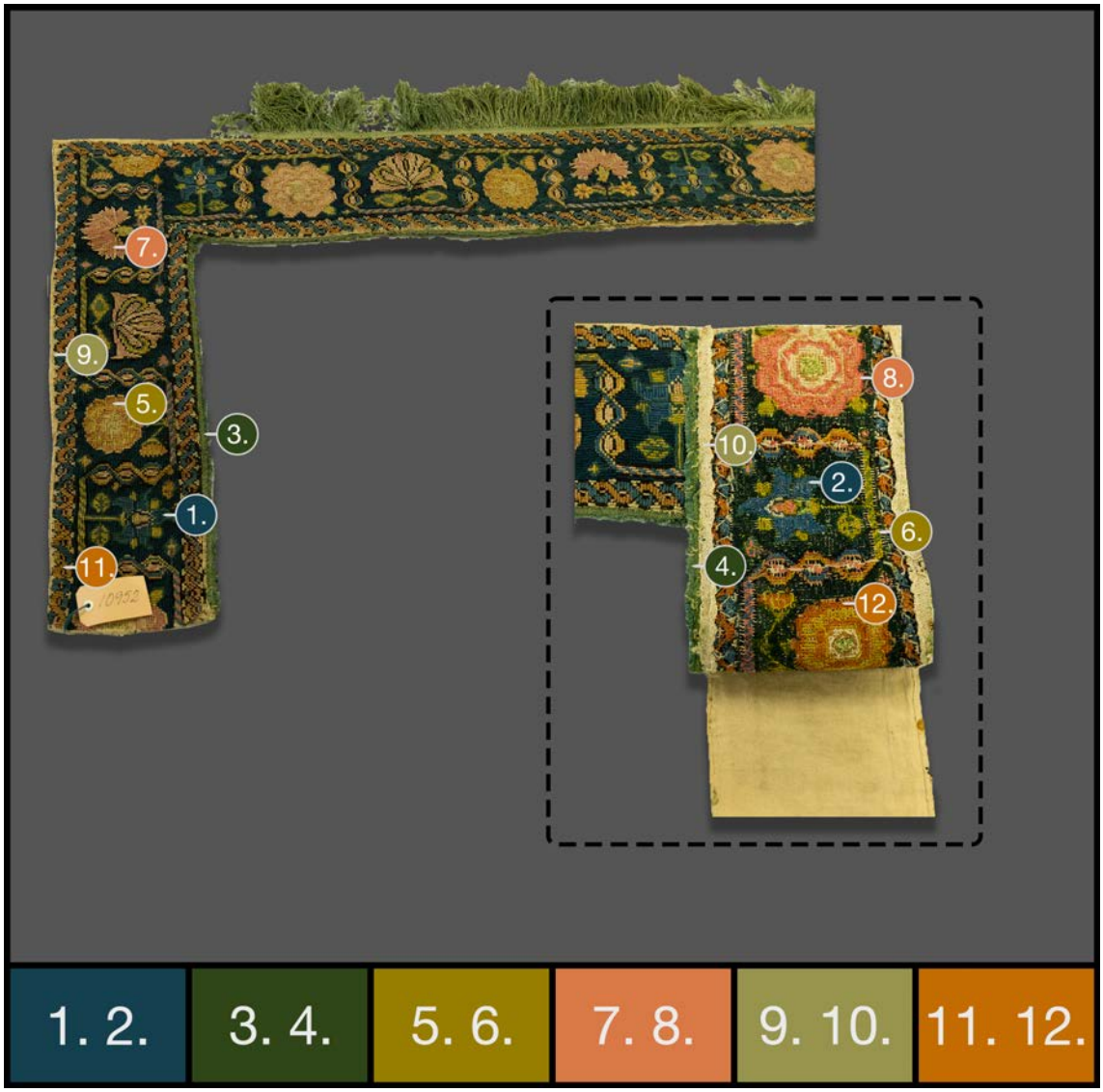


Figure 7. Textile 10952 Sample Sites

According to the Sarpur description, this textile may have been from 1657. It has six colors to sample Blue, Green, Yellow, Pink, Orange, and the undyed Ground Cloth. Similar to the 1997 textile, we could also take measurements from the reverse side, which was much more saturated. Once again, the Blue and Green colors relate to an Indigo Spectrum with minima at 660nm and 665nm, respectively. The Yellow measurement from the obverse side once again has an absorbance feature at 650nm, while the measurement from the reverse side behaved as you would expect, without any features. The Pink color displayed a minimum at 525nm which most closely resembles the Brazilwood dye reference. The Orange color also hints at a feature around 540nm, which is most closely correlated to insect dyes like Cochineal. Finally, the Ground color is without any features.

Figure 8. Textile 3942 Sample Sites

3942

This altar cloth is embroidered with the year 1683 on it. It has seven total colors sampled: Dark and Light Blue, Dark and Light Green, Red, Yellow, and White. Again, Indigo dye is indicated by all four Blue and Green measurements. Here, the Yellow and White samples did not produce any absorbance features. Finally, the Red color spectra have minima between 520 and 530nm, which is closest to the Brazilwood spectrum; however, it may also indicate another dye present, such as Cochineal.

10940

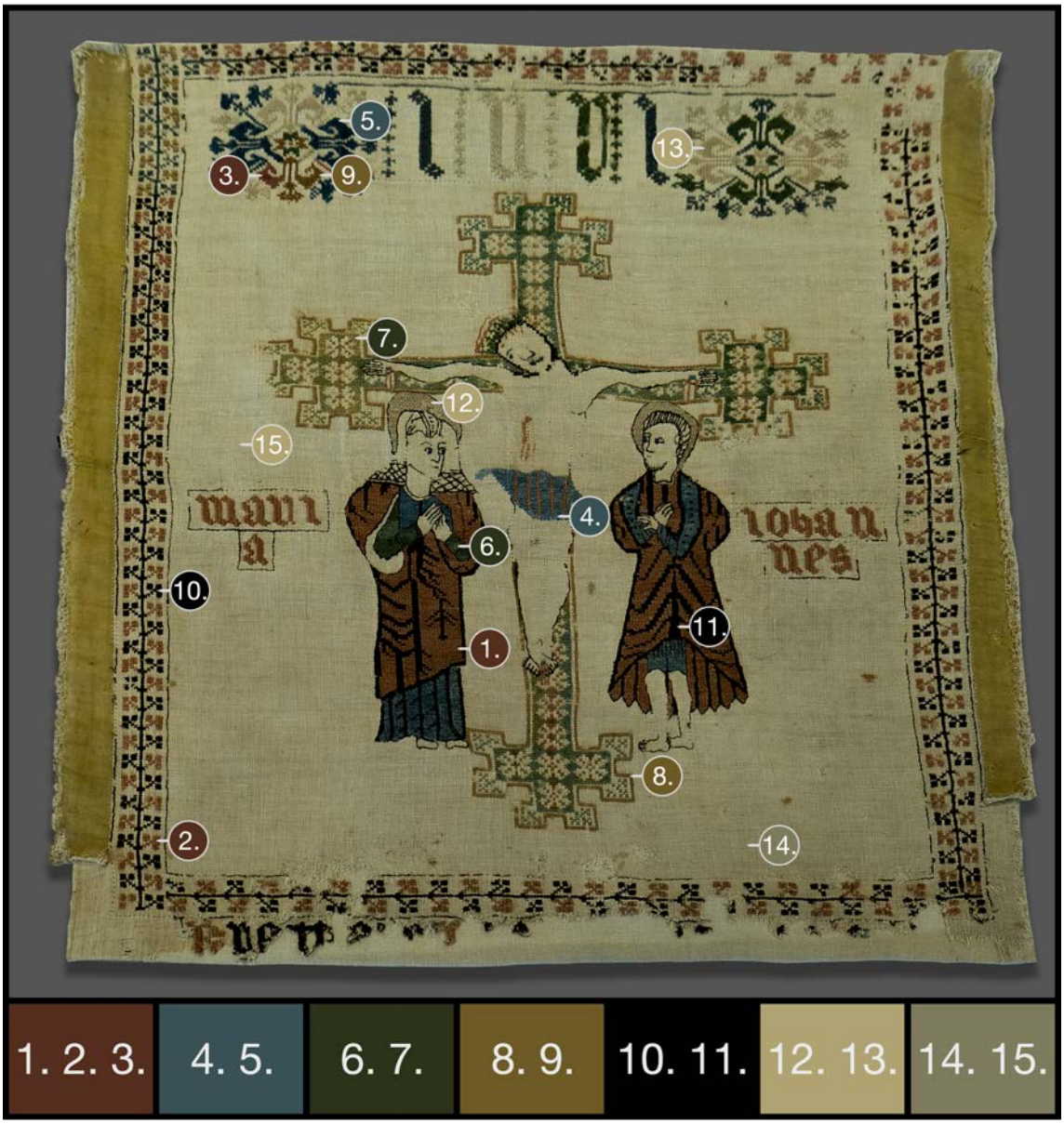


Figure 9. Textile 10940 Sample Sites

Likely from the 1600s, this textile has seven colors that were sampled: Red, Blue, Green, Yellow, Brown, White, and the Ground Cloth. The Red color again has an absorbance feature between 520-530nm, most closely related to Brazilwood (520nm), but could also represent Cochineal (540nm) or an unknown third dye. The Blue and Green results indicate Indigo with absorbance features between 655-660nm. Finally, the Yellow, Brown, White, and Ground measurements have no absorbance features.

2371

Figure 10. Textile 2371 Sample Sites

This textile is likely from 1400-1550, according to the Sarpur database. It has five colors that we tested: Red, Green, Blue, Yellow, and Ground Cloth. The red spectra came back very

dark but appear to have a minimum of 510nm, which is most similar to the Indian Madder. The Green color has different minima between the two areas; the first resembled that of the Red dye at 510nm, perhaps indicating a "miss," however, the second sample has a minima at 660nm, indicating Indigo and consistent with the other textiles thus far. The Blue measurements also indicated Indigo with an absorbance feature at 650nm. Finally, the Yellow and Ground Cloth measurements.

10885

Figure 11. Textile 10885 Sample Sites

This textile has seven separate colors sampled: Red, Dark and Light Blue, Yellow, Green, Tan, and Ground Cloth. The Red dye presents an absorbance feature at 500nm indicating the use of Madder. The Dark Blue and Green have an absorbance feature indicating Indigo; however, the Light Blue's spectrum appears different, with a minimum at 645nm slightly out of the indigo range. The Yellow, Tan, and Ground Cloth measurements present no minima of valley features.

647

Figure 12. Textile 647 Sample Sites

This textile utilizes seven colors: Blue, Green, Red, Dark and Light Yellow, Ground Cloth, and a separate blue on the attached border. Both Blues and the Green areas exhibit minima between 655-660nm, again pointing to Indigo dye being used for these colors. The two Red measurements show slightly varied minima, the first falling at 515nm and the second at 508nm, splitting the difference between our Madder (500nm) and Brazilwood (520) reference spectra,

possibly indicating that either one or both were used to create this textile or that a third dye not included in our references was used. Finally, both Yellows and the Ground Cloth exhibit no features.

3465

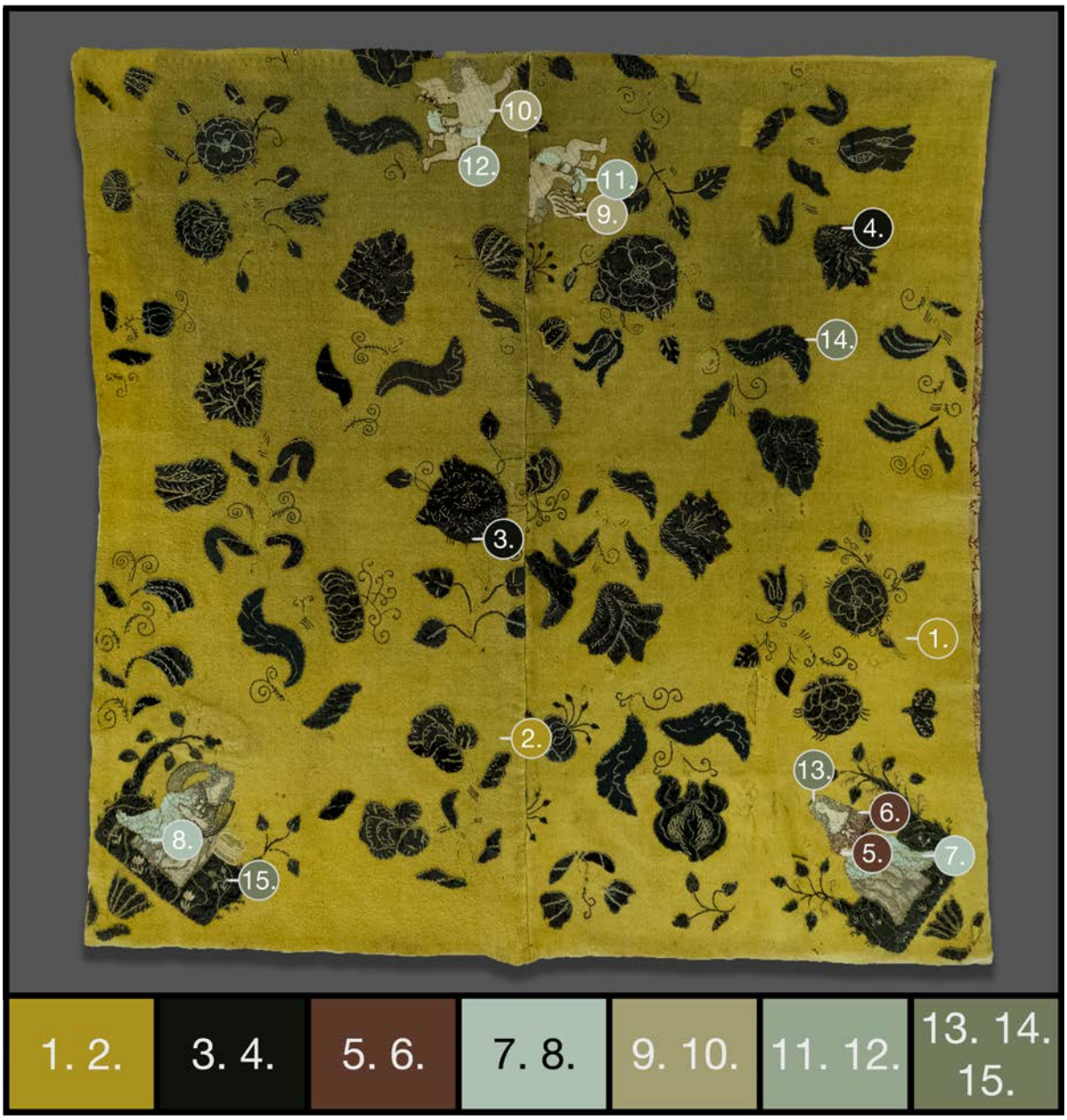


Figure 13. Textile 3465 Sample Sites

This textile has seven distinct colors. It is dominated by a vibrant yellow background with Black floral designs throughout. Additionally, two female figures and two angles contain the remaining five colors: Red, Light Blue, Pink, White, and Green. Surprisingly, while the Green falls within the range for Indigo at 650nm, the Blue and the white exhibit minima at 640 and 645nm, respectively, possibly relating to the uncertain light blue dye used on textile 10885, and worthy of further investigation. The Red dye exhibits two minima in the first measurement at 525nm and 564nm and a relatively neutral line with minimal depressions in its second. The minimum at 525nm is indicative of Brazilwood, while the feature at 564nm most closely relates to Madwood. The measured Yellow, Black, and Pink areas gave no discernible absorbance features.

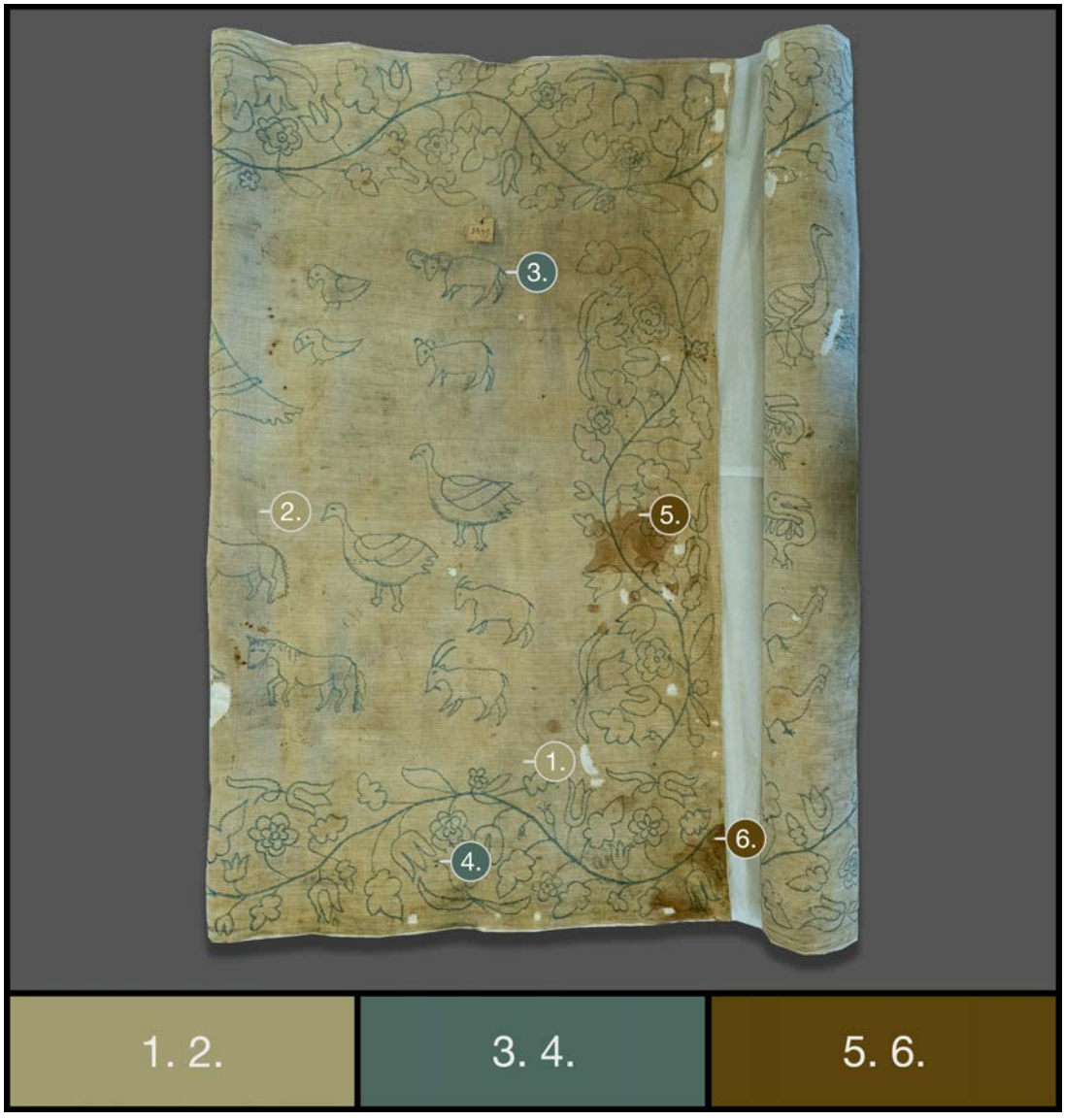


Figure 14. Textile 3449 Sample Sites

3449

For this textile, I measured three areas of color: The Ground cloth, the Green Embroidery, and the Stained areas. The Green yarn measured had an absorbance feature at 665, likely indicating the use of Indigo. The Ground cloth and stained areas gave no discernible features.

10886

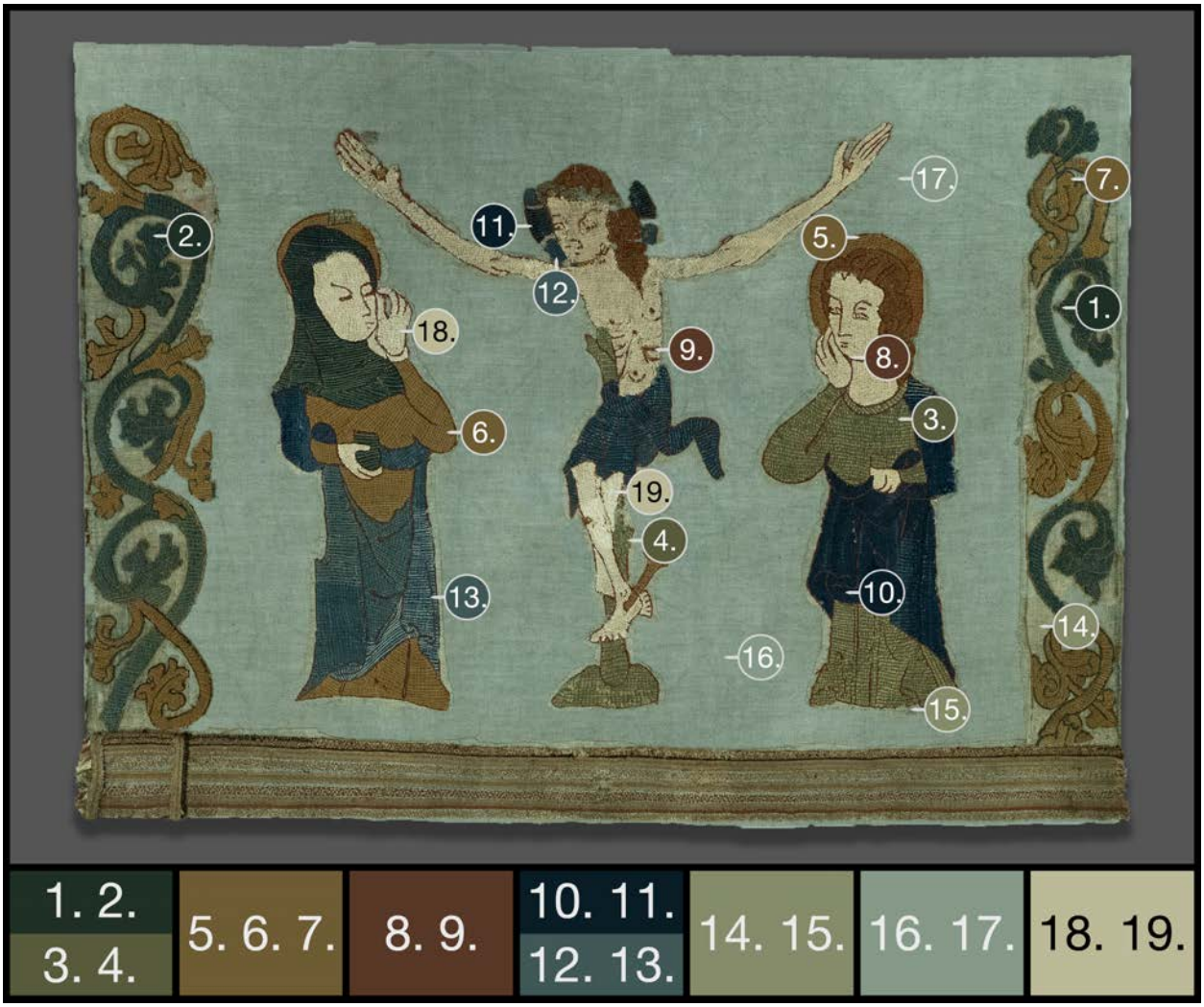


Figure 15. Textile 10886 Sample Site

The original imagery of this textile appears to have been sewn onto a new ground cloth due to damage; some areas of the original ground fabric are visible. This textile had nine colors

present: Dark and Light Green, Yellow, Red, Dark, and Light Blue, The Original Ground Cloth, a Younger Ground Cloth, and White. The Dark Green (660nm) and both Blues (650-665nm) fall within the Indigo range. However, Light green again exhibits the 645nm minimum seen in Textiles 3465 and 10885. The Red dye's spectra contained one minimum at 508, putting it within the range for Indian Madder (500nm). The Young Ground cloth for this textile was a light blue linen, with absorbance features at at 570nm and 630nm, possibly likening it to logwood dye. The Original Ground Cloth exhibits a minimum of 665, likening it to some contact with Indigo. The Yellow and White colors present no special absorbance features.

3110

Figure 16. Textile 3110 Sample Sites

This textile has 11 colors sampled. This includes Green, Dark and Light Blue, Yellow, Red, Fuchsia, Dark and Light Pink, Black, the Ground Cloth, and Tan. Once again, Green, Dark and Light Blue all fall within 655-660nm, indicating Indigo dye. The Red and Light Pink show minima at 500nm, suggesting Madder dye. Interestingly, the Fuchsia and Dark Pink exhibit features at 520nm and 525nm, respectively, most closely related to our Brazilwood reference. Finally, Yellow, Black Ground Cloth, and Tan spectra are absent of features.

1149

Figure 17. Textile 1149 Sample Sites

This textile has six colors: Green, Blue, Dark and Light Yellow, Red, and Ground Cloth. Consistent with previous textiles, the Green and Blue colors sampled have minima present at 655nm, again indicative of the use of Indigo dye. The only other color with an absorbance feature is the Red dye, with a feature at 515nm similar to that of Brazilwood (520nm). The remaining Colors, Dark and Light Yellow, and Ground Cloth have no features present.

10895a

Figure 18. Textile 10895a Sample Sites

This textile has seven Colors present. This includes Green, Blue, Red, Pink, Yellow, White, and the Ground Cloth. Green has a minimum present at 660nm, while Blue has a minimum present at 650nm, both indicative of Indigo. Red and Pink spectra share a minimum of 525nm, indicative of Brazilwood. The Yellow and White spectra exhibit minima between 645 and 650nm in areas unlikely to have "miss." This may be related to Indigo in some way or, as mentioned previously, a dye unaccounted for in our references. Finally, the Ground Cloth had no absorbance features present.

10895b

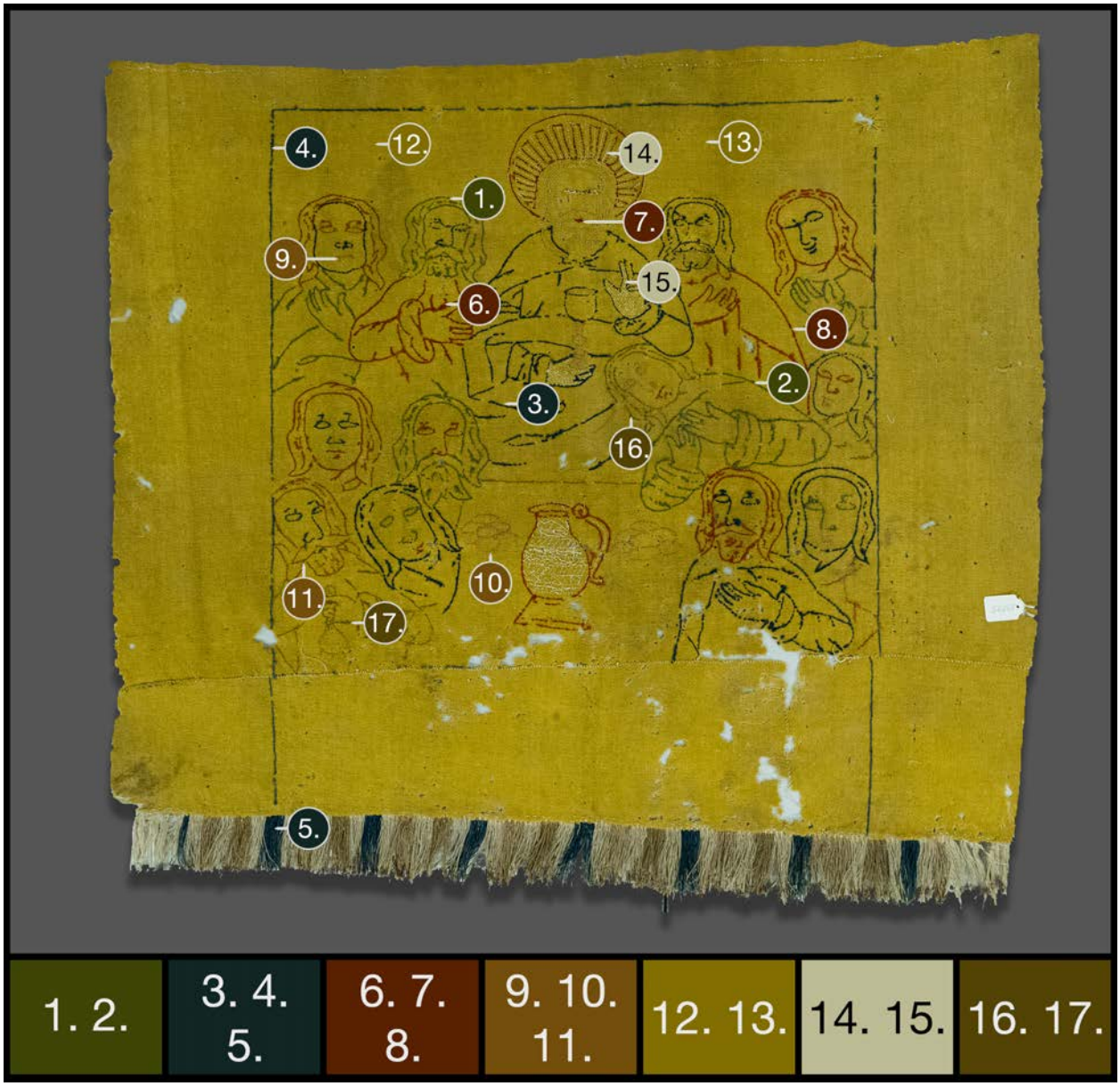


Figure 19. Textile 10895b Sample Sites

This textile has seven colors present: Green, Blue, Red, Pink, Yellow (Ground Cloth), White, and Tan. Both the Green and Blue spectra fit the Indigo model; the green minimum is at 660nm, and the blue minimum is at 650nm. The Red and Pink spectra have very subtle features, if at all. The Red spectra are very dark and flat, with a possible minimum of 550nm. Pink has a sloping spectrum similar to that of indistinct yellow; however, it has a slight valley or step of around 555nm. Both of these may relate to Madwood or another dye that is yet to be added to our reference collection.

10951

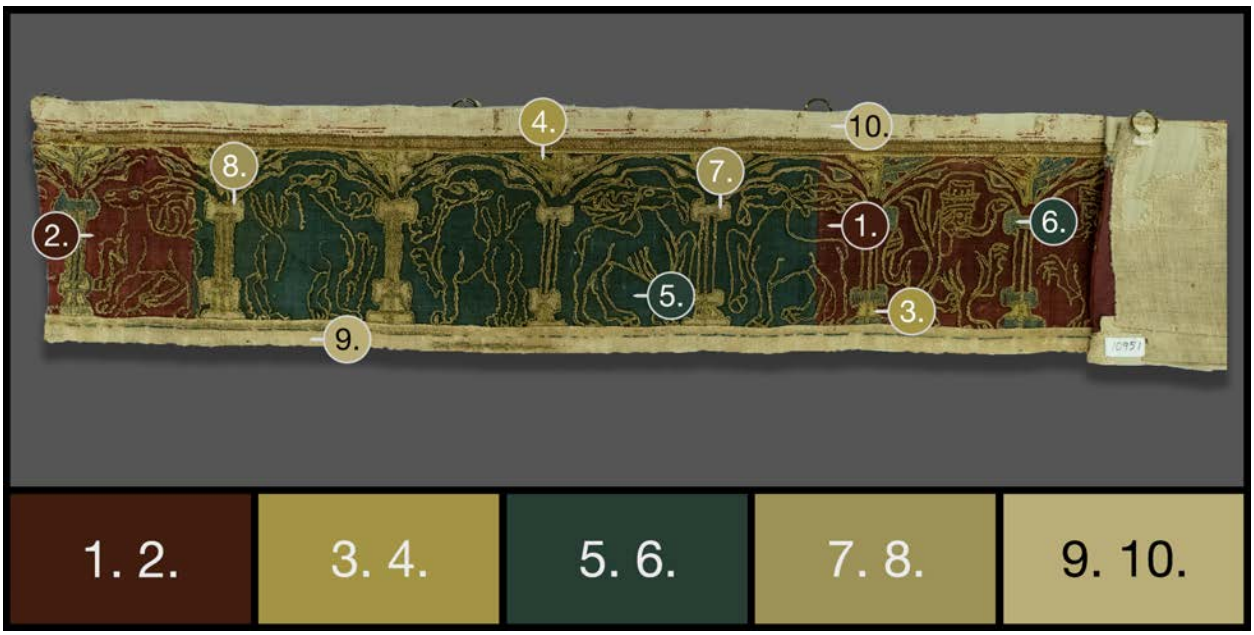


Figure 20. Textile 10951 Sample Sites

This textile only has five colors sampled: Red, Yellow, Green, White, and Ground Cloth. Only the Red and Green areas display absorbance features. The Red spectra have minima at 540nm, likely indicating a red insect dye such as Cochineal. The Green spectra have minima between 650 and 660nm, once again indicating an Indigo dye. The Yellow, White, and Ground Cloth spectra display no absorbance features.

4500

This Textile has 8 colors present, Dark and Light Blue, Green, Red, Yellow, White, Brown, and the Base fabric the cross image was embroidered on to. I sampled two points on the main areas of the Dark Blue and Green colors and a third on the darker outline of these color blocks. The Dark Blue areas all pertain to the Indigo range with minima 655 and 665nm. However, the Light Blue spectra each have an absorbance feature at 645nm, indicating the possibility of a dye other than indigo. The first two Green spectra have a minimum of 665, fitting within the Indigo model. However, the third point on the darker outline exhibits a minimum at 600nm, possibly indicating an association with Logwood dye. We still need to create additional

logwood references to confirm this result further. The Red appears to again match the Brazilwood model with an absorbance feature at 525nm. The Yellow, White, Brown, and Base Fabric provided nondistinct spectra without any absorbance features.

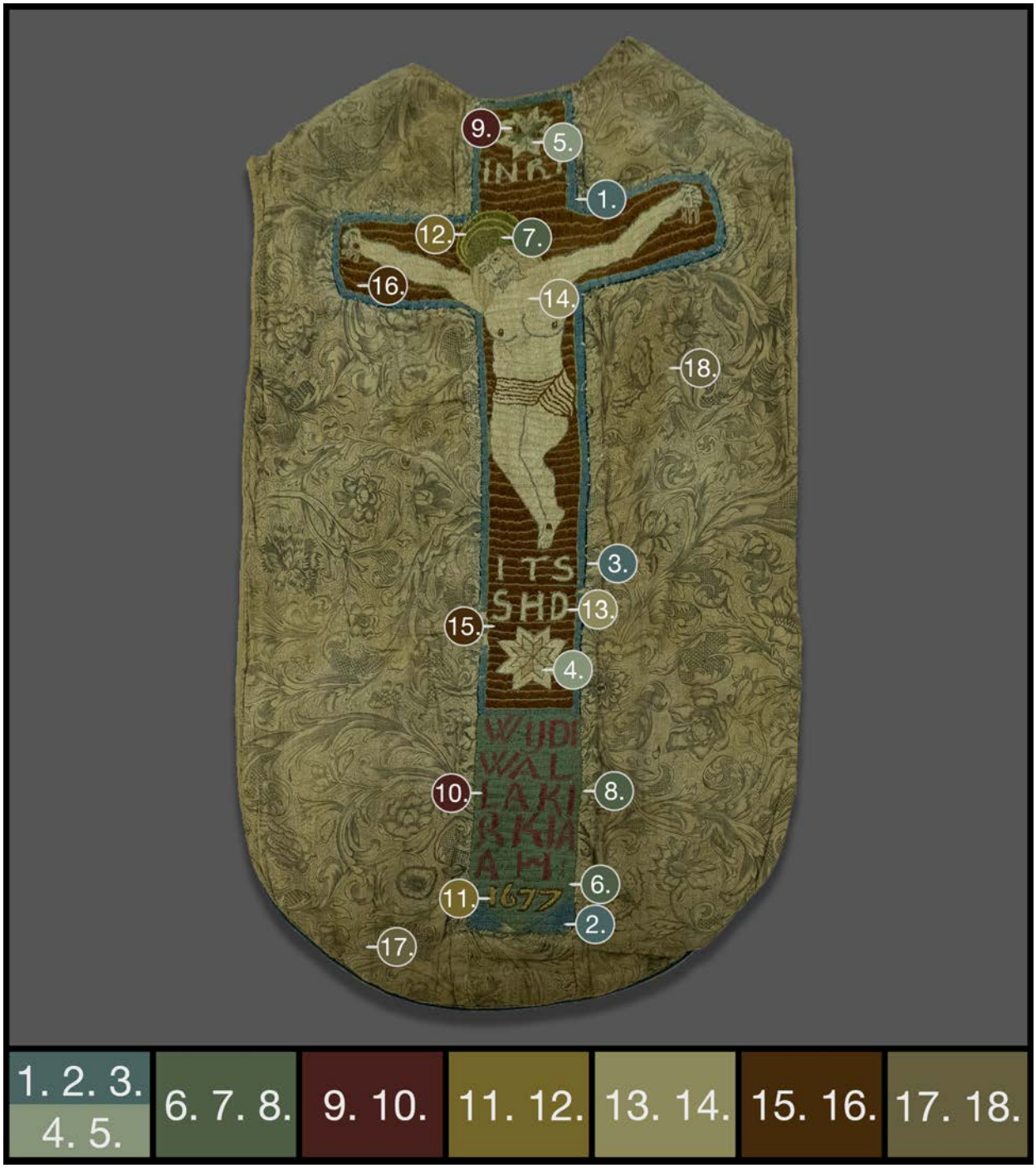


Figure 21. Textile 4500 Sample Sites

4279

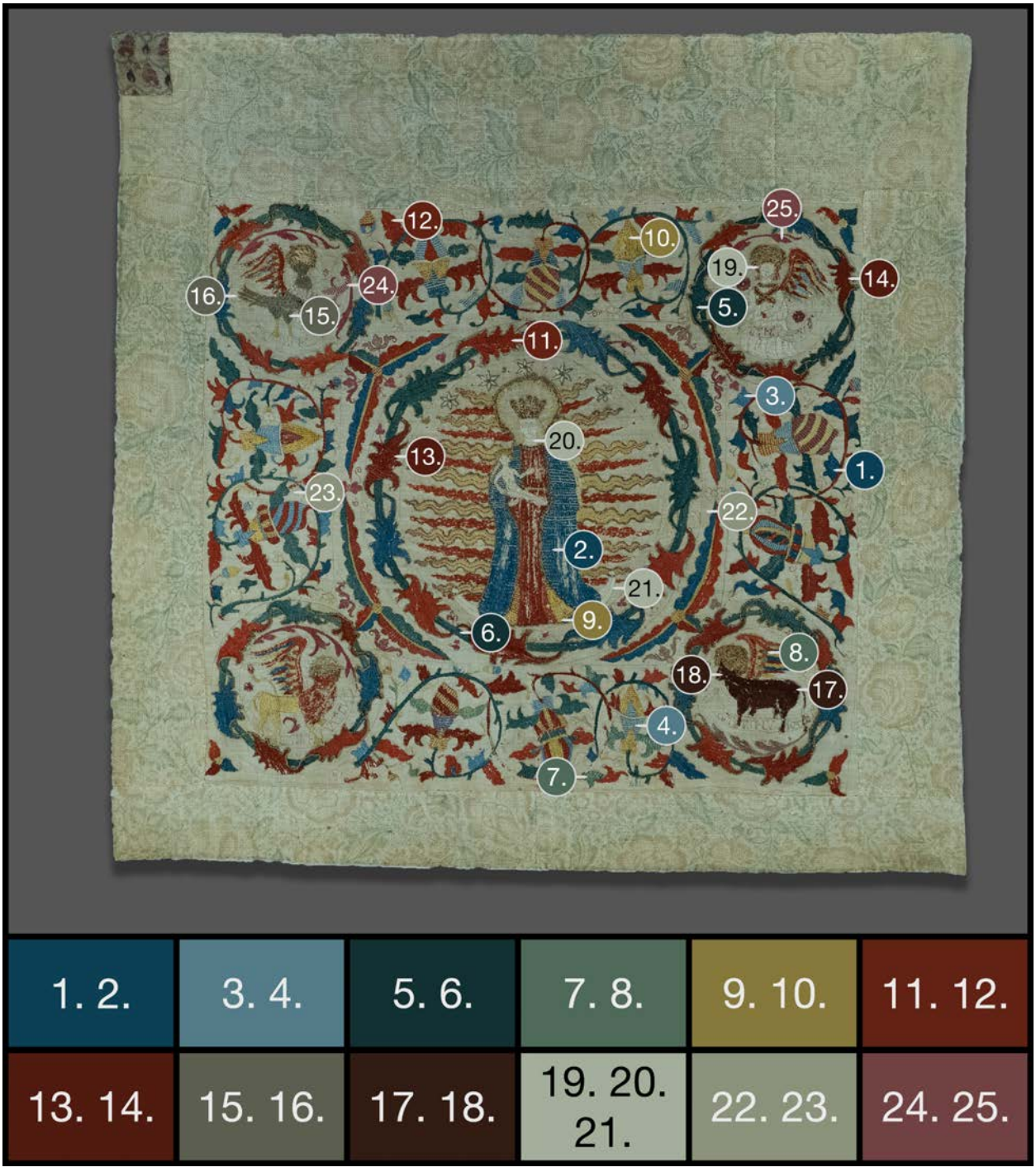


Figure 22. Textile 4279 Sample Sites

This textile has 12 colors, including Dark and Light Blue, Dark and Light Green, Yellow, Red, Crimson, Grey, Brown, White, the Ground Cloth, and Pink. As one may predict by this

point, The Dark Blue and Dark and Light Greens all exhibit minima within the Indigo range at 650nm. The Light Blue has an absorbance feature at a slightly earlier wavelength, 645nm. The Crimson spectra may have minima present at 524nm, but it is perhaps too dark and noisy to say confidently. Surprisingly, neither the Red nor Pink spectra display a visible absorbance feature. The Yellow, Brown, White, and Ground Cloth are also absent observable features.

4380

Figure 23. Textile 4380 Sample Sites

This is the final preserved textile measured under my parameters. It has 10 colors: Dark and Light Blue, Dark and Light Red, Yellow, Tan, Dark and Light Brown, White, and Green. Both Light and Dark Blue have minima present at wavelengths 660nm and 665nm, respectively, indicating Indigo. The darker Red has an absorbance feature at 510nm, existing between the

ranges of Madder (500nm) and Brazilwood (520nm). The Green areas tested have minima at slightly shorter wavelengths than Indigo's range, between 635 and 646nm. The remaining colors, Yellow, Tan, Dark and Light Brown, and White, are all devoid of any discernible features.

3924

Figure 24. Textile 3924 Sample Sites Courtesy of Maurizio Aceto

This textile analysis and its results were carried out and generously shared by Dr. Maurizio Aceto. He sampled 11 separate colors: Dark Blue (1, 19, 20, 21), Red (2, 9, 11, 15, 16), Light Brown (3), Light Green (4), Dark Green (5, 14, 17), Dark Brown (6, 23), Blue (8, 13), Yellow (10), Dark Yellow (12), Dark Red (18), and Black (22). The spectra of all Blue points

have been identified as Indigo/Woad. All Green points have been identified as a mixture of Indigo/Woad and a nondescript yellow dye. All Red points have been identified as Madder, whereas the Dark Red point was identified as "tannins." The point for Yellow was identified as Yellow dye. However, the remaining Dark and Light brown, Dark Yellow, and Black points were also identified as tannins.

Conclusions

We see consistent evidence for the use of Indigo dye across most of the textiles in the spectra of Blues and Greens. There is a possibility that Logwood or a third dye is responsible for some of the blues in textiles#. As for the 33 possible identifications of Red colorants, Brazilwood dye was the most common, with 14 instances (however, several of these minima were on the borderline between Brazilwood and Madder or Cochineal). Madder was the second most common, with 11 identifications, including that from Maurizio Aceto's results. Cochineal or some red insect dye appeared to be present in 5 spectra. Madwood may have been present in 2 spectra but needs further reference material. I am curious why multiple yellow and white yarns reflected spectra similar to indigo. I hope to investigate this further to provide a better explanation for this phenomenon. Finally, my goal, along with Noemi Cubas Martin, is to create a more robust reference collection of dyes relevant to the Medieval Scandinavian context to solidify these conclusions and eliminate other possible candidates.

Archaeological Textiles

These tests aimed to find out if we could detect a previously dyed textile in what is otherwise a brown scrap of cloth stained by centuries in the soil. The methodologies and parameters used to take these measurements are consistent with those used for the preserved textiles. As will become obvious, the dark, often brown, coloration of these fragments causes many of the measurements to be flat lines with no detectable absorbance features. In the future, if we wish to attempt to use FORS to detect unobservable dyes, we either need to select light-colored or less stained fragments; otherwise, we must proceed with a different methodology. Noemi Cubas Martin plans to investigate this further with a larger sample of archaeological textiles. The full reflectance spectra have been included in Appendix C.

2006-36-1251

Figure 25. Textile 2006-36-1251 Sample Sites

Four areas were sampled on these fragments, distinguished as Yellow, Dark Brown, Grey, and Light-Colored areas. None of the areas measured present any distinct absorbance features. The Dark Brown spectra has a small peak at 460nm but no discernible minima due to its darkness. Additionally, in the Grey measurements, there is a small disruption to the otherwise slopping spectra at 640nm, but it is weak enough to be explained as noise.

2007-44-544

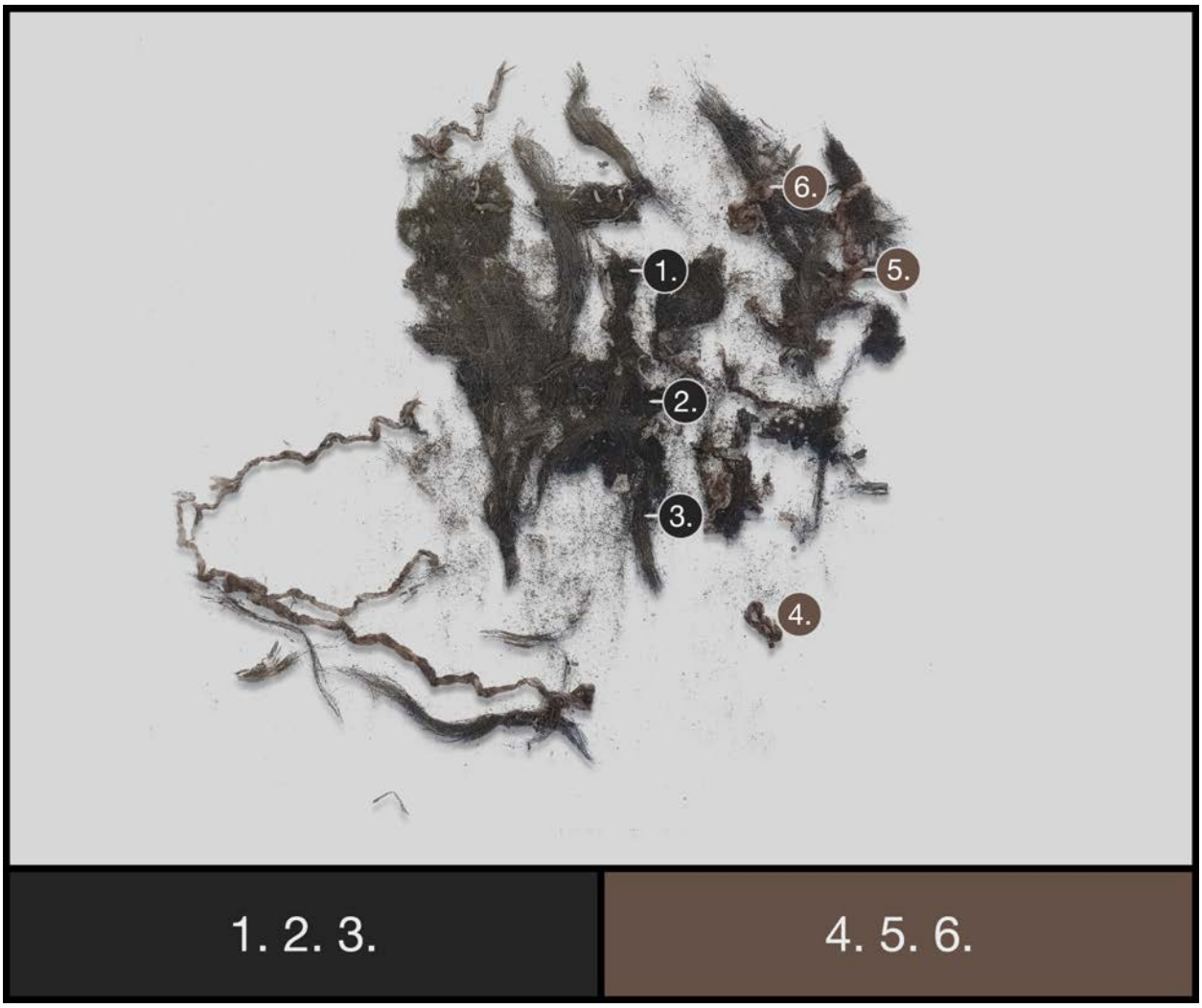


Figure 26. Textile 2007-44-544 Sample Sites

Two colors on these fragments were sampled, labeled Dark and Possible Color. Neither have any observable absorbance features.

2007-44-655

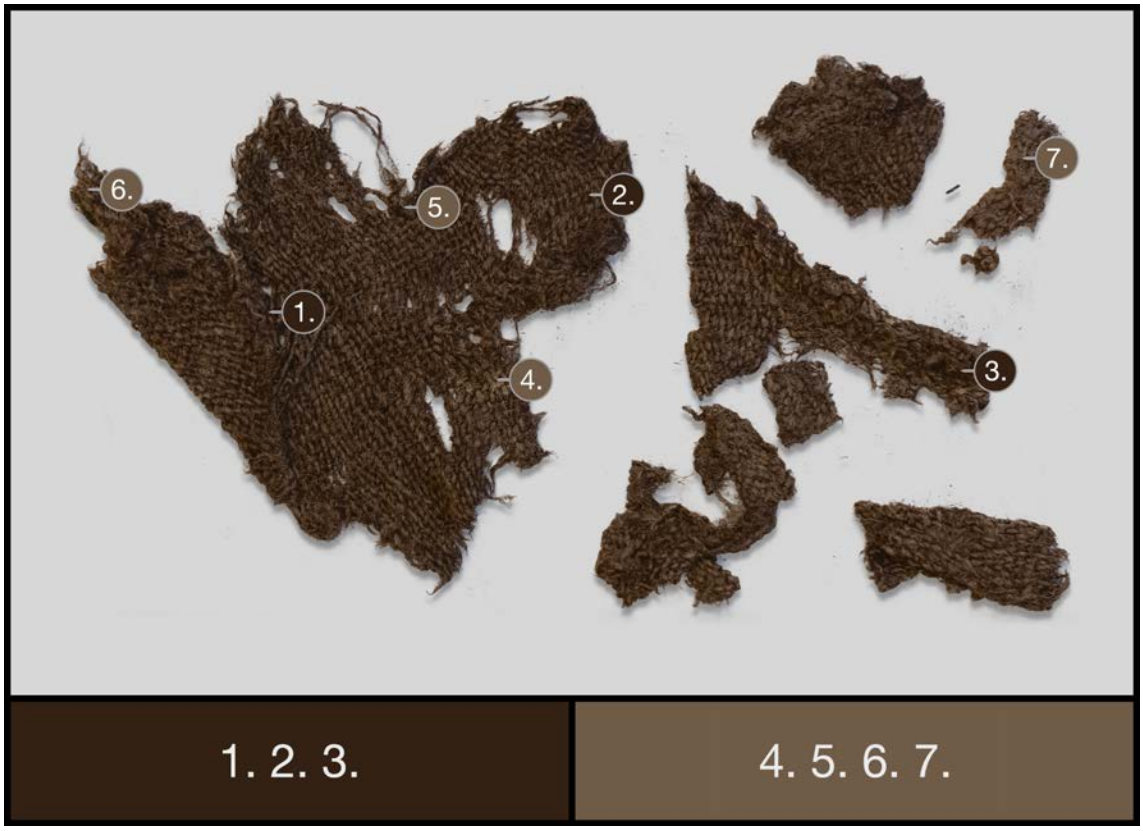


Figure 28. Textile 2007-44-779 Sample Sites

These fragments have two colors sampled: the predominant Brown color and a slightly lighter Color. Neither exhibited any spectra with absorbance features.

2007-44-779

This fragment was sampled at six points, which were distinguished as either Brown or Light. None of the six resulting spectra contained an absorbance feature.

2007-44-731

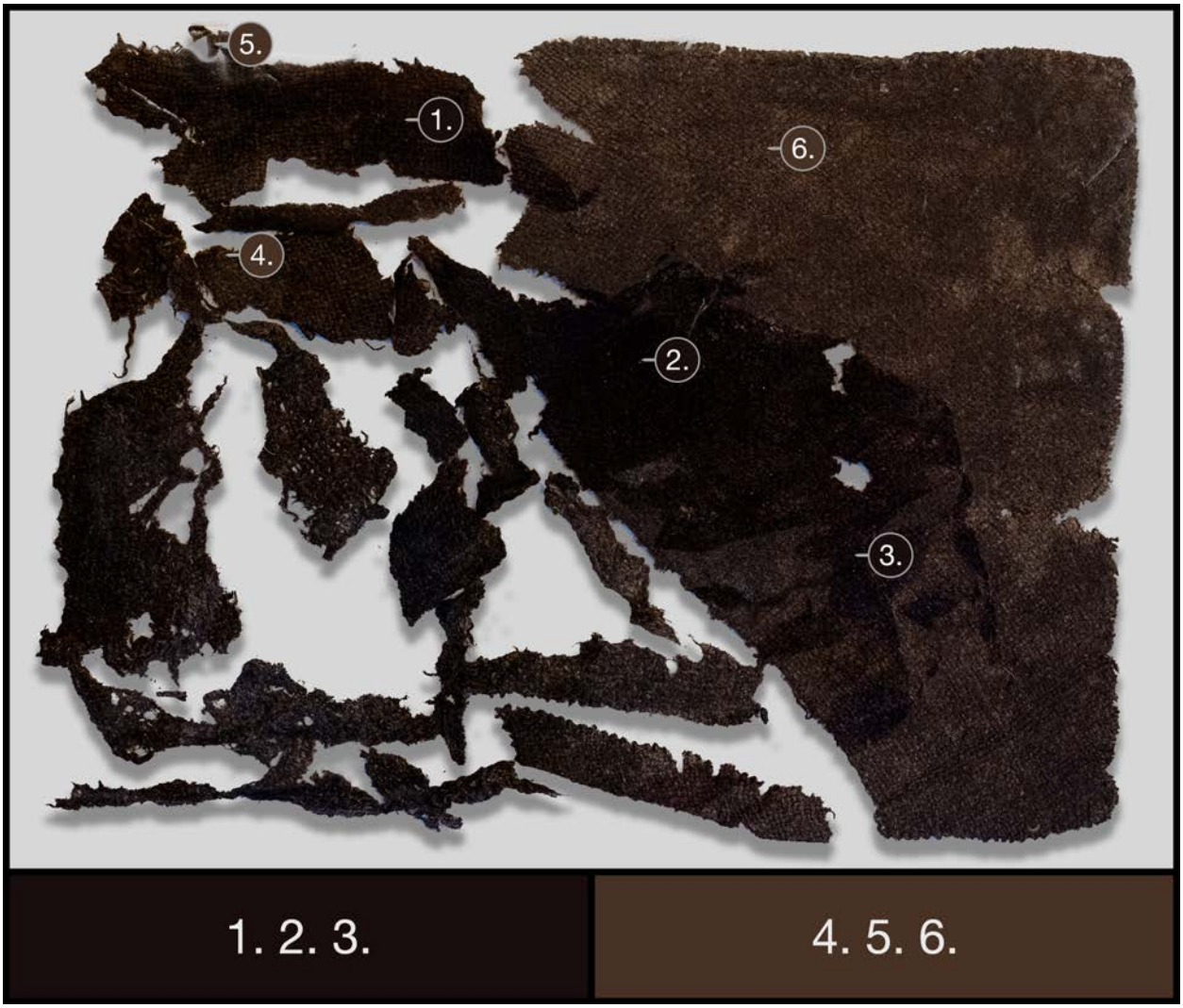


Figure 29. Textile 2007-44-731 Sample Sites

These fragments were sampled at eight points and distinguished as either Dark or Light. None of these produced a spectrum with a discernible absorbance feature.

2007-44-780

Figure 30. Textile 2007-44-780 Sample Sites

These spun yarns were measured at four points, and all were considered to be consistent Brown. They were also consistent in the absence of absorbance features.

2007-44-873

These textile fragments were sampled at six points on relatively Dark and Light colored areas. None of the resulting spectra contain any observable absorbance features.

Figure 31. Textile 2007-44-873 Sample Sites

2022-7-100

This textile fragment is distinguished by a small area of what appears to be staining from oxidized copper. Due to its fragility, only three measurements were taken, two on the Dark Brown areas and one from the likely Copper area. The Dark areas produced no absorbance features. The Copper area presented a broad valley between wavelengths 660 and 760nm with an absolute minimum of around 700nm. I am unsure if this is a true absorbance feature as it is a shallow valley, but it warrants further consideration when thinking of possible future applications for the FORS system.

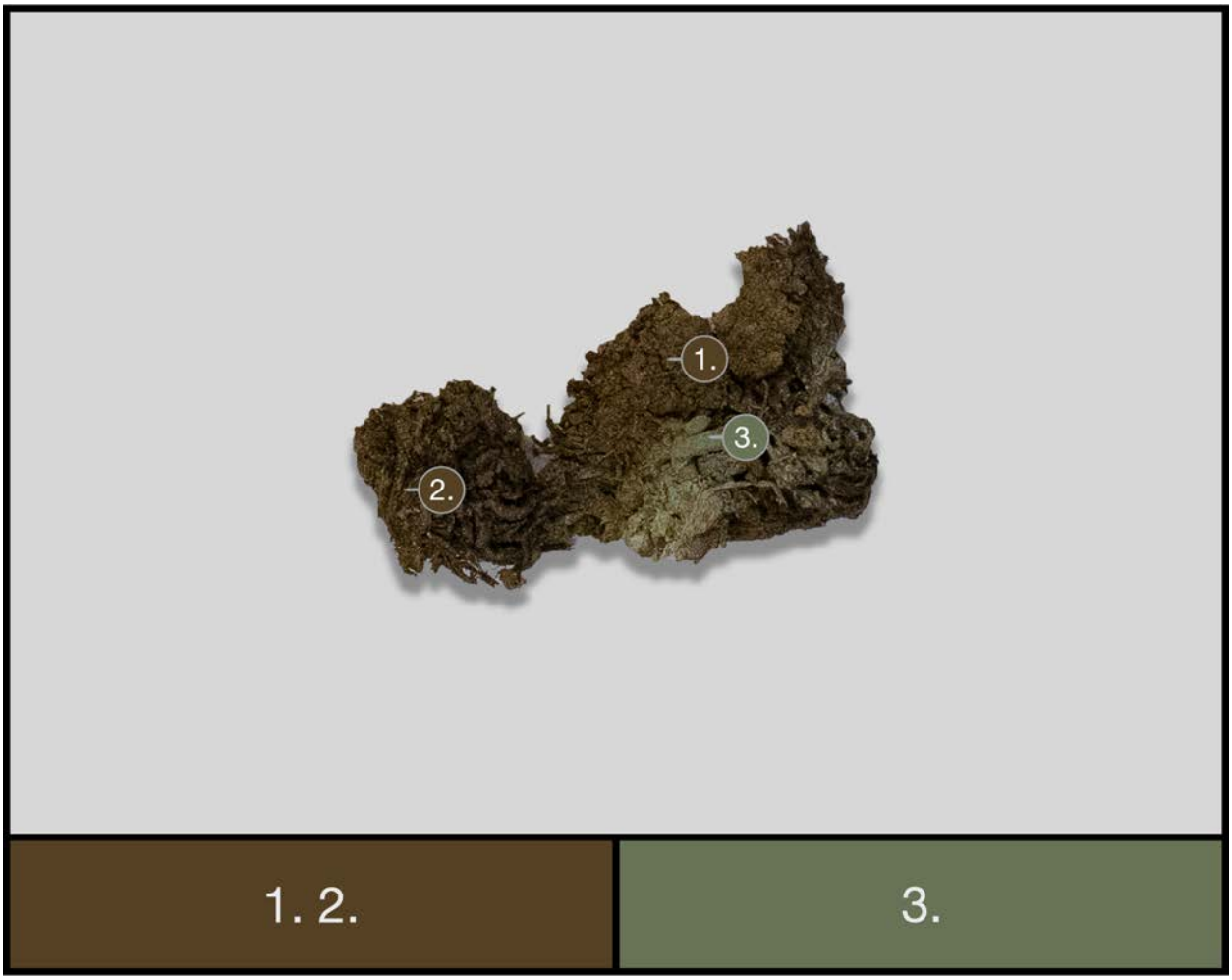


Figure 32. Textile 2022-7-100 Sample Sites

2022-7-101

Due to its fragility, this small fragment was only sampled in two areas: one relatively Light area and one relatively Dark area. Neither produced an absorbance feature. It should also be noted that there was a considerable amount of sediment present, but it could not be removed in fear of damaging the integrity of the fragment.

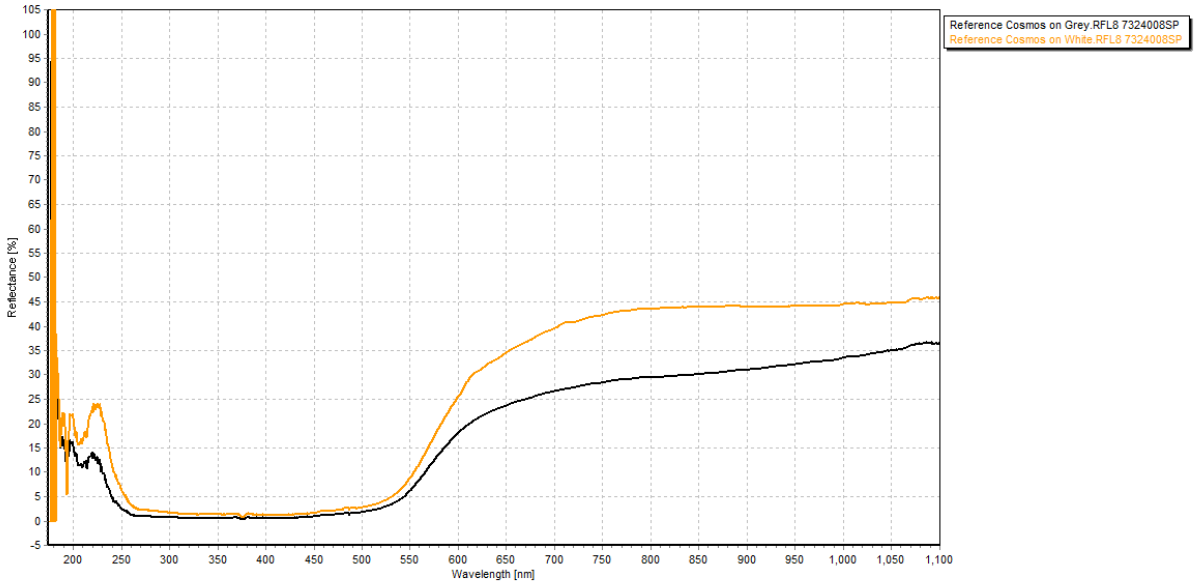
Figure 33. Textile 2022-7-101 Sample Sites

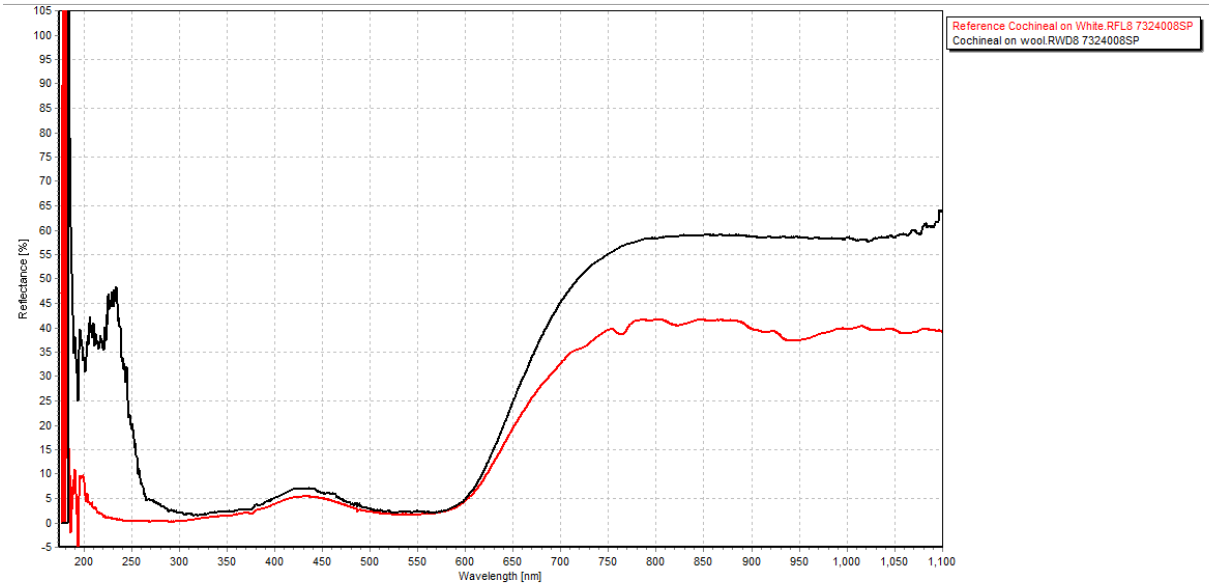
Figure 34. Textile 2022-7-102 Sample Sites

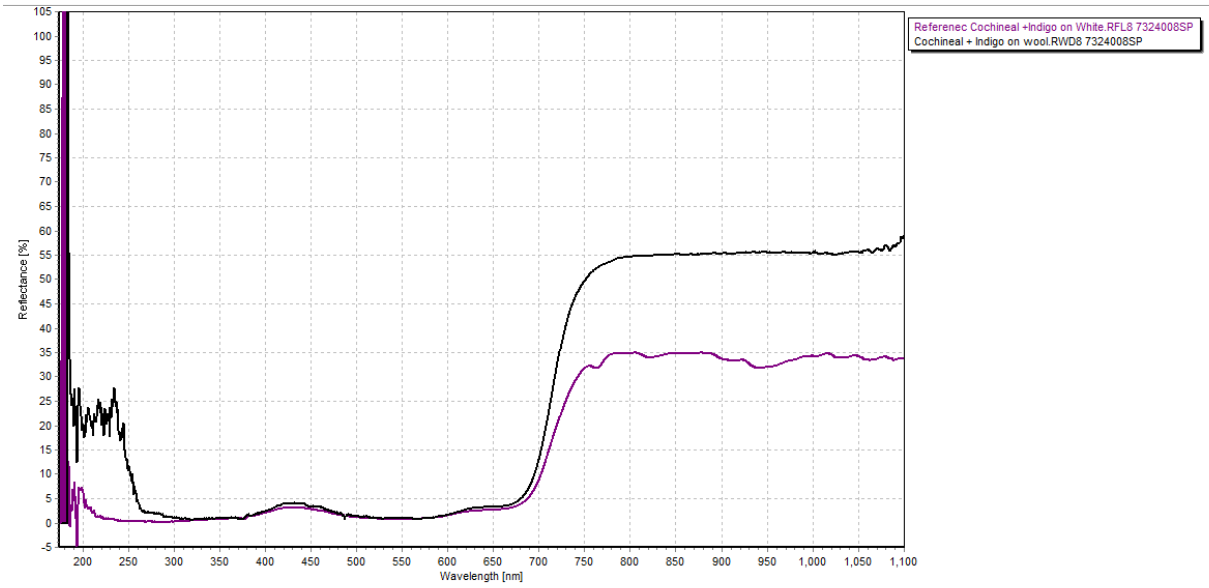
2022-7-102

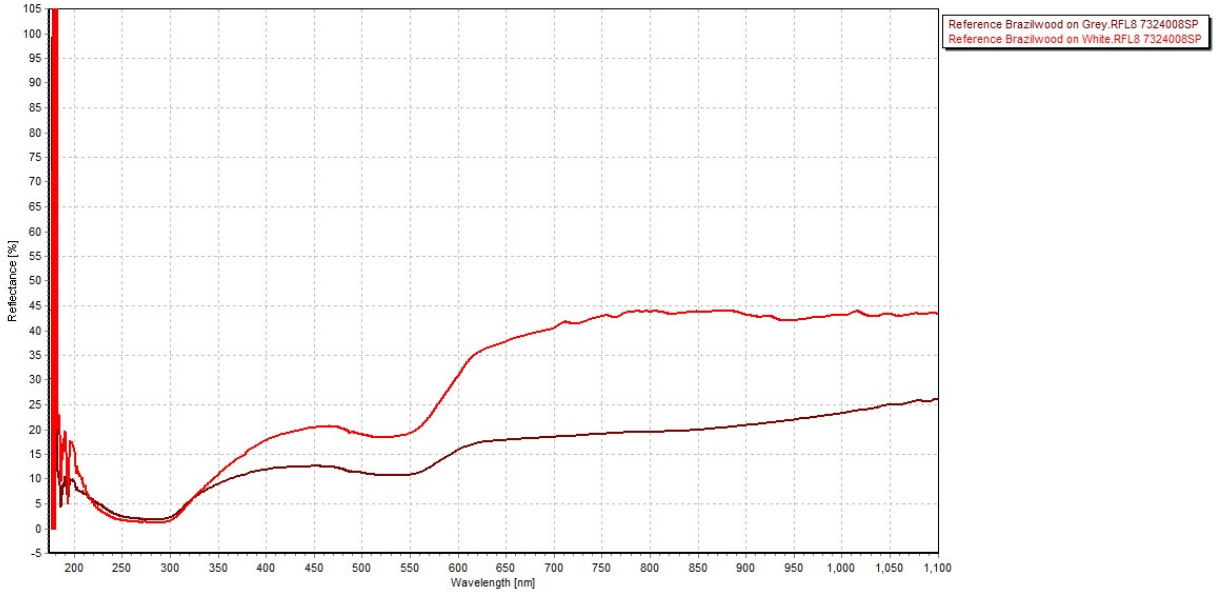
This small textile fragment was consistent in color but was sampled twice on the obverse side and once on the reverse side. None of the resulting spectra contain an observable absorbance feature.

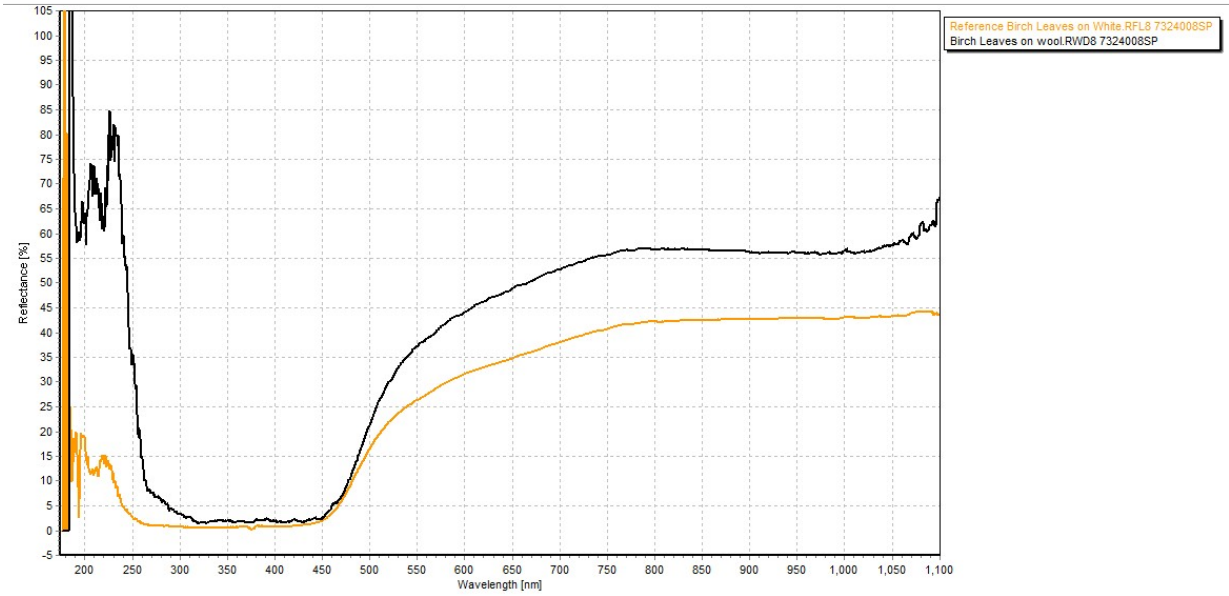
Appendix A: Reference Spectra

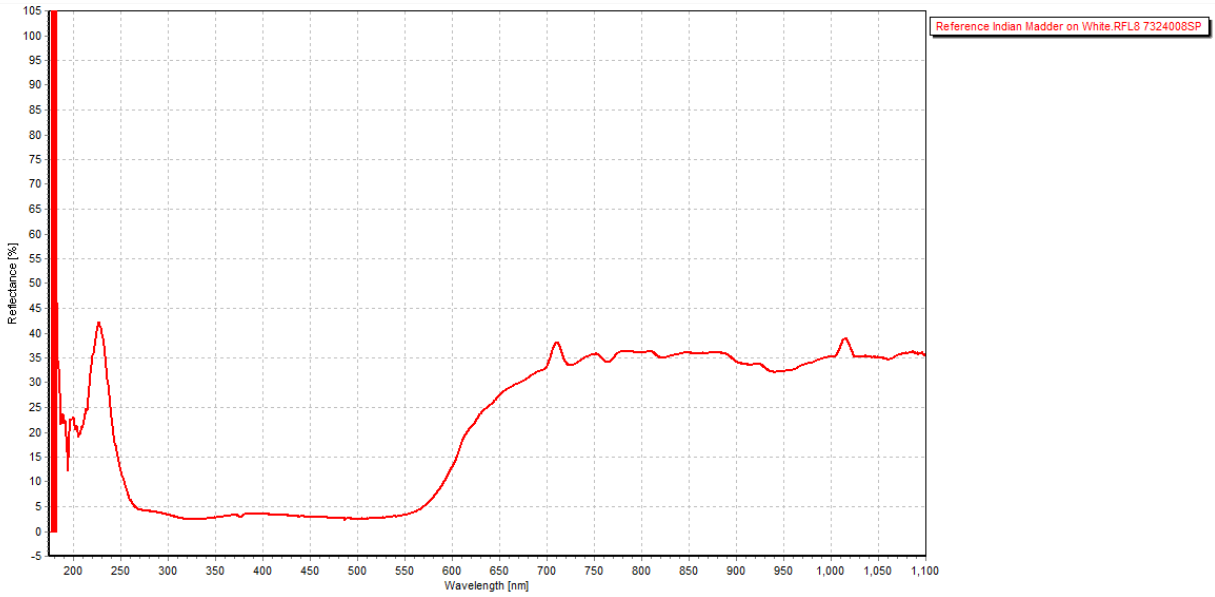


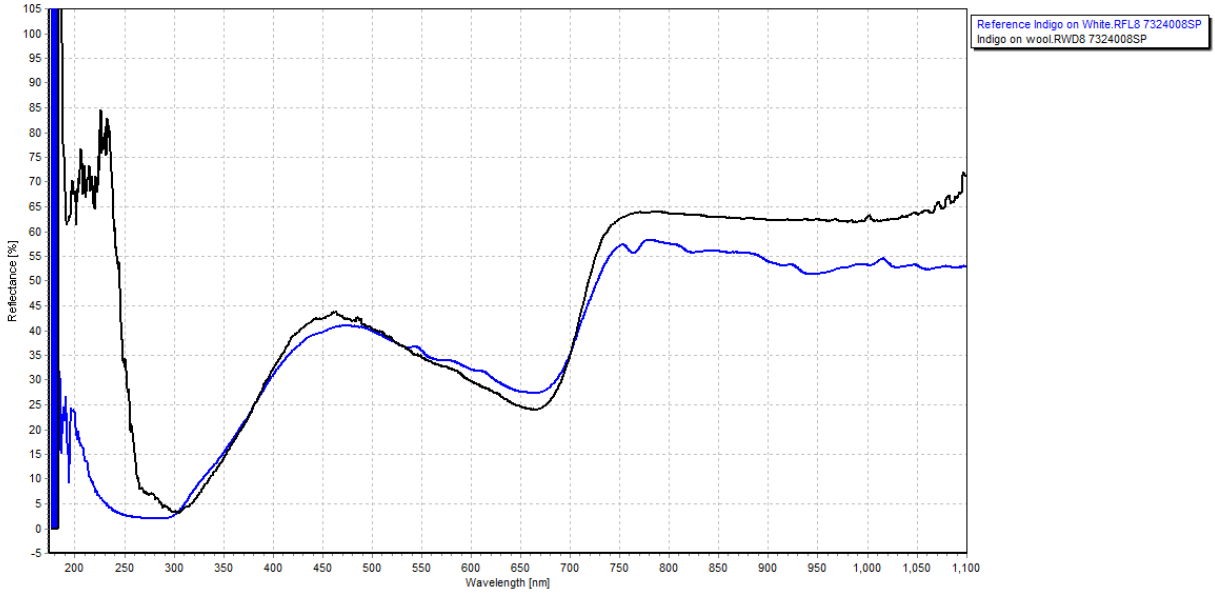


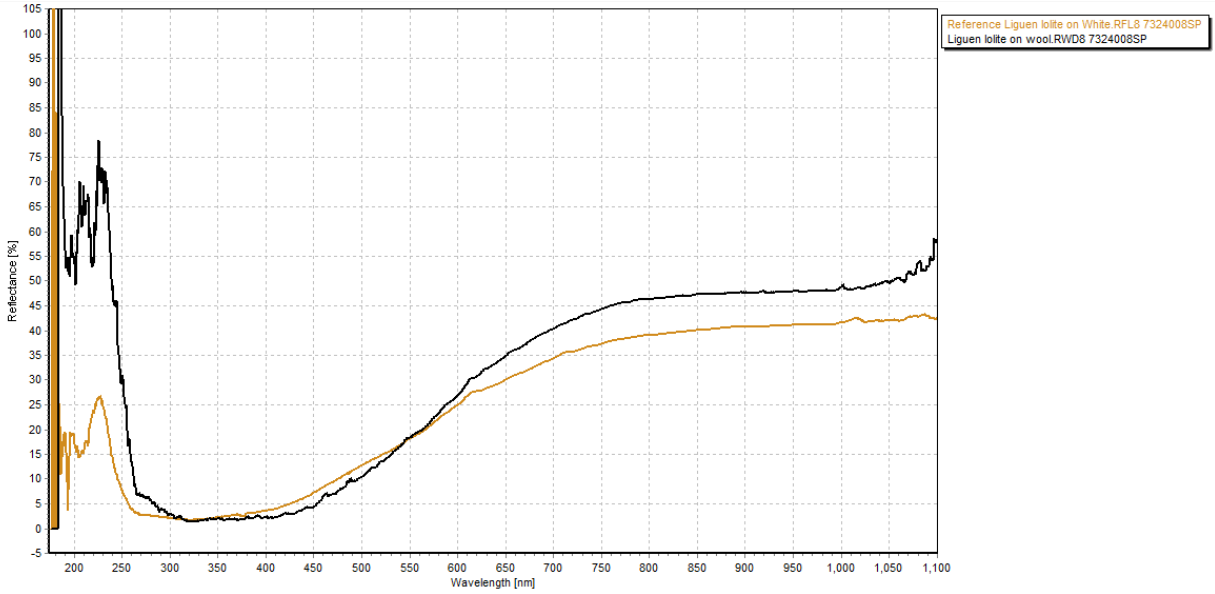


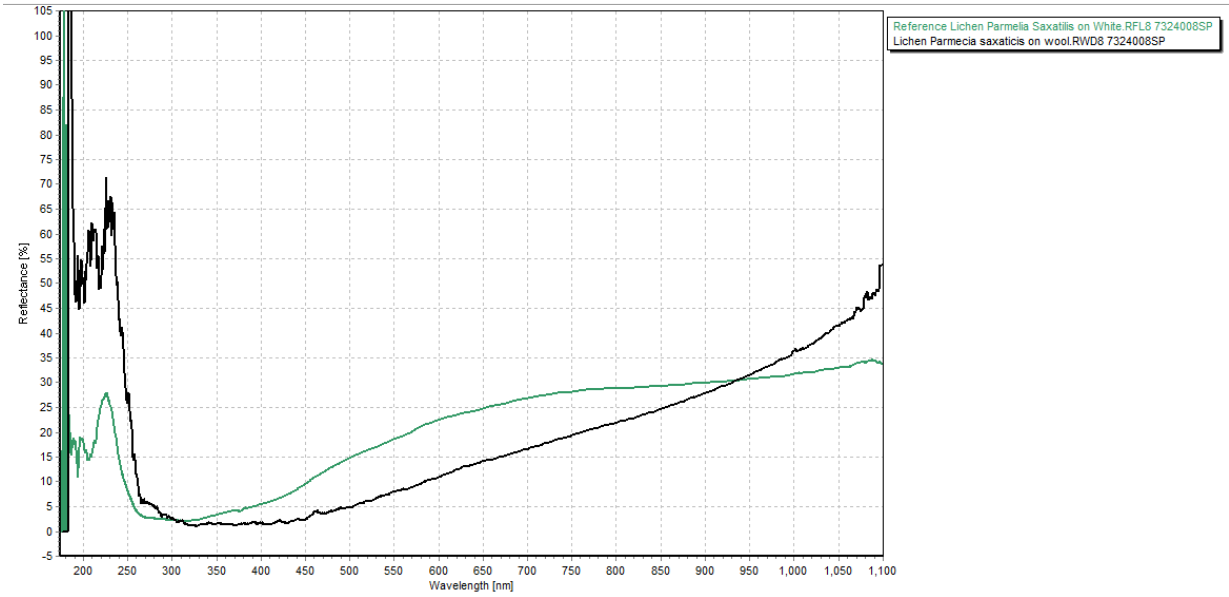

Reference Brazilwood on Grey.RFL8 7324008SP
Reference Brazilwood on White.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

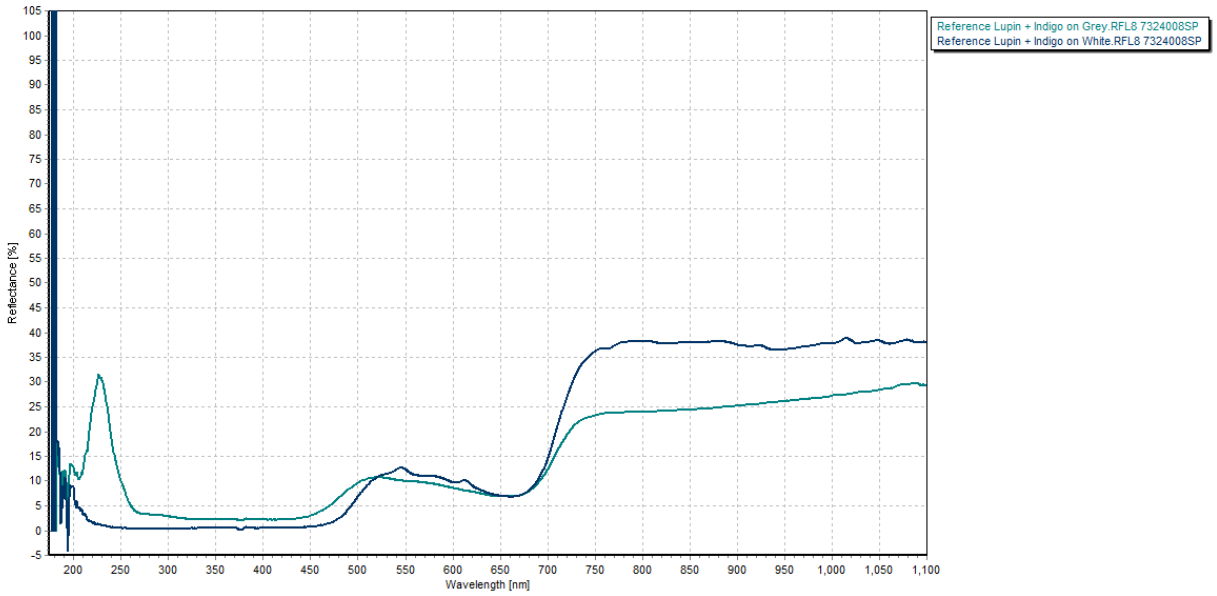

Reference Birch Leaves on White.RFL8 7324008SP
Birch Leaves on wool.RWD8 7324008SP
Reflectance [%]
Wavelength [nm]

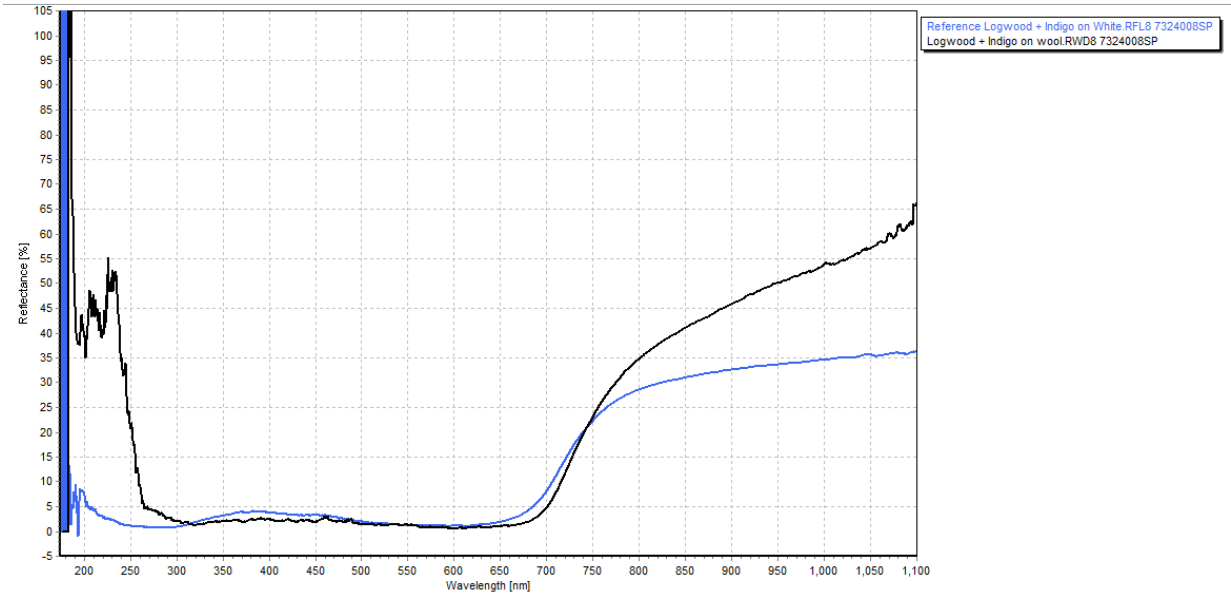

Reference Indian Madder on White.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

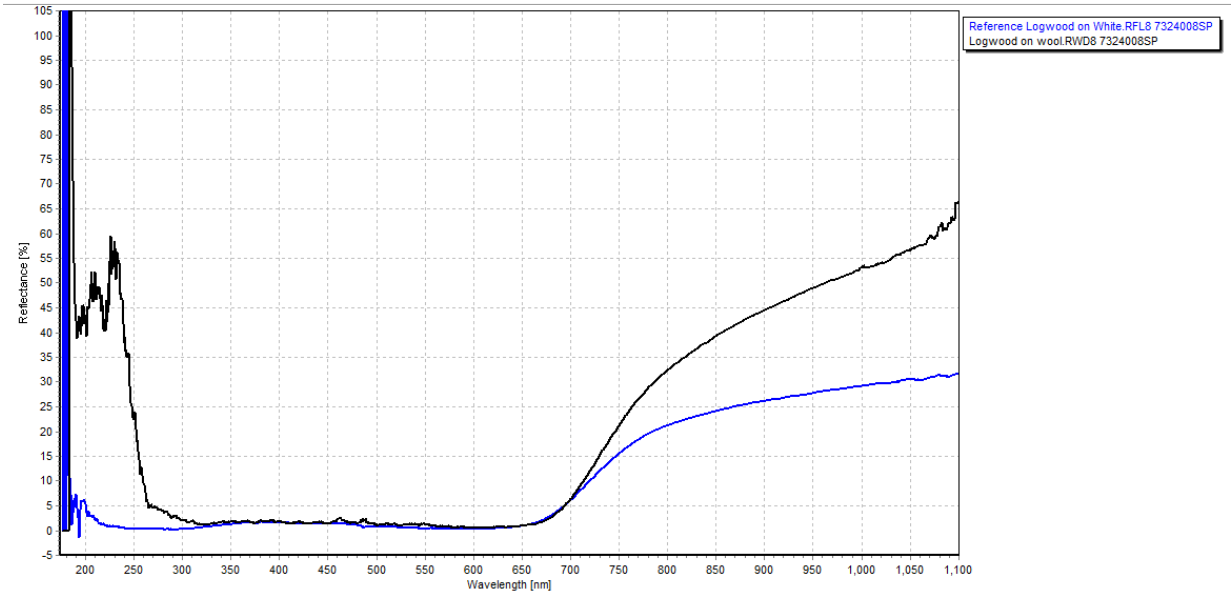

Reference Indigo on White.RFL8 7324008SP
Indigo on wool.RWD8 7324008SP
Reflectance [%]
Wavelength [nm]

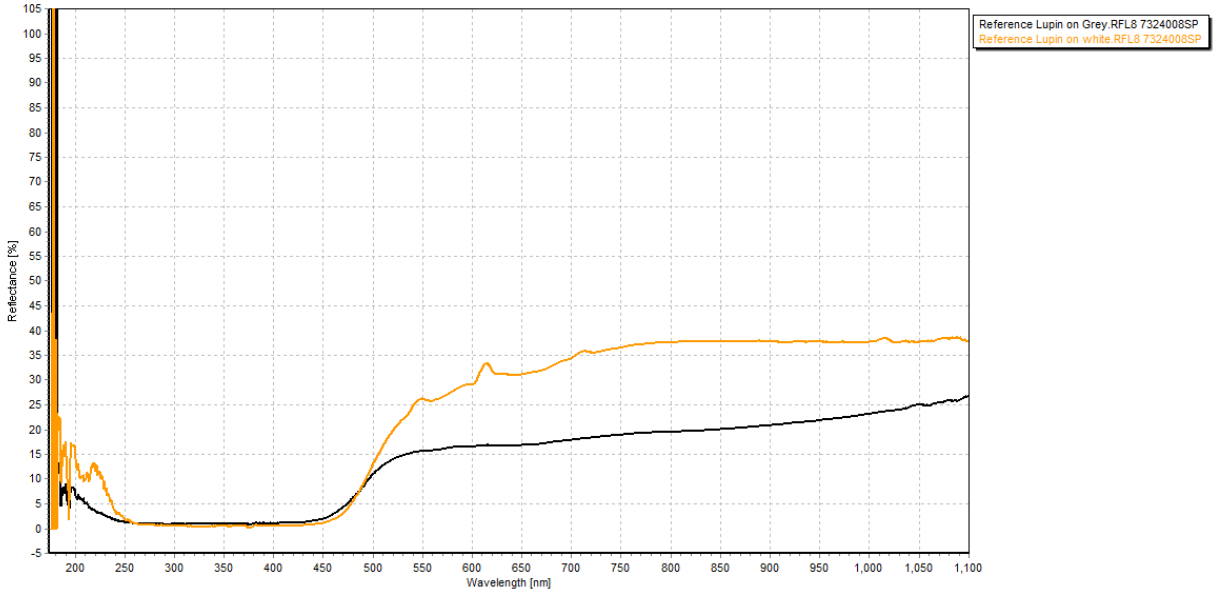

Reference Liguen lolite on White.RFL8 7324008SP
Liguen lolite on wool.RWD8 7324008SP
Reflectance [%]
Wavelength [nm]

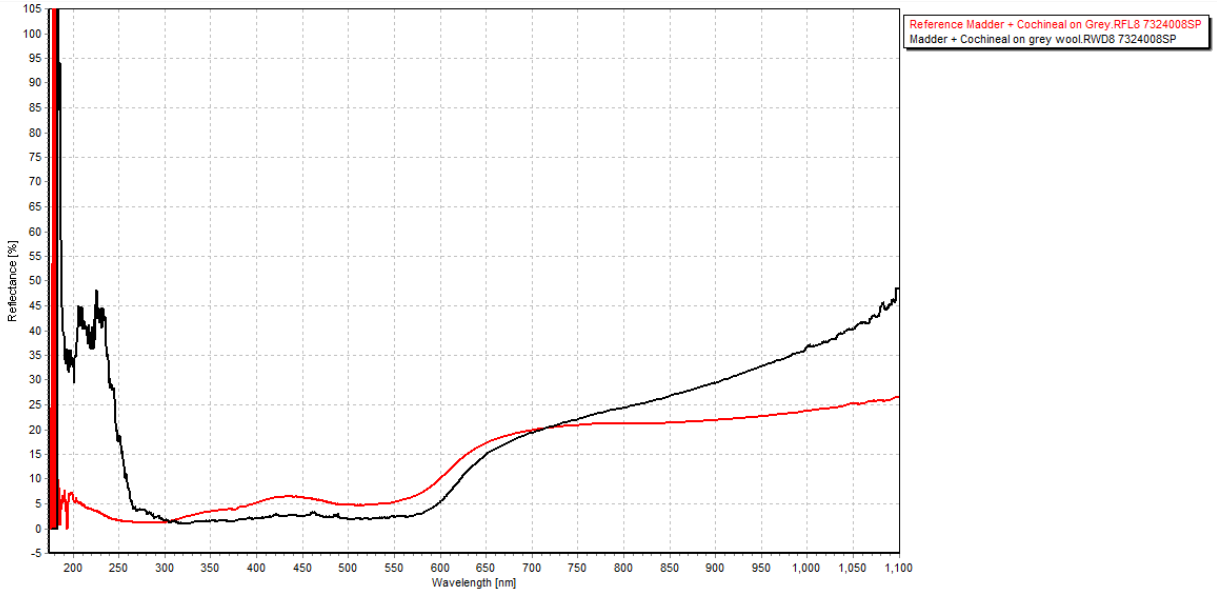

Reference Lichen Parmelia Saxatilis on White.RFL8 7324008SP
Lichen Parmecia saxaticis on wool.RWD8 7324008SP
Reflectance [%]
Wavelength [nm]

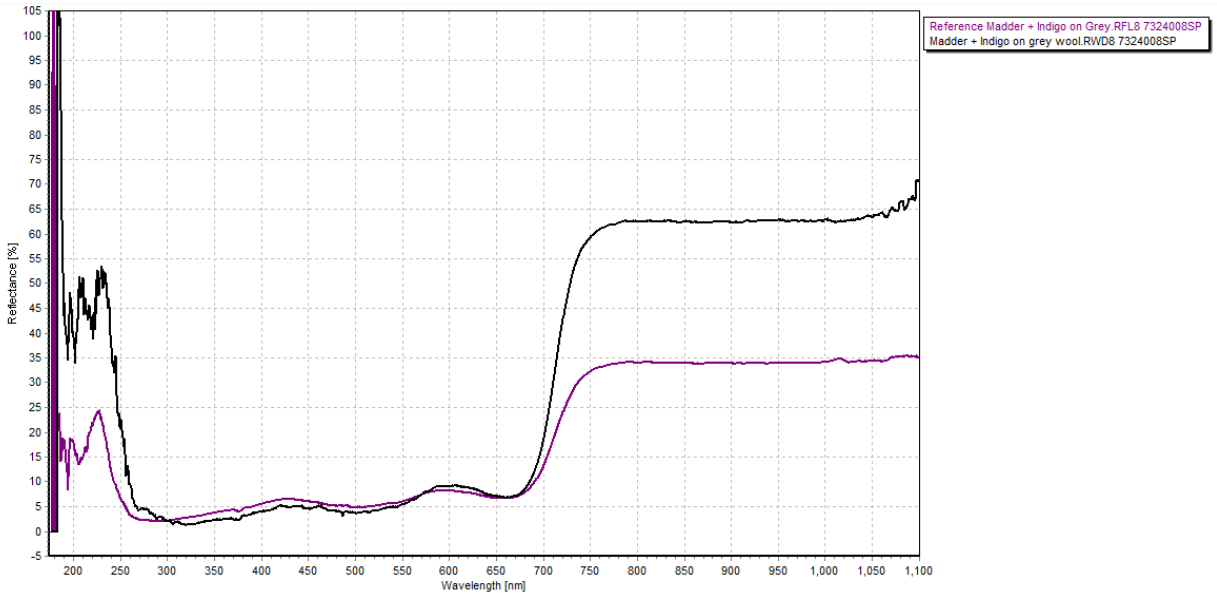

Reference Lupin + Indigo on Grey.RFL8 7324008SP
Reference Lupin + Indigo on White.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

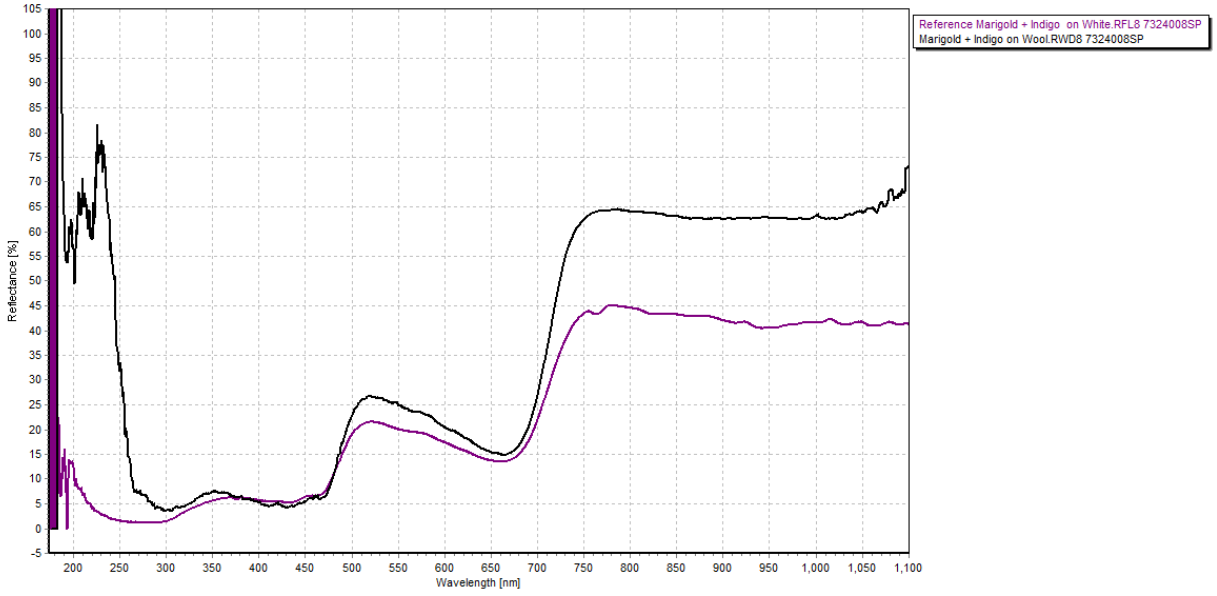

Reference Logwood + Indigo on White.RFL8 7324008SP
Logwood + Indigo on wool.RWD8 7324008SP
Reflectance [%]
Wavelength [nm]

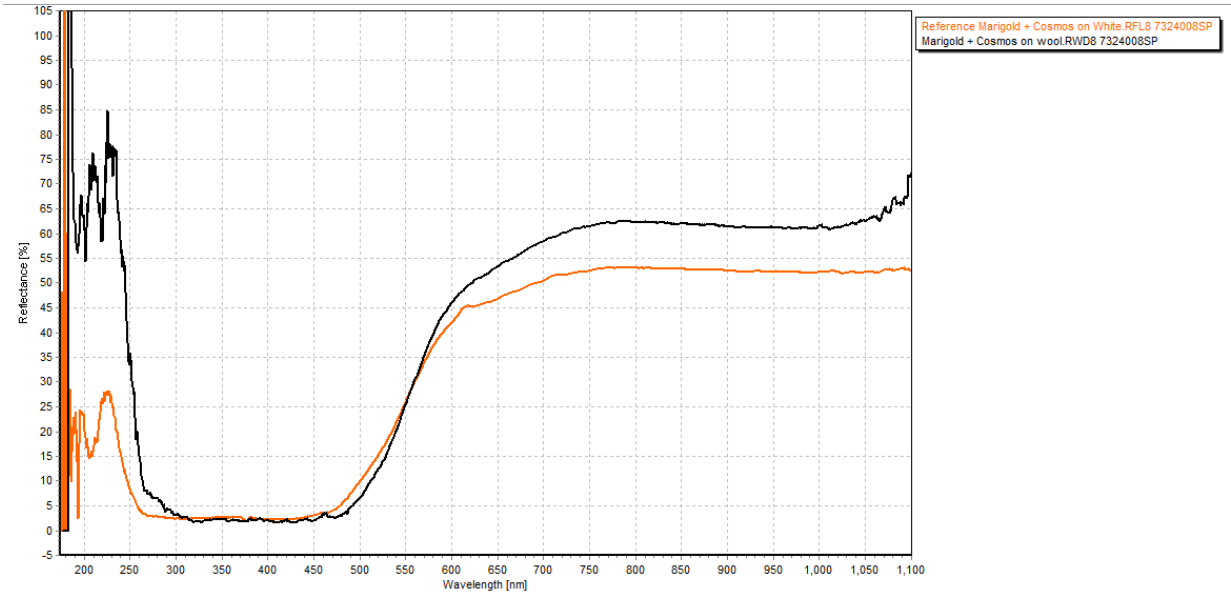

Reference Logwood on White.RFL8 7324008SP
Logwood on wool.RWD8 7324008SP
Reflectance [%]
Wavelength [nm]

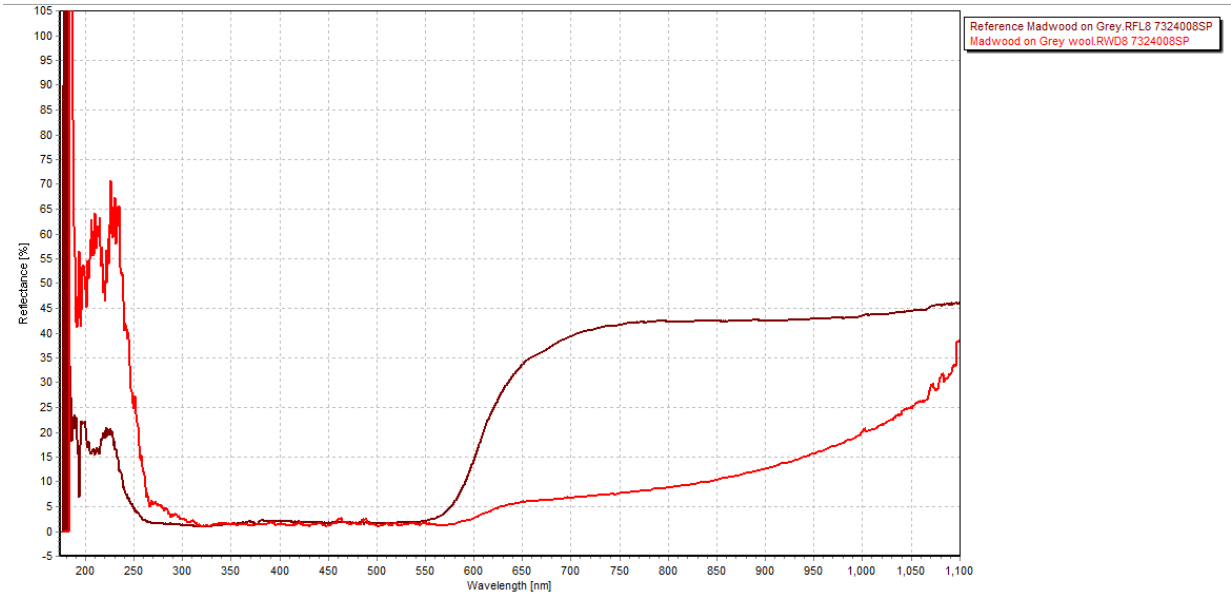

Reference Lupin on Grey.RFL8 7324008SP
Reference Lupin on white.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

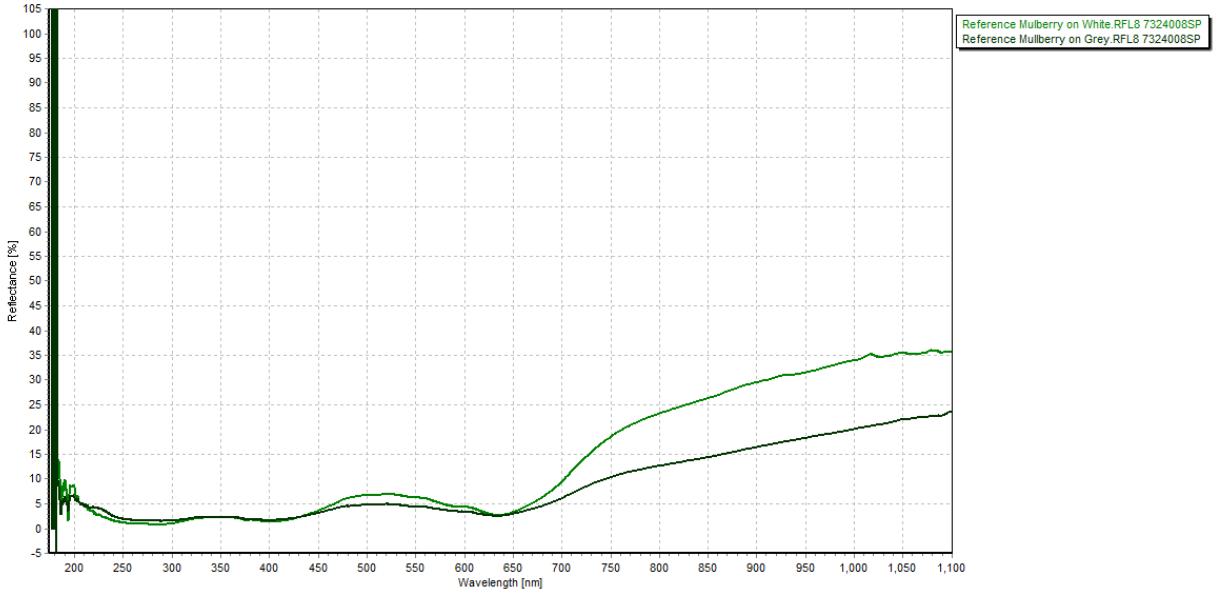

Reference Madder + Cochineal on Grey.RFL8 7324008SP
Madder + Cochineal on grey wool.RWD8 7324008SP
Reflectance [%]
Wavelength [nm]

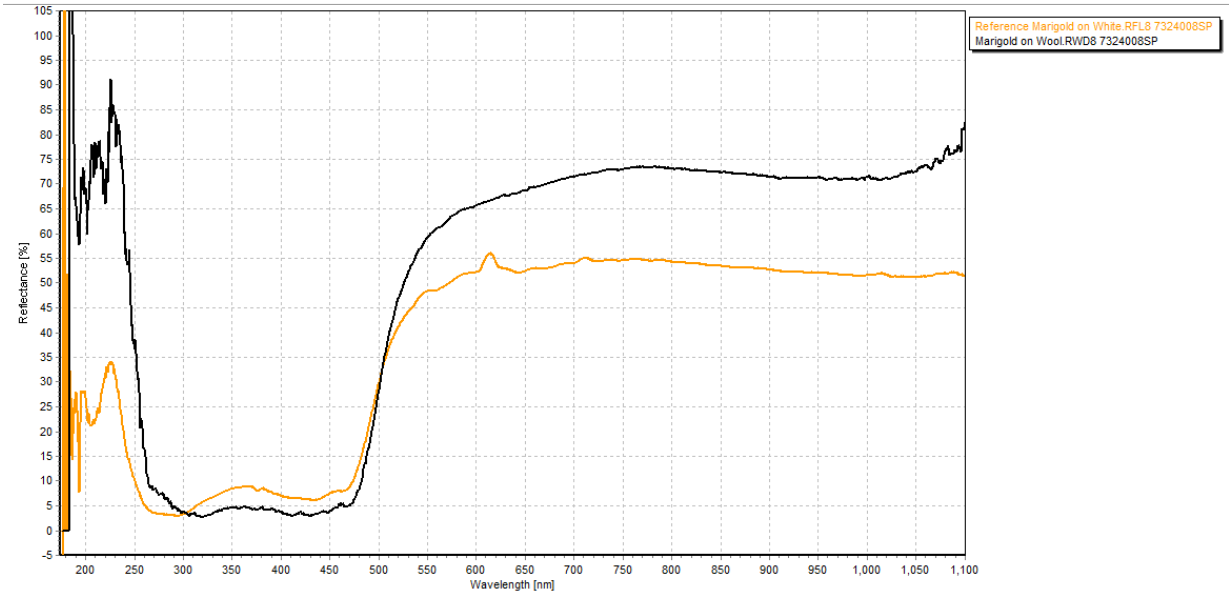

Reference Madder + Indigo on Grey.RFL8 7324008SP
Madder + Indigo on grey wool.RWD8 7324008SP
Reflectance [%]
Wavelength [nm]

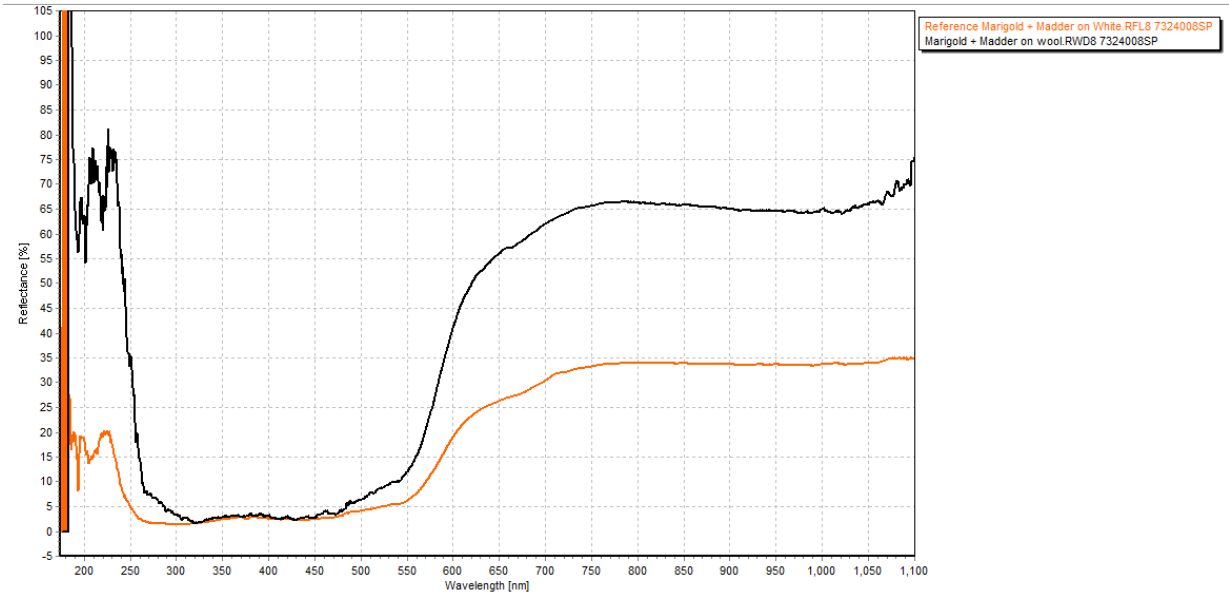

Reference Marigold + Indigo on White.RFL8 7324008SP
Marigold + Indigo on Wool.RWD8 7324008SP
Reflectance [%]
Wavelength [nm]

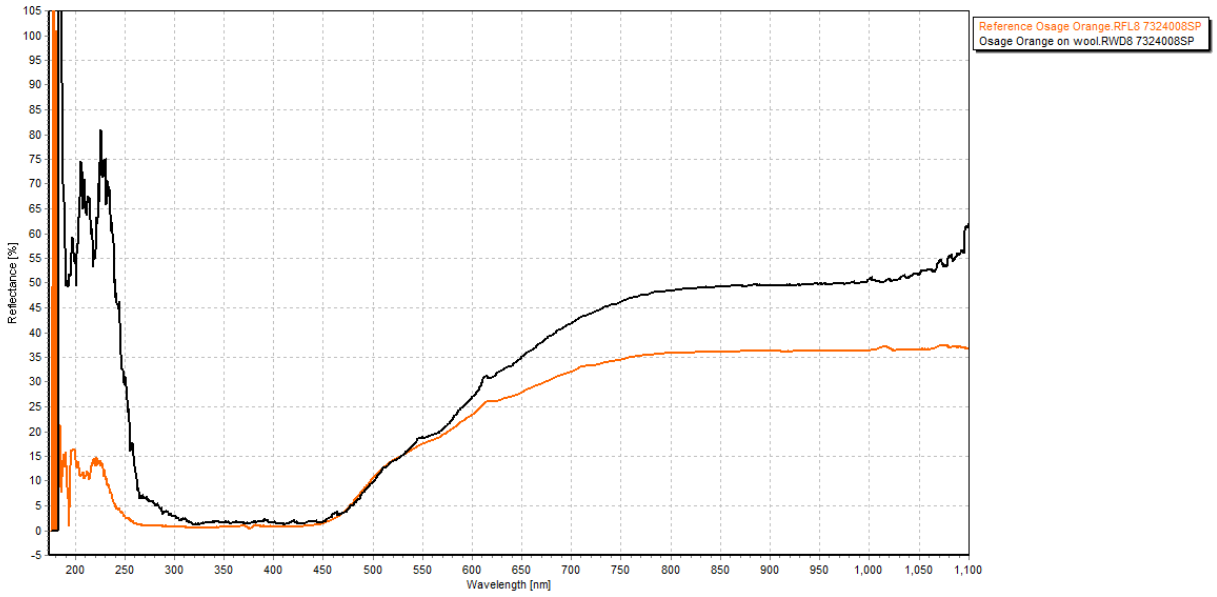

Reference Marigold + Cosmos on White.RFL8 7324008SP
Marigold + Cosmos on wool.RWD8 7324008SP
Reflectance [%]
Wavelength [nm]

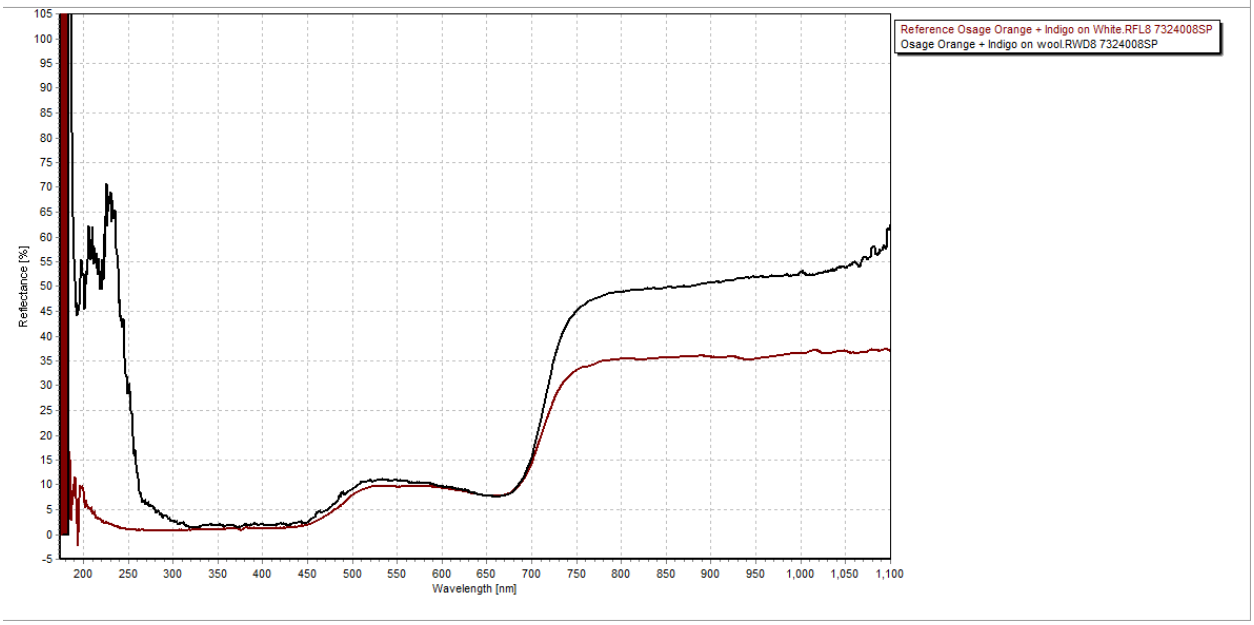

Reference Madwood on Grey.RFL8 7324008SP
Madwood on Grey wool.RWD8 7324008SP
Reflectance [%]
Wavelength [nm]


Reference Mulberry on White.RFL8 7324008SP
Reference Mullberry on Grey.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]


Reference Marigold on White.RFL8 7324008SP
Marigold on Wool.RWD8 7324008SP
Reflectance [%]
Wavelength [nm]

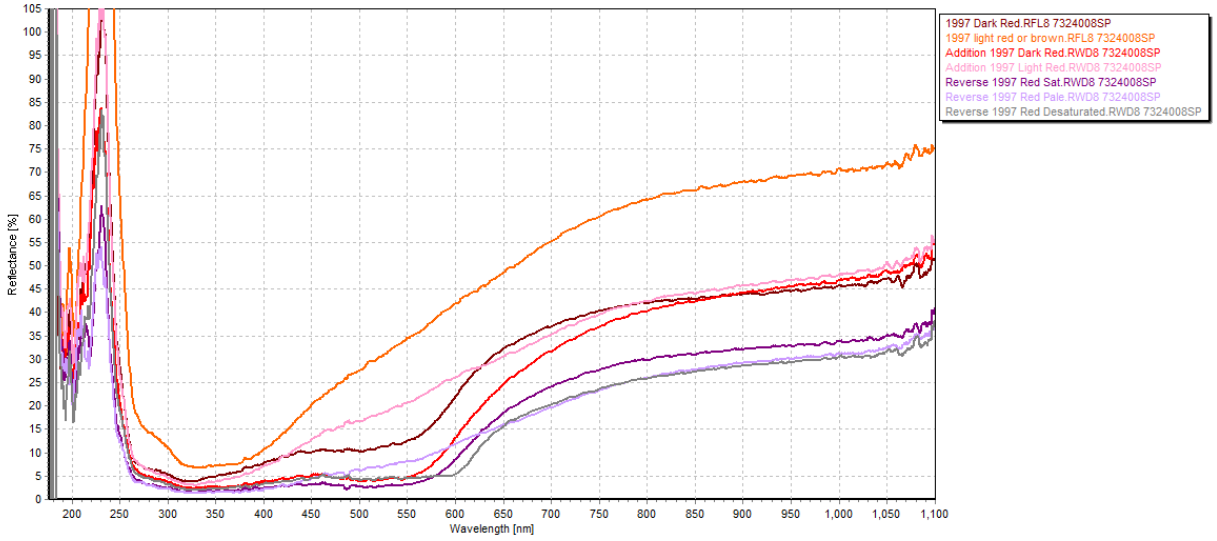

Reference Marigold + Madder on White.RFL8 7324008SP
Marigold + Madder on wool.RWD8 7324008SP
Reflectance [%]
Wavelength [nm]

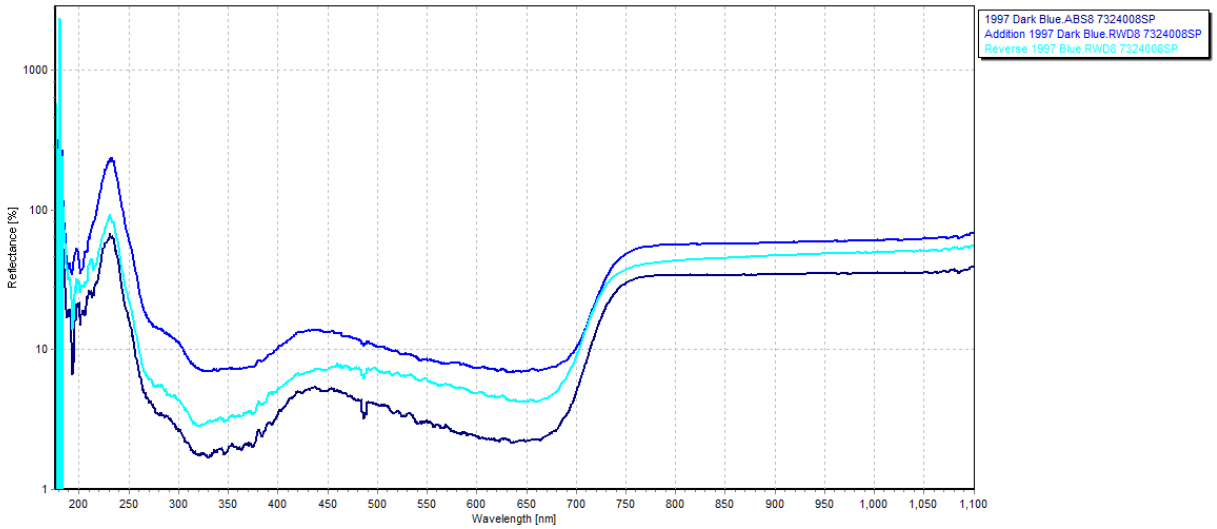

Reference Osage Orange.RFL8 7324008SP
Osage Orange on wool.RWD8 7324008SP
Reflectance [%]
Wavelength [nm]

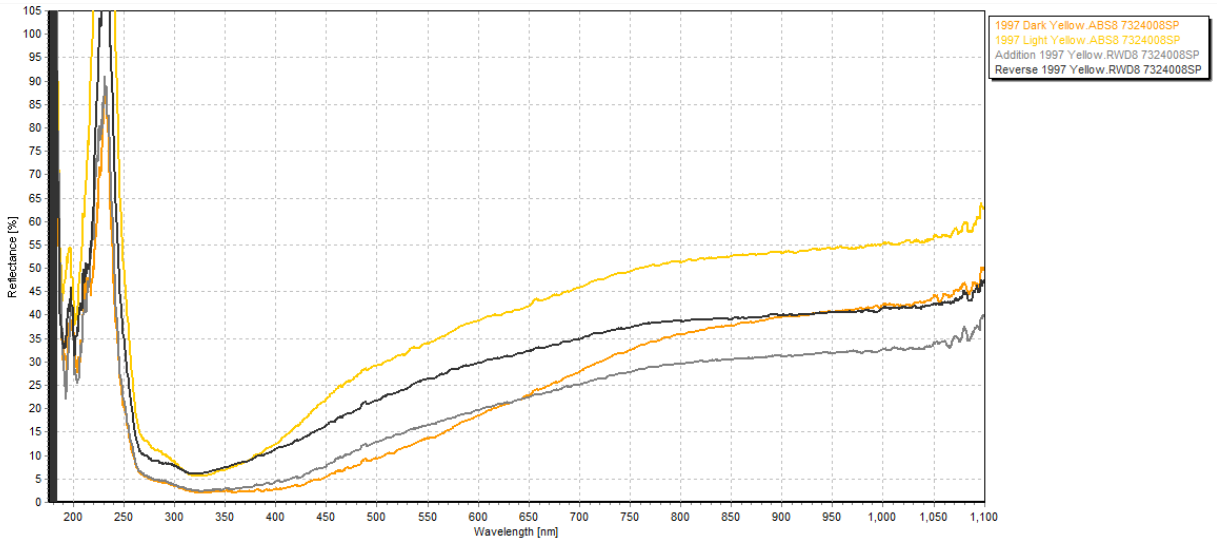

Reference Osage Orange + Indigo on White.RFL8 7324008SP
Osage Orange + Indigo on wool.RWD8 7324008SP
Reflectance [%]
Wavelength [nm]

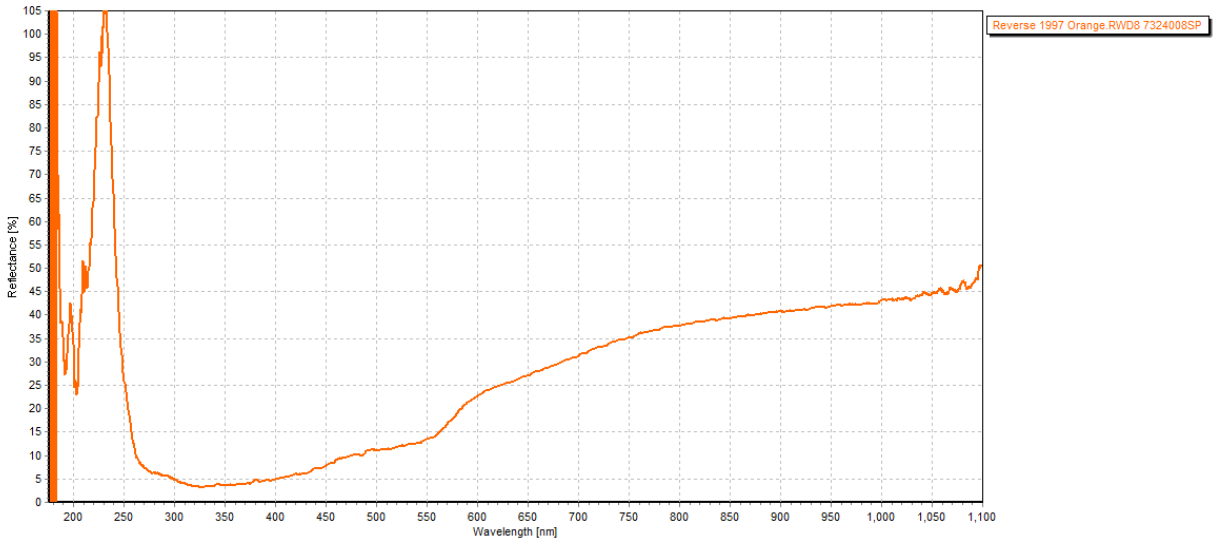
Appendix B: Preserved Spectra

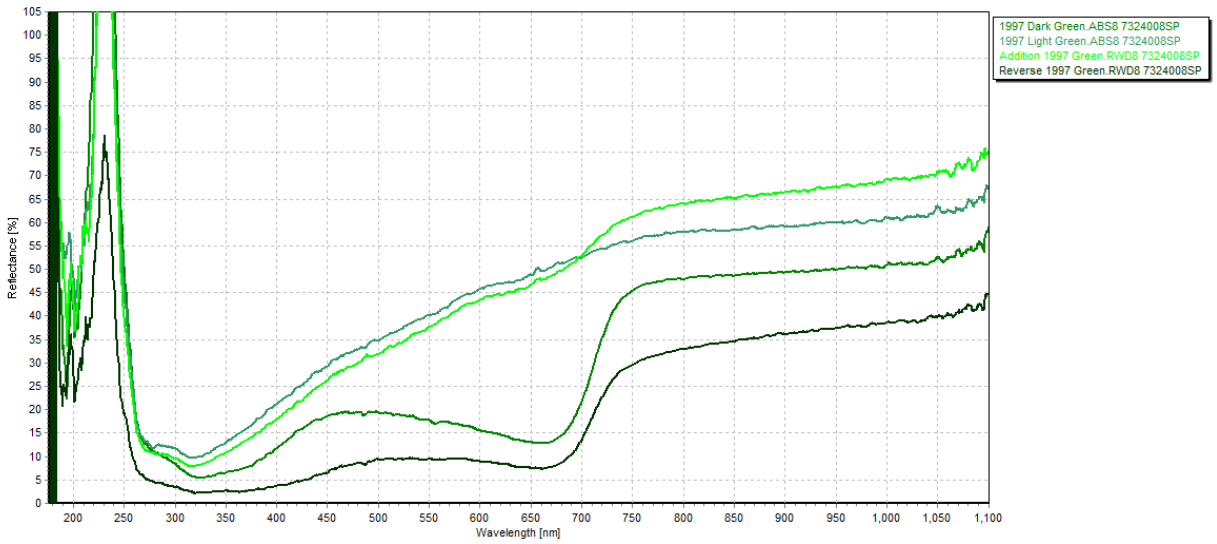
1997

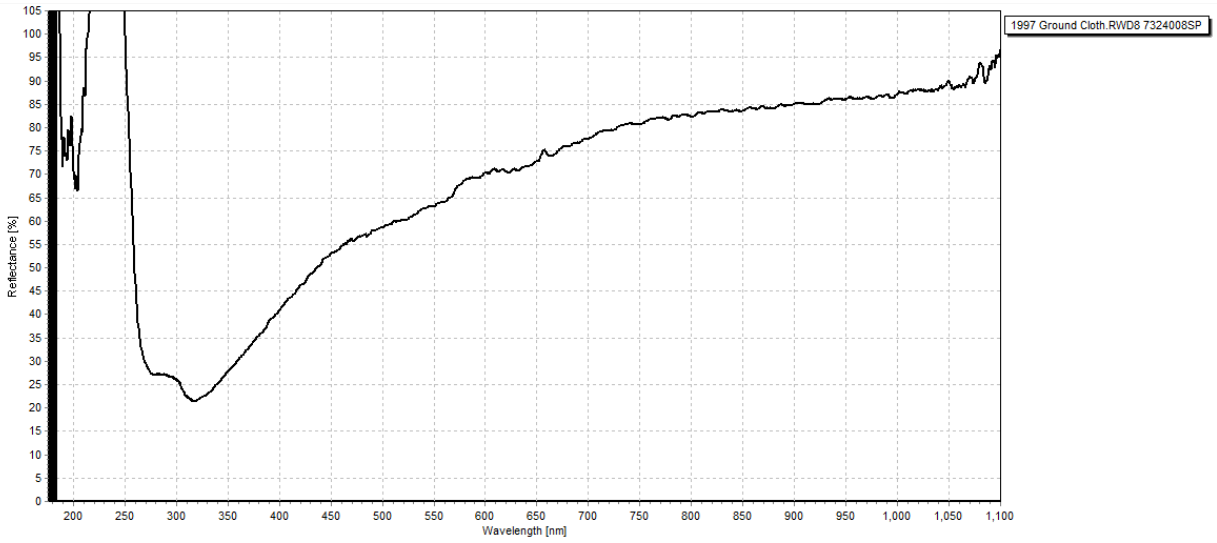




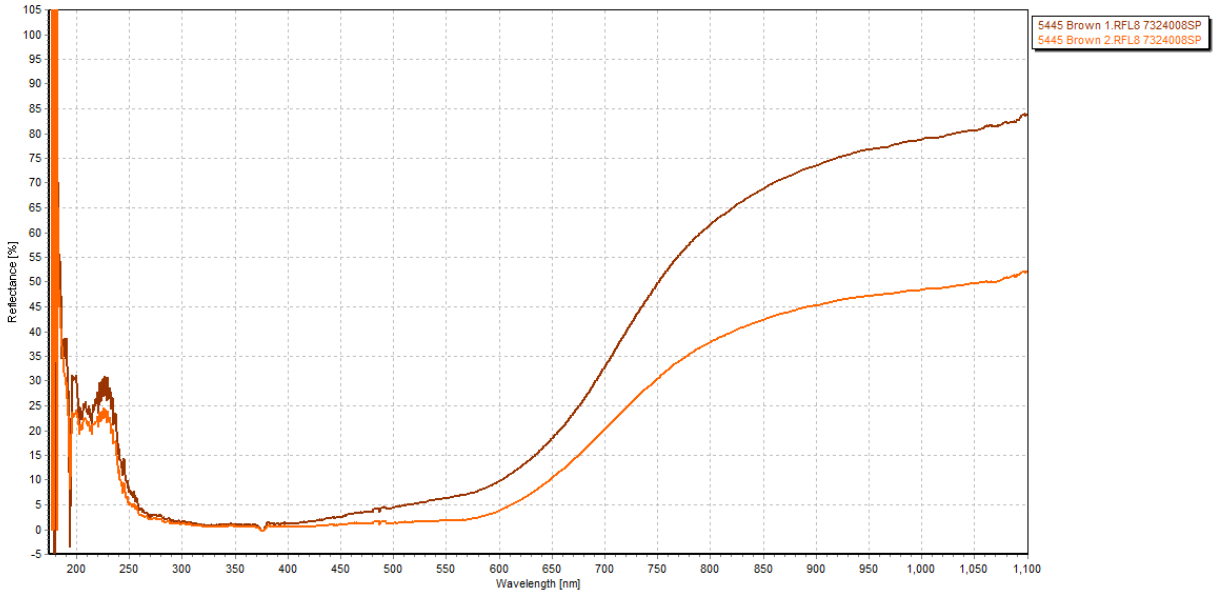


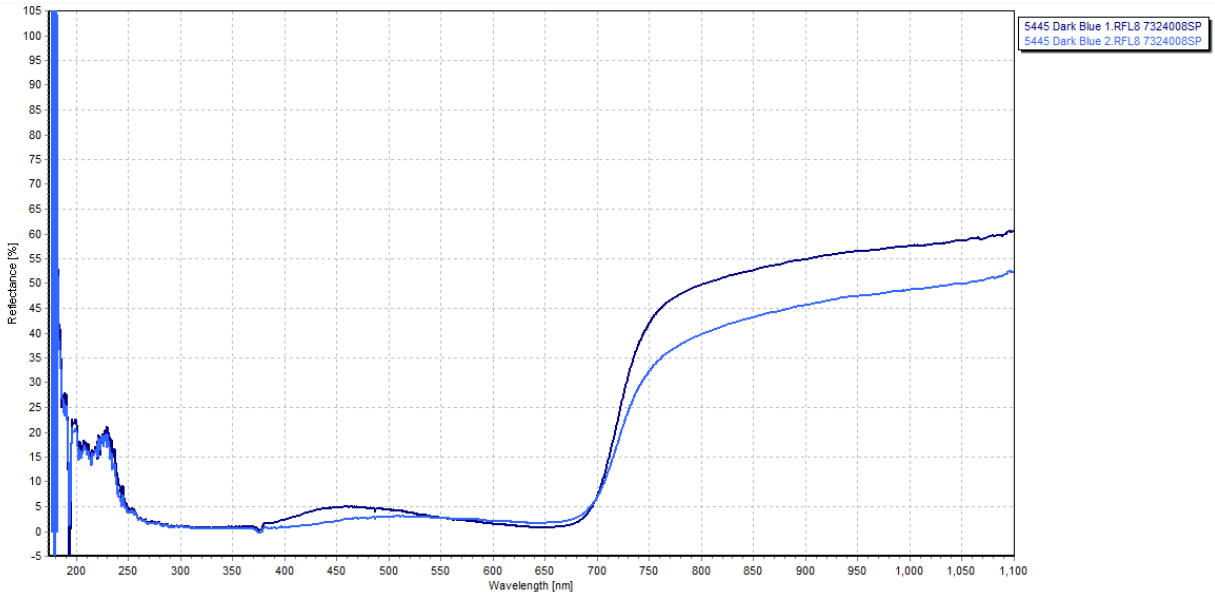

Reverse 1997 Orange.RWD8 7324008SP
Reflectance [%]
Wavelength [nm]

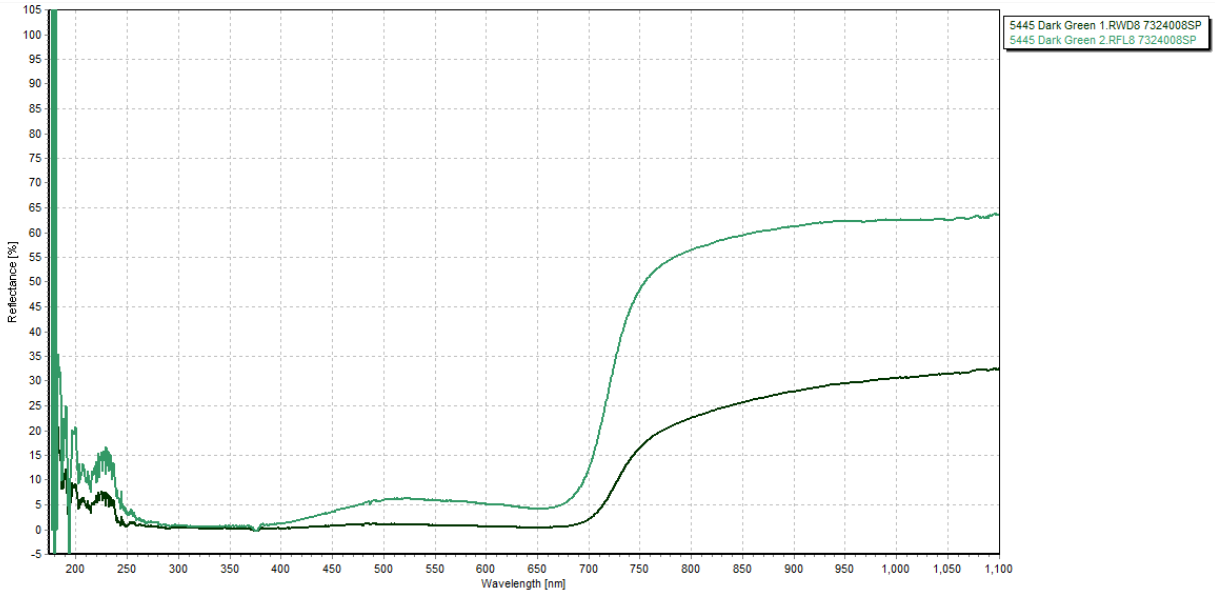

1997 Dark Green.ABS8 7324008SP
1997 Light Green.ABS8 7324008SP
Addition 1997 Green.RWD8 7324008SP
Reverse 1997 Green.RWD8 7324008SP
Reflectance [%]
Wavelength [nm]

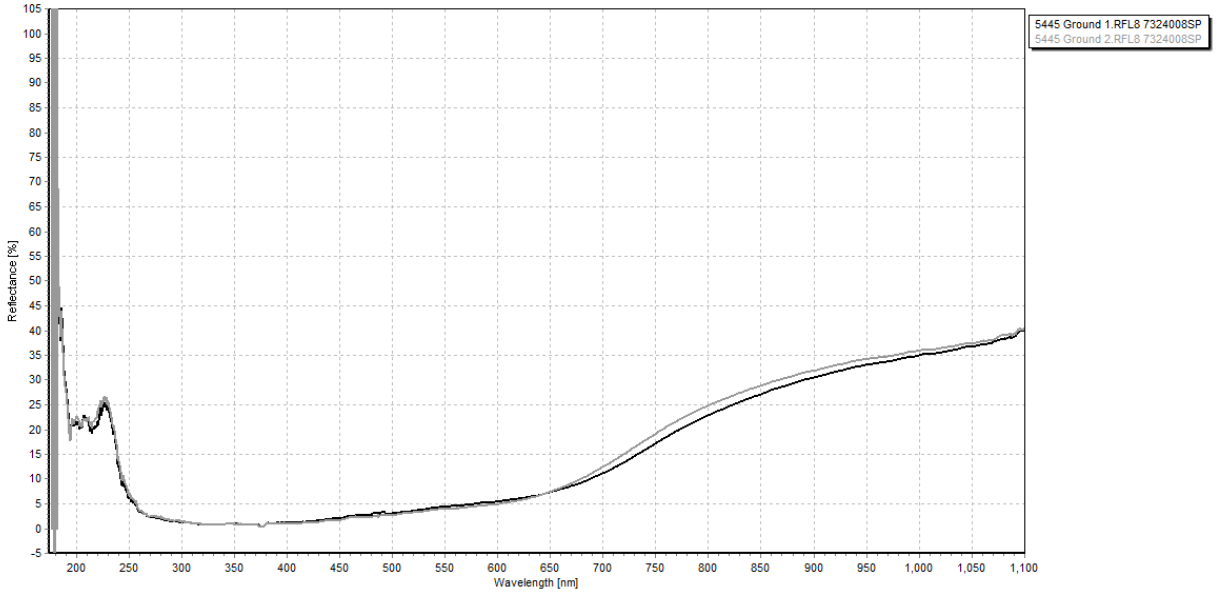

1997 Ground Cloth.RWD8 7324008SP
Reflectance [%]
Wavelength [nm]

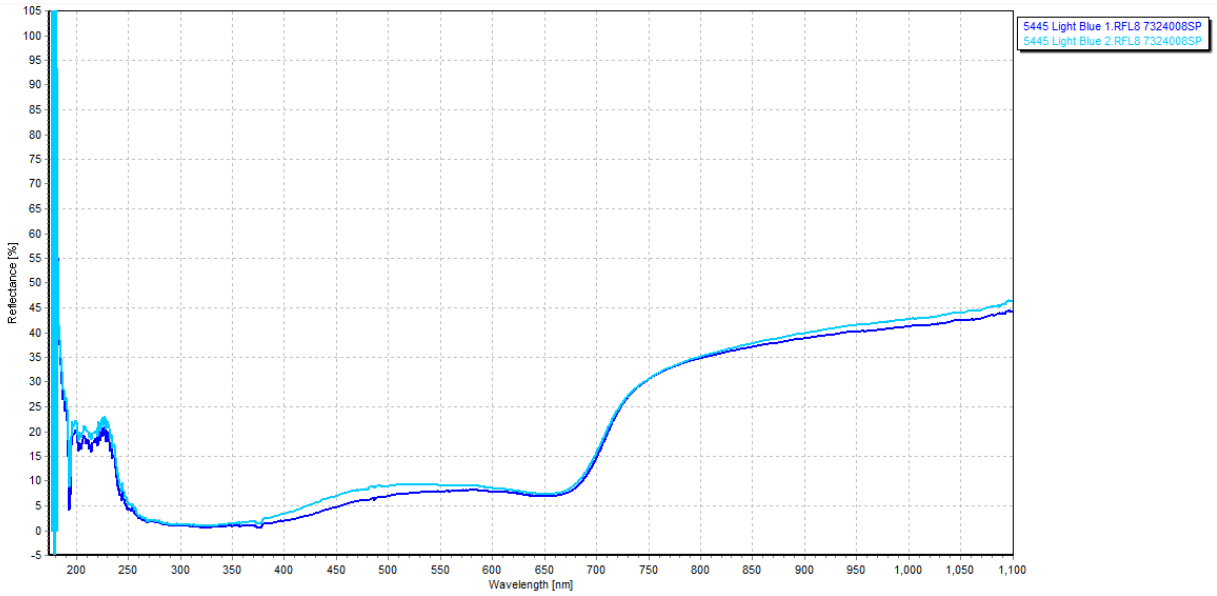
5445

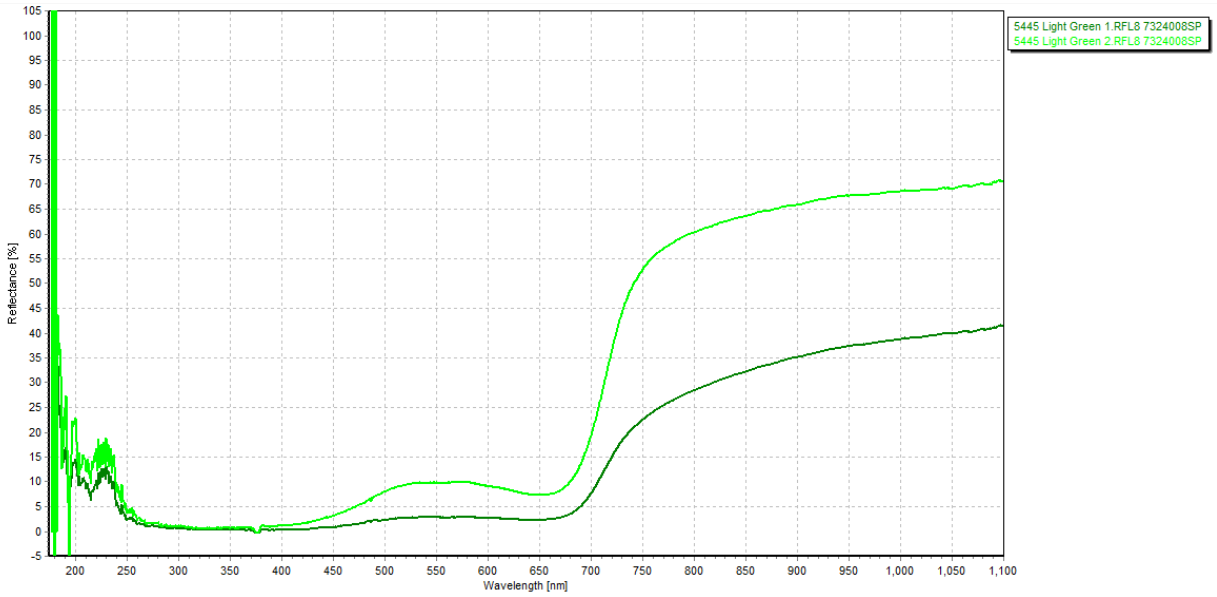

5445 Brown 1.RFL8 7324008SP
5445 Brown 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

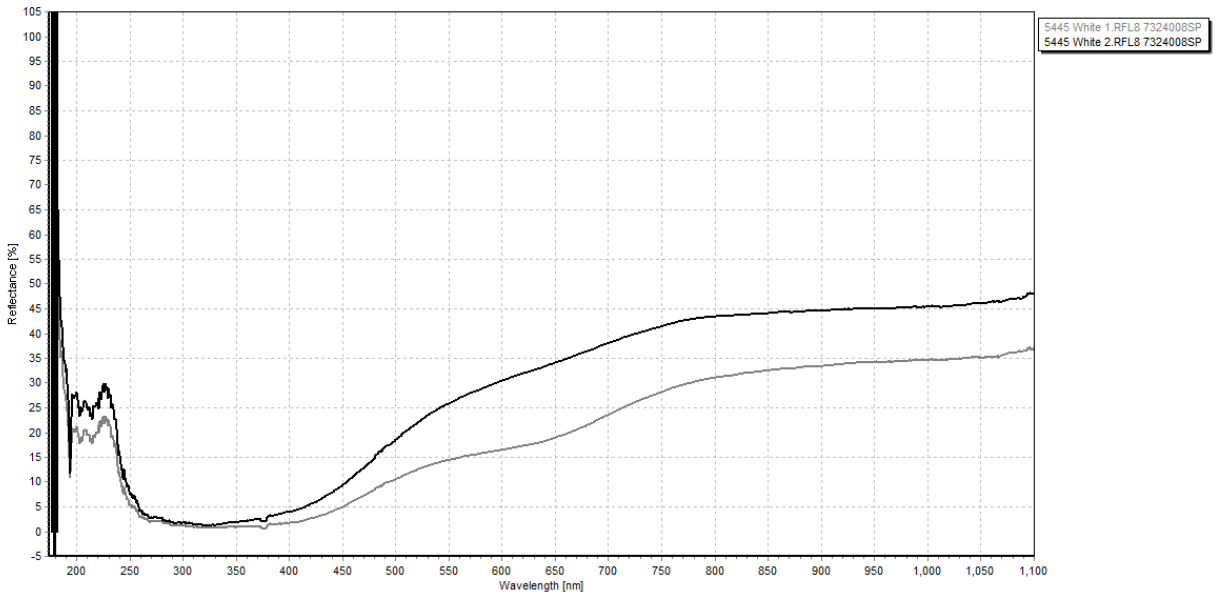

5445 Dark Blue 1.RFL8 7324008SP
5445 Dark Blue 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

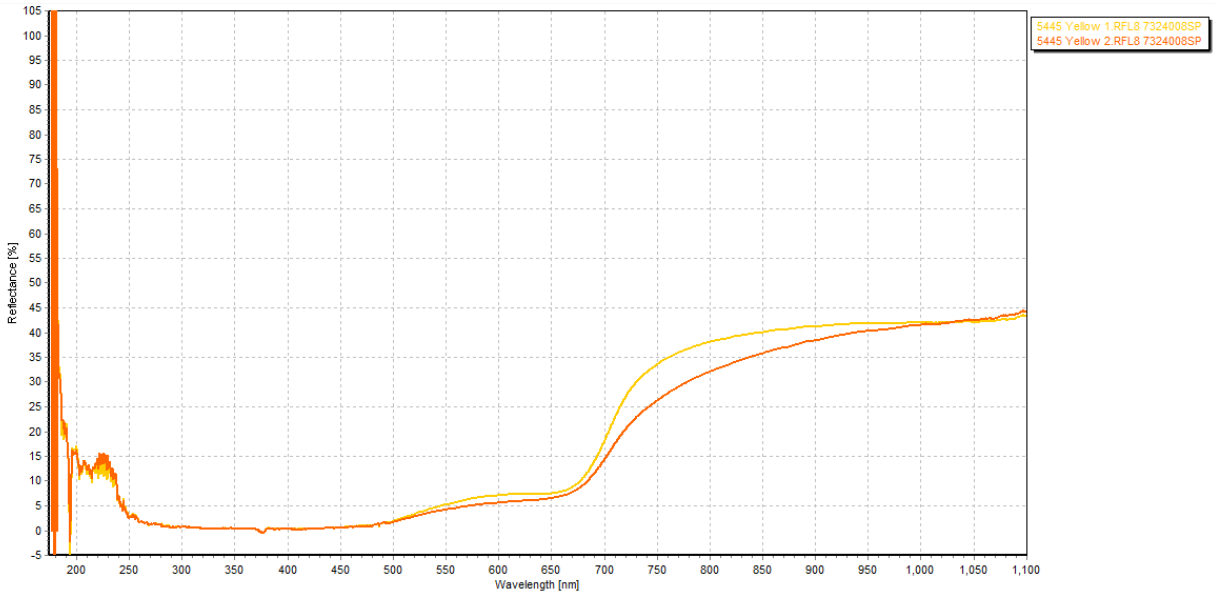

5445 Dark Green 1.RWD8 7324008SP
5445 Dark Green 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]


5445 Ground 1.RFL8 7324008SP
5445 Ground 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

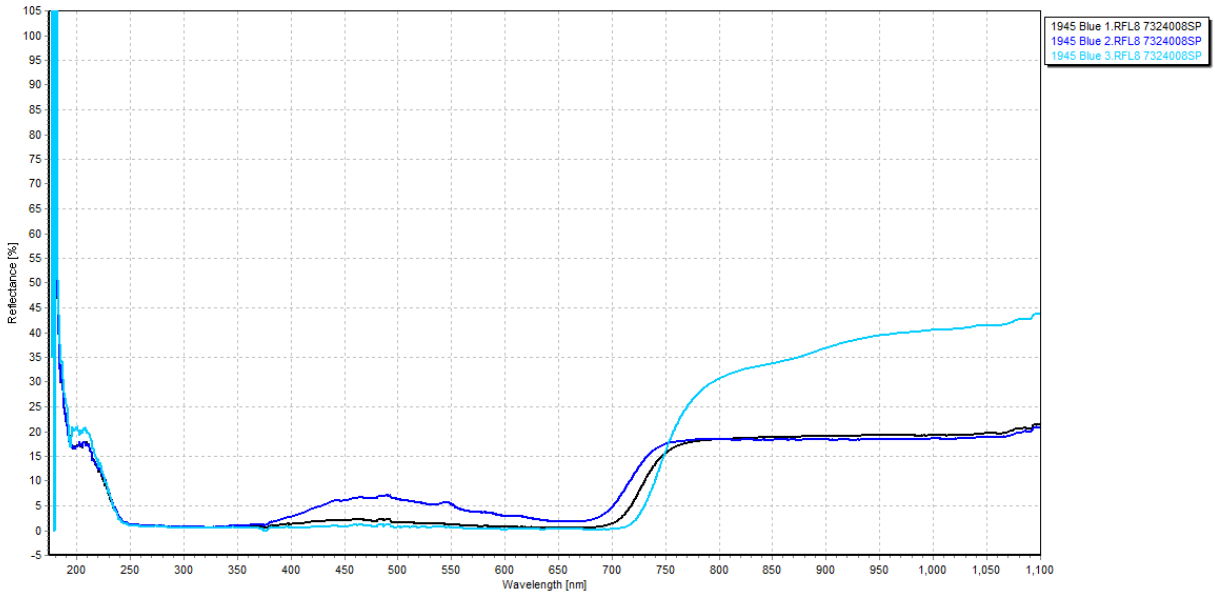

5445 Light Blue 1.RFL8 7324008SP
5445 Light Blue 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

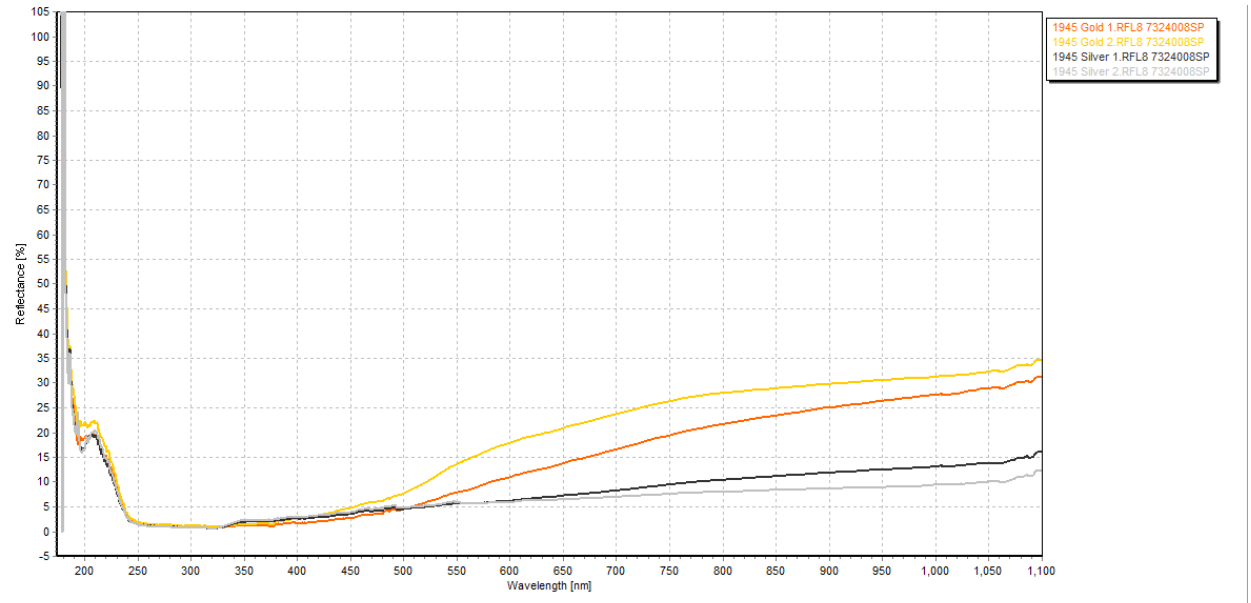

5445 Light Green 1.RFL8 7324008SP
5445 Light Green 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

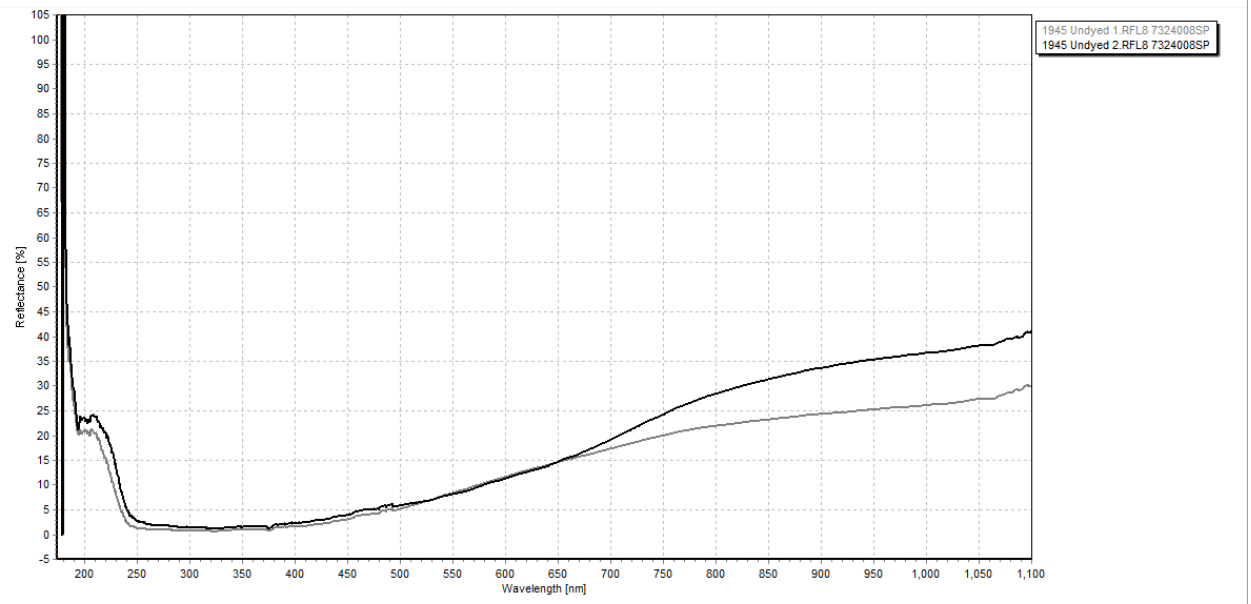

5445 White 1.RFL8 7324008SP
5445 White 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]


5445 Yellow 1.RFL8 7324008SP
5445 Yellow 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

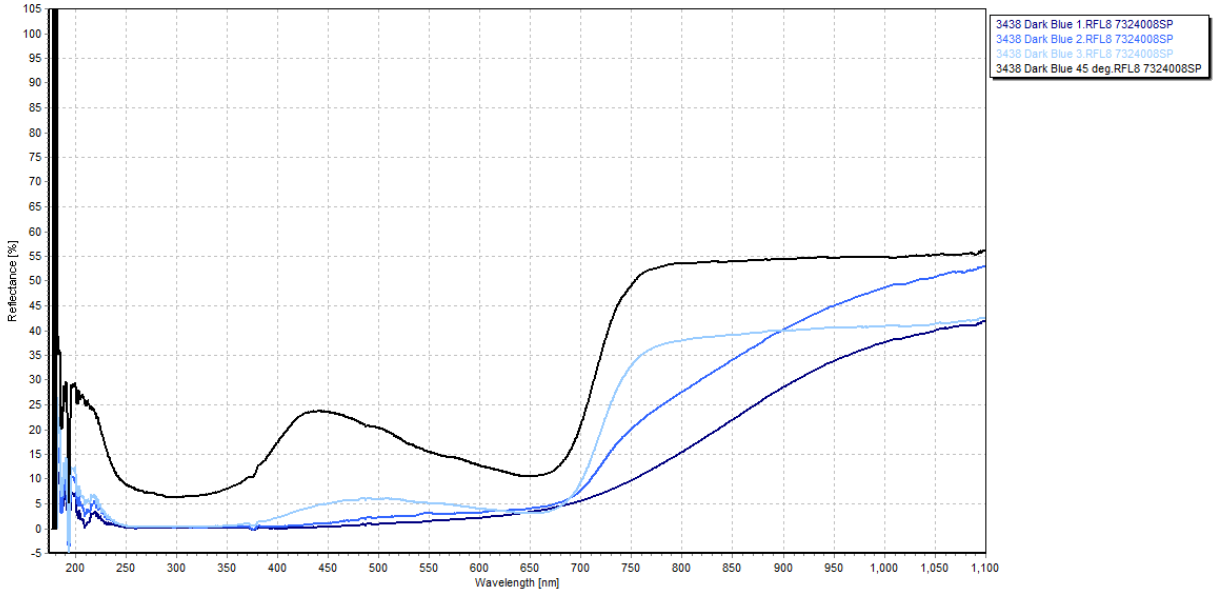
1945

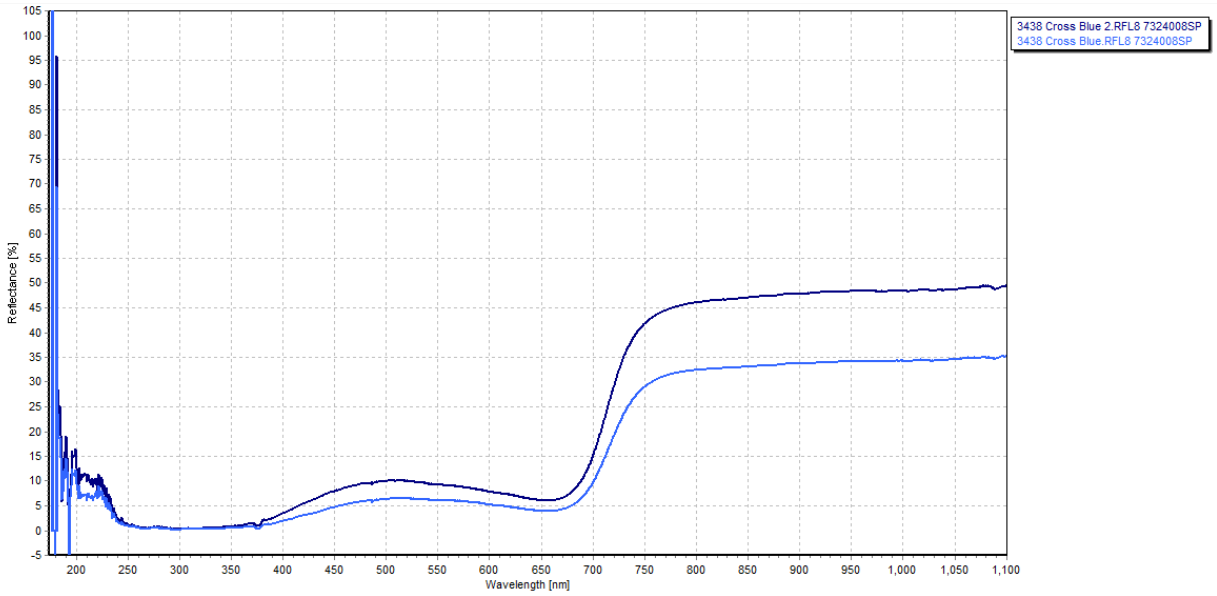

1945 Blue 1.RFL8 7324008SP
1945 Blue 2.RFL8 7324008SP
1945 Blue 3.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

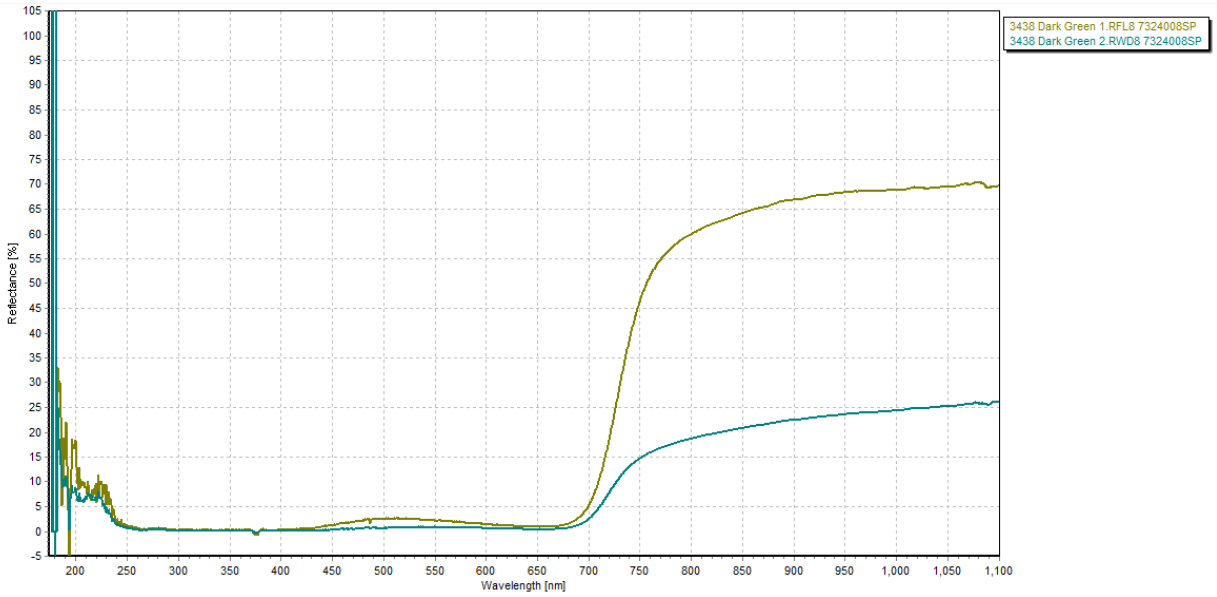

1945 Gold 1.RFL8 7324008SP
1945 Gold 2.RFL8 7324008SP
1945 Silver 1.RFL8 7324008SP
1945 Silver 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

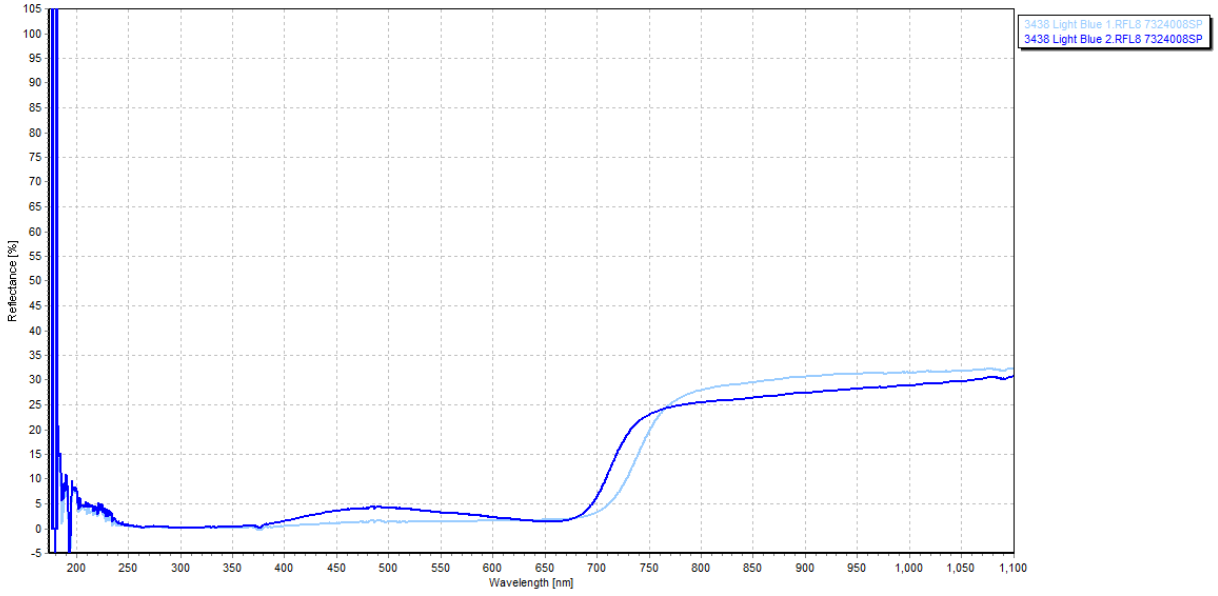

1945 Undyed 1.RFL8 7324008SP
1945 Undyed 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

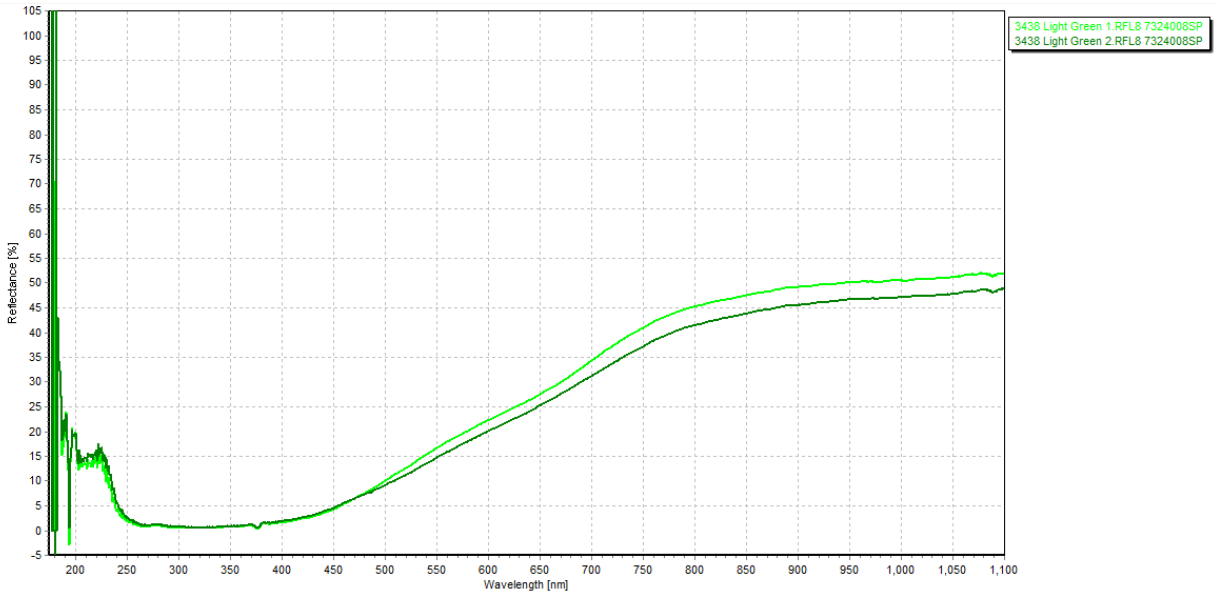
3438

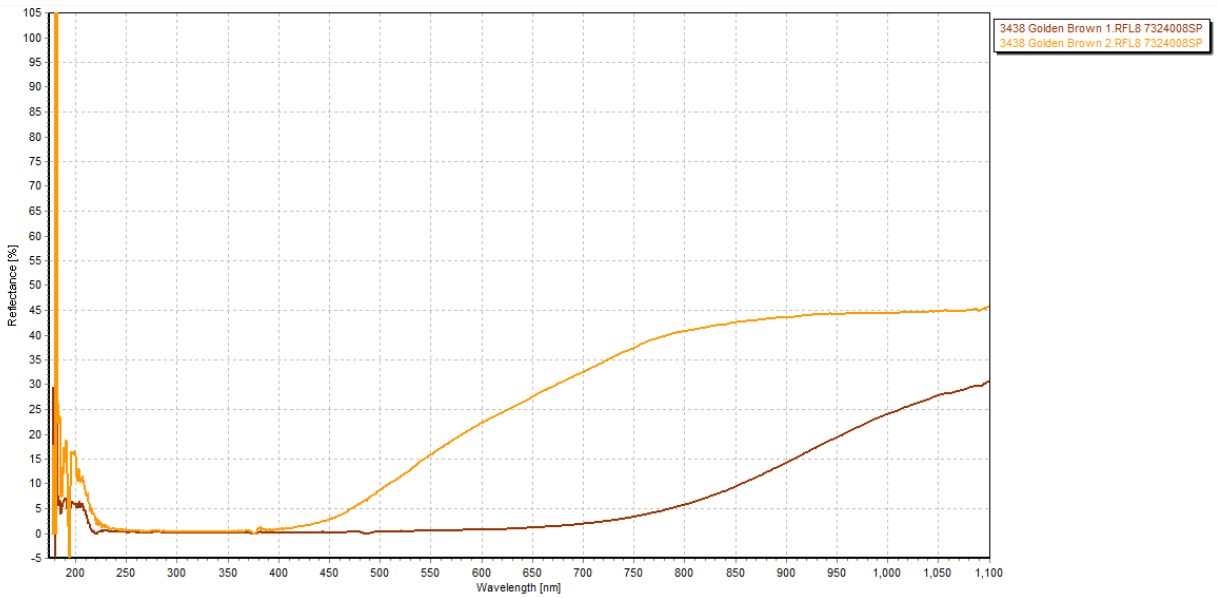

3438 Dark Blue 1.RFL8 7324008SP
3438 Dark Blue 2.RFL8 7324008SP
3438 Dark Blue 3.RFL8 7324008SP
3438 Dark Blue 45 deg.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

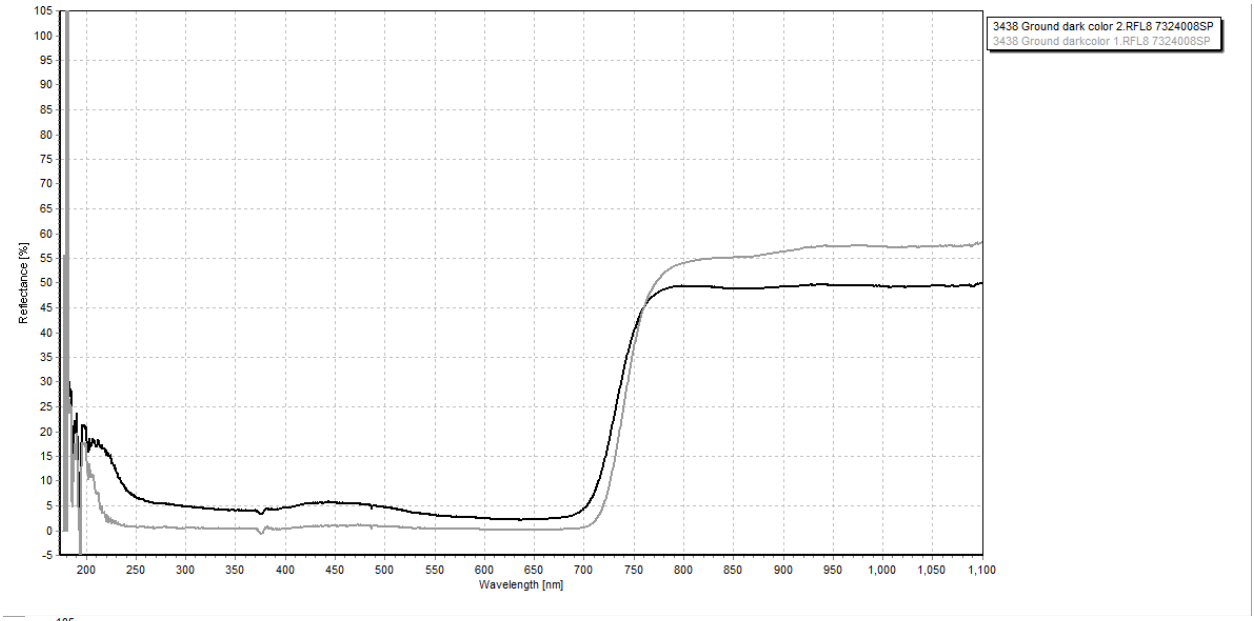

3438 Cross Blue 2.RFL8 7324008SP
3438 Cross Blue.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

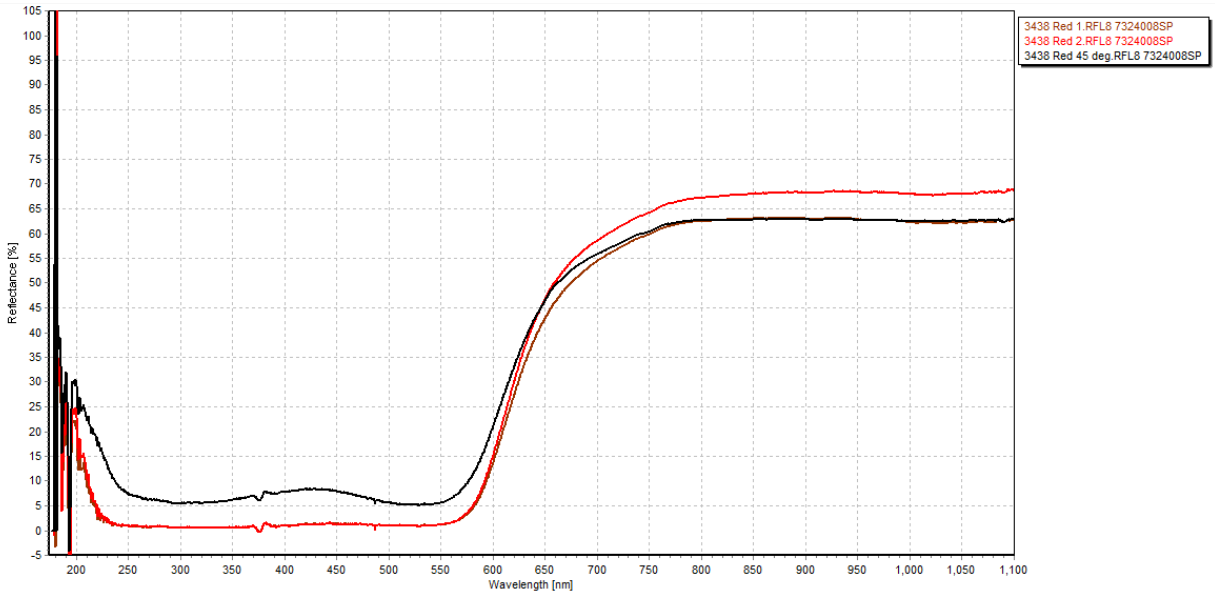

3438 Dark Green 1.RFL8 7324008SP
3438 Dark Green 2.RWD8 7324008SP
Reflectance [%]
Wavelength [nm]

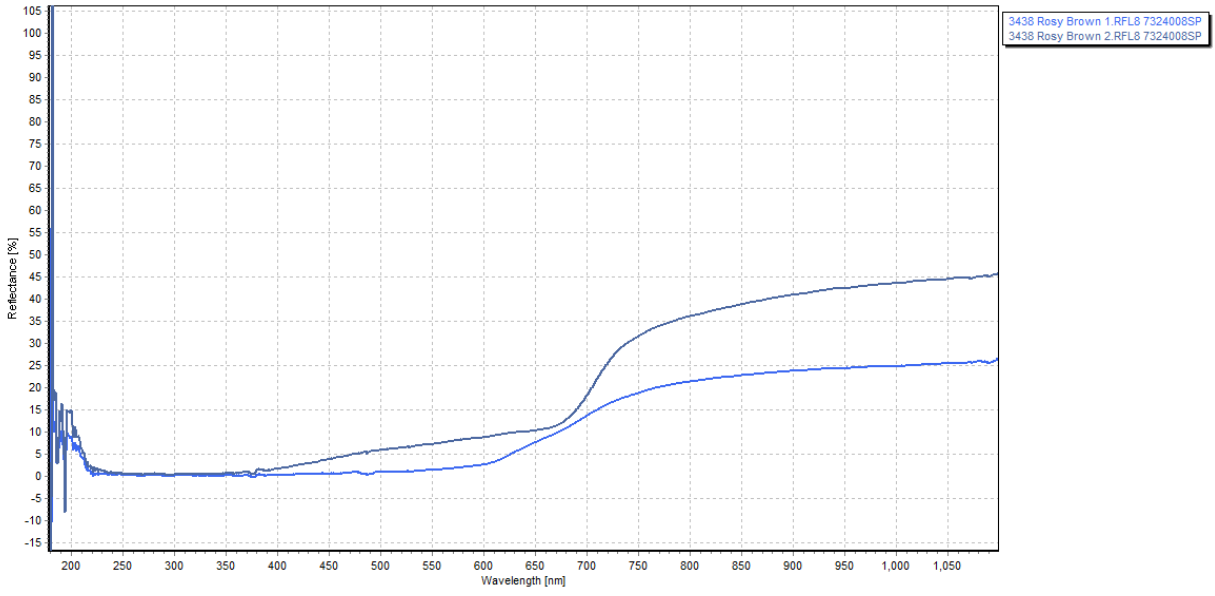

3438 Light Blue 1.RFL8 7324008SP
3438 Light Blue 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

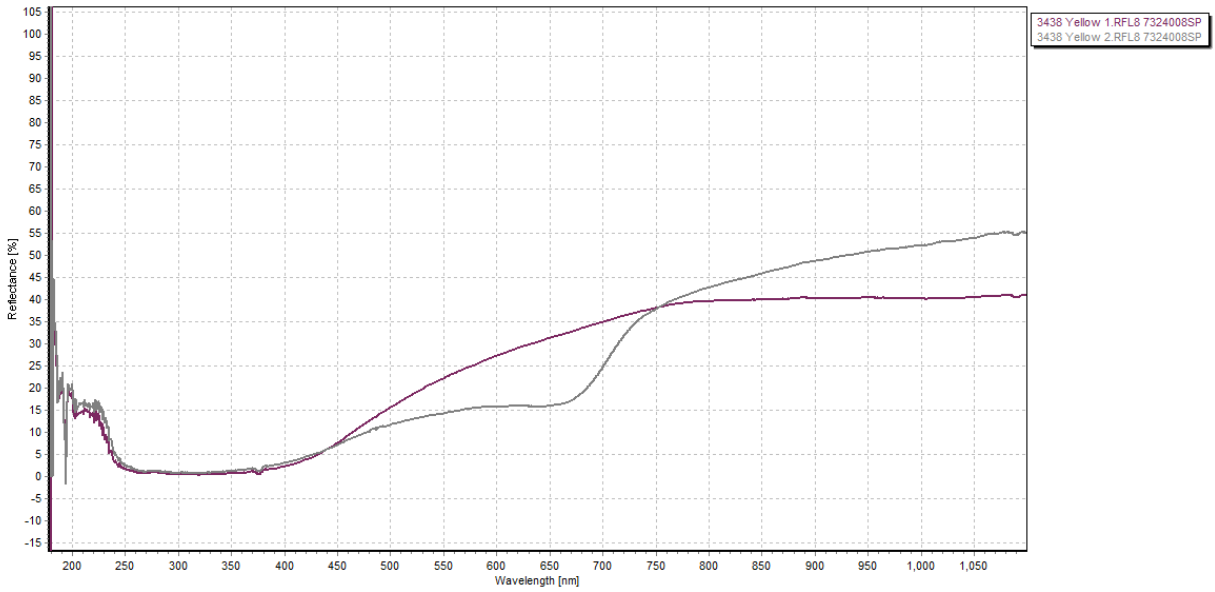

3438 Light Green 1.RFL8 7324008SP
3438 Light Green 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]


3438 Golden Brown 1.RFL8 7324008SP
3438 Golden Brown 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

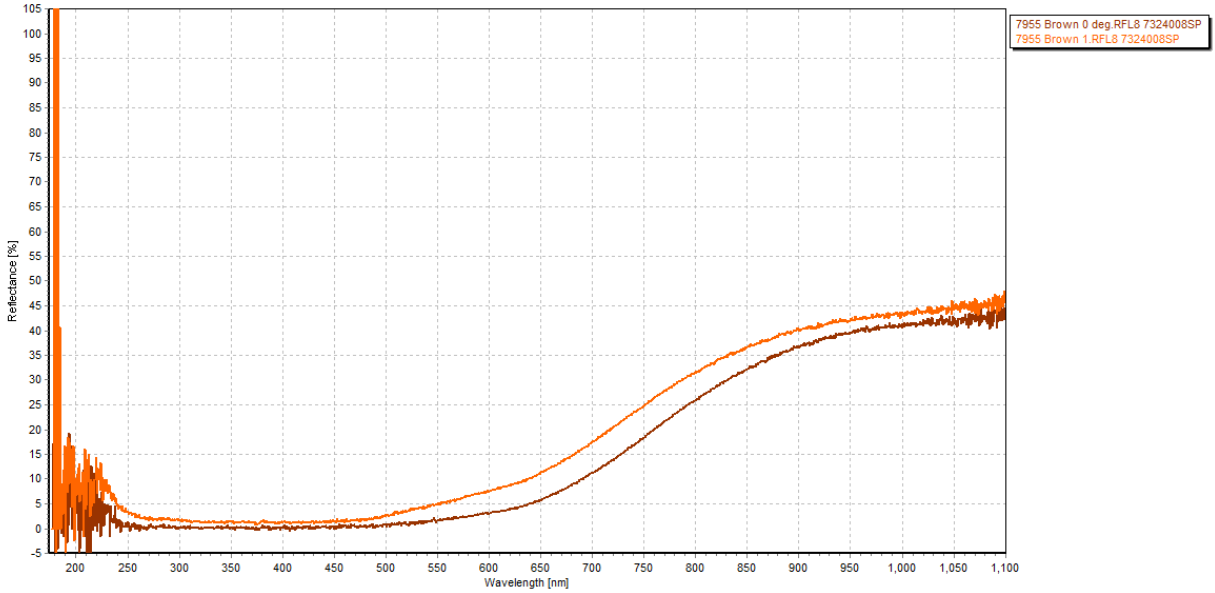

3438 Ground dark color 2.RFL8 7324008SP
3438 Ground darkcolor 1.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

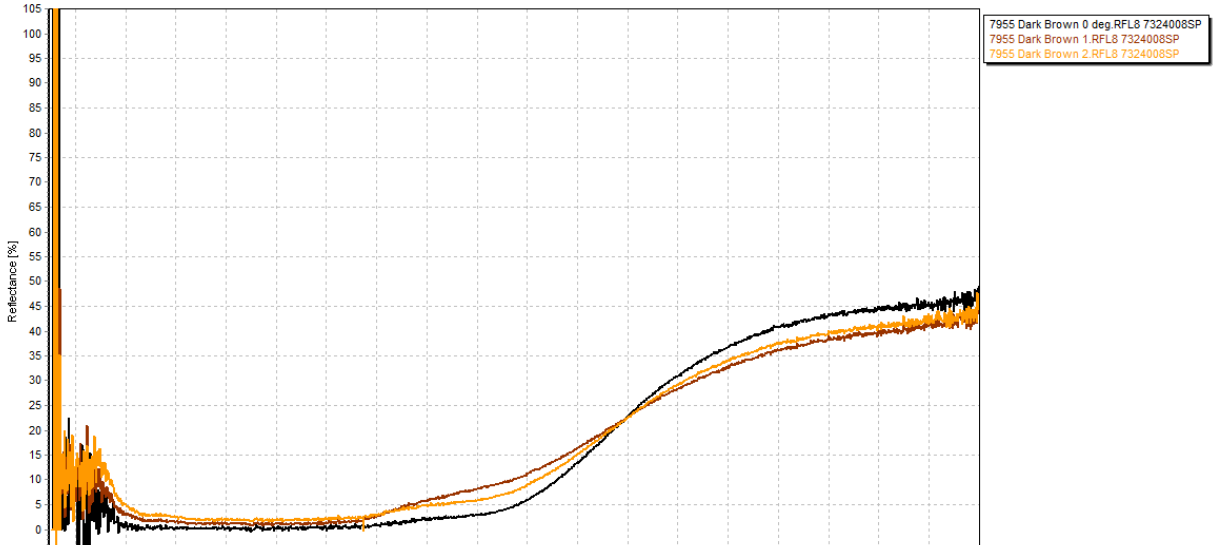

3438 Red 1.RFL8 7324008SP
3438 Red 2.RFL8 7324008SP
3438 Red 45 deg.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

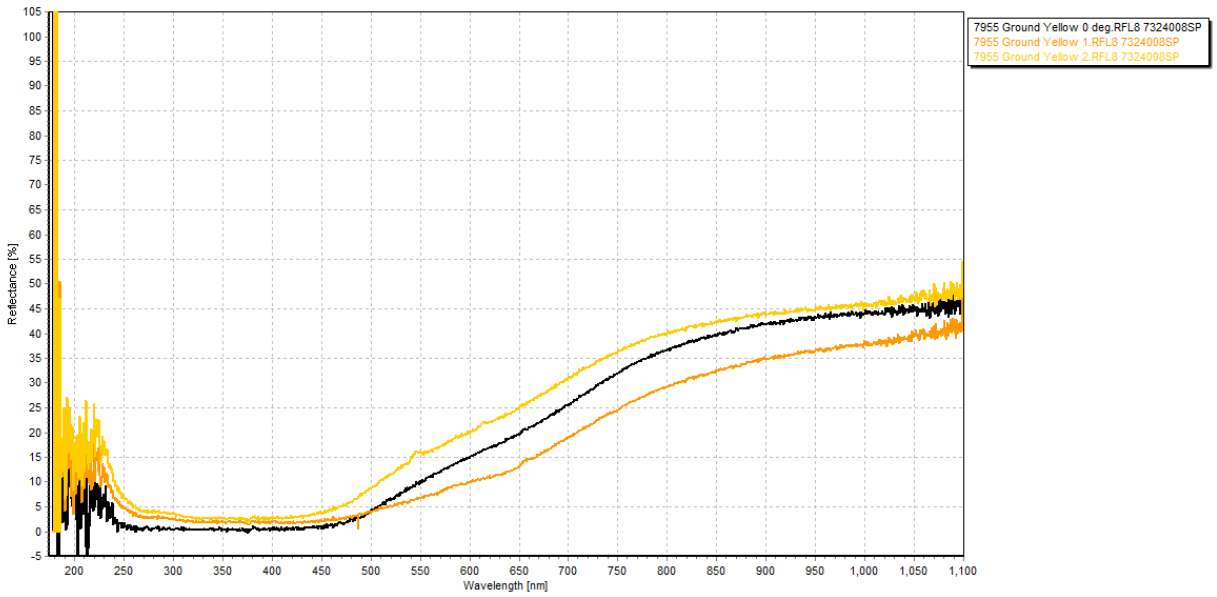

3438 Rosy Brown 1.RFL8 7324008SP
3438 Rosy Brown 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]


3438 Yellow 1.RFL8 7324008SP
3438 Yellow 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

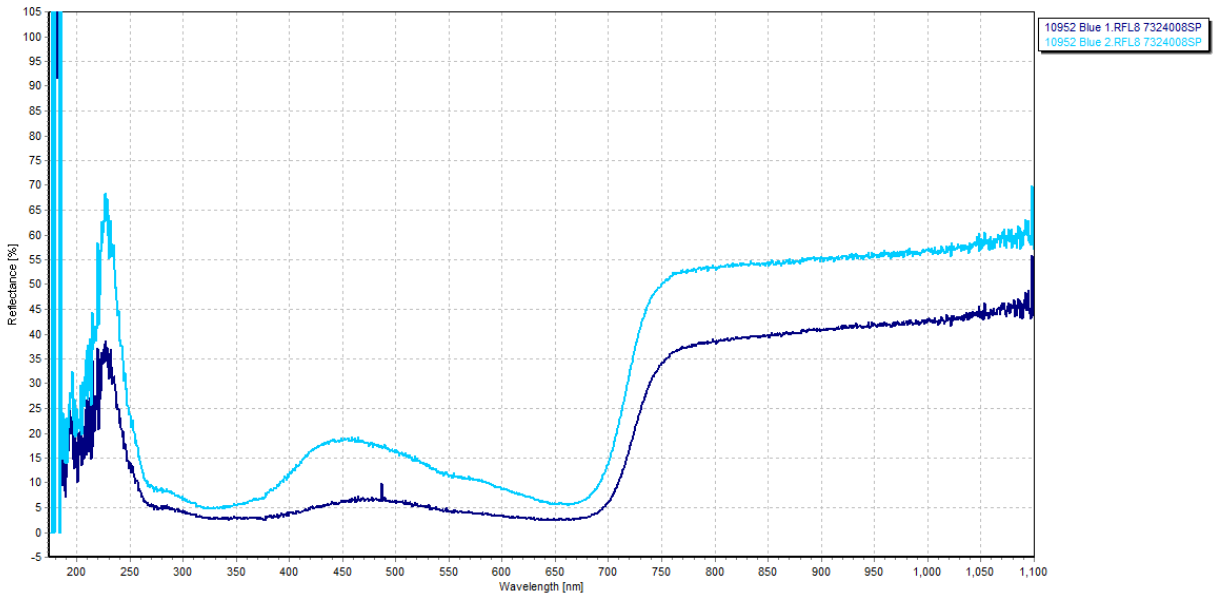
7955

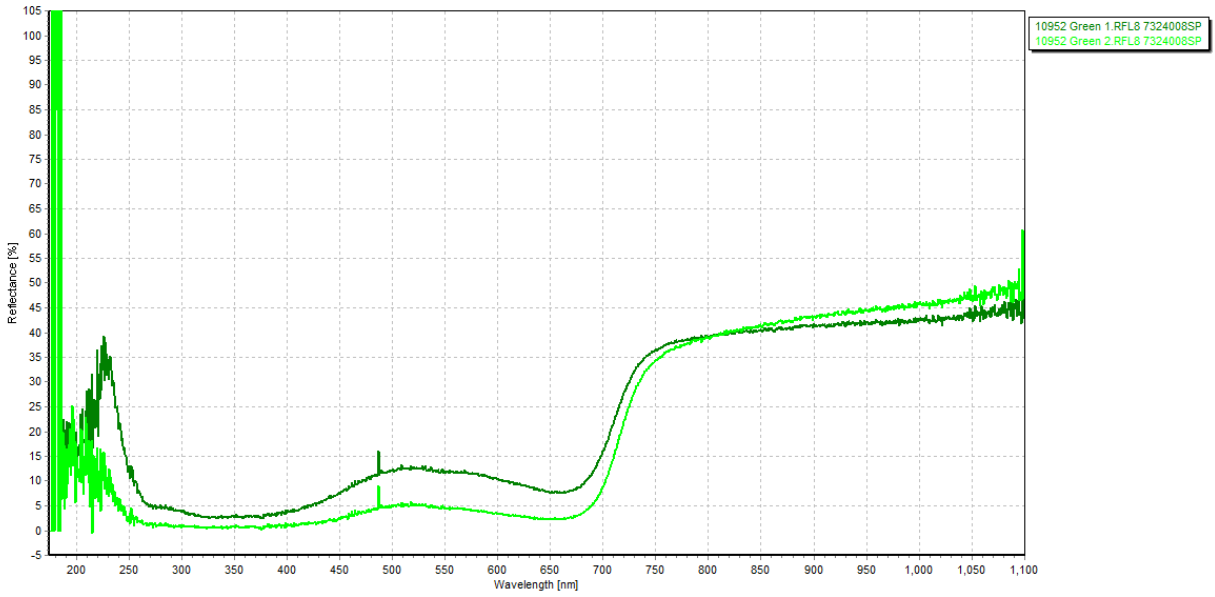

7955 Brown 0 deg.RFL8 7324008SP
7955 Brown 1.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

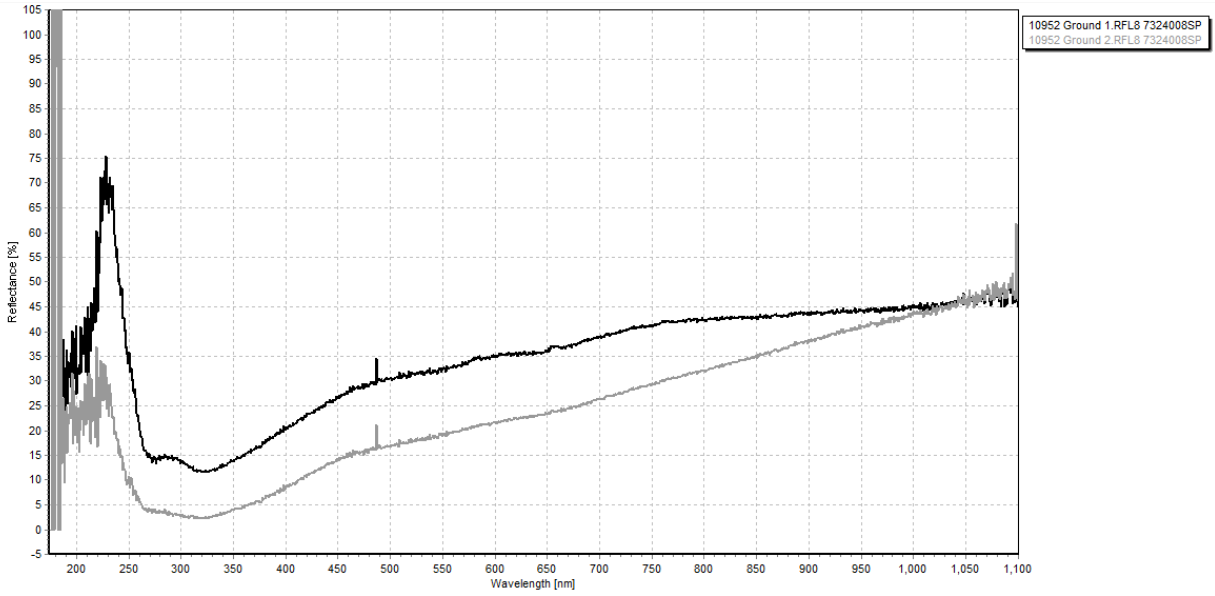

7955 Dark Brown 0 deg.RFL8 7324008SP
7955 Dark Brown 1.RFL8 7324008SP
7955 Dark Brown 2.RFL8 7324008SP
Reflectance [%]

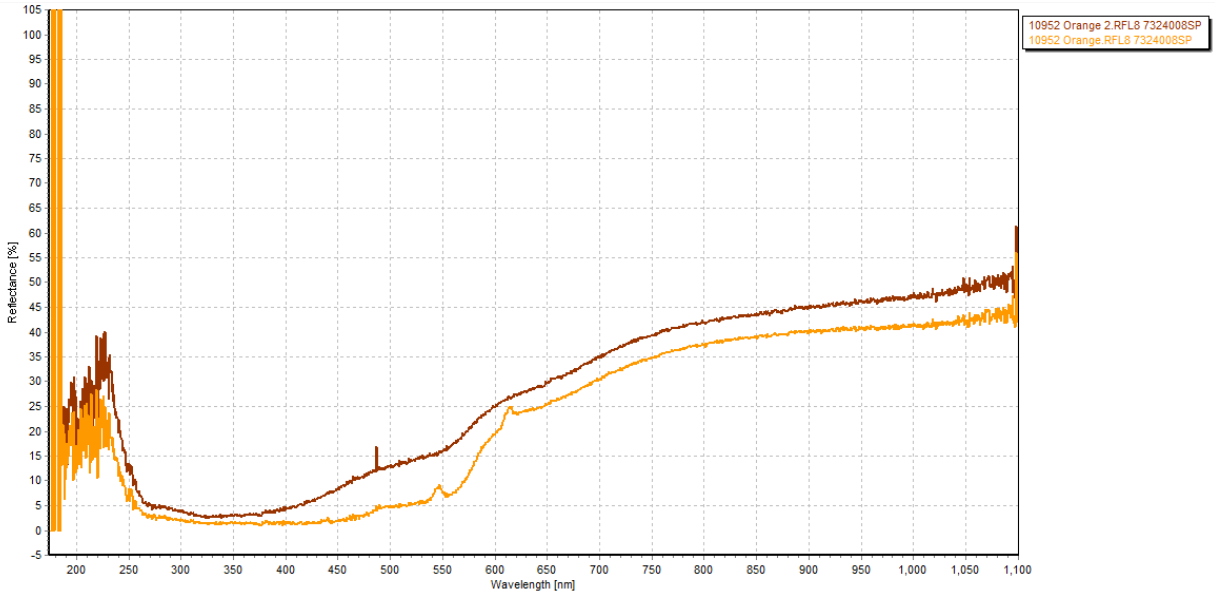

7955 Ground Yellow 0 deg.RFL8 7324008SP
7955 Ground Yellow 1.RFL8 7324008SP
7955 Ground Yellow 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

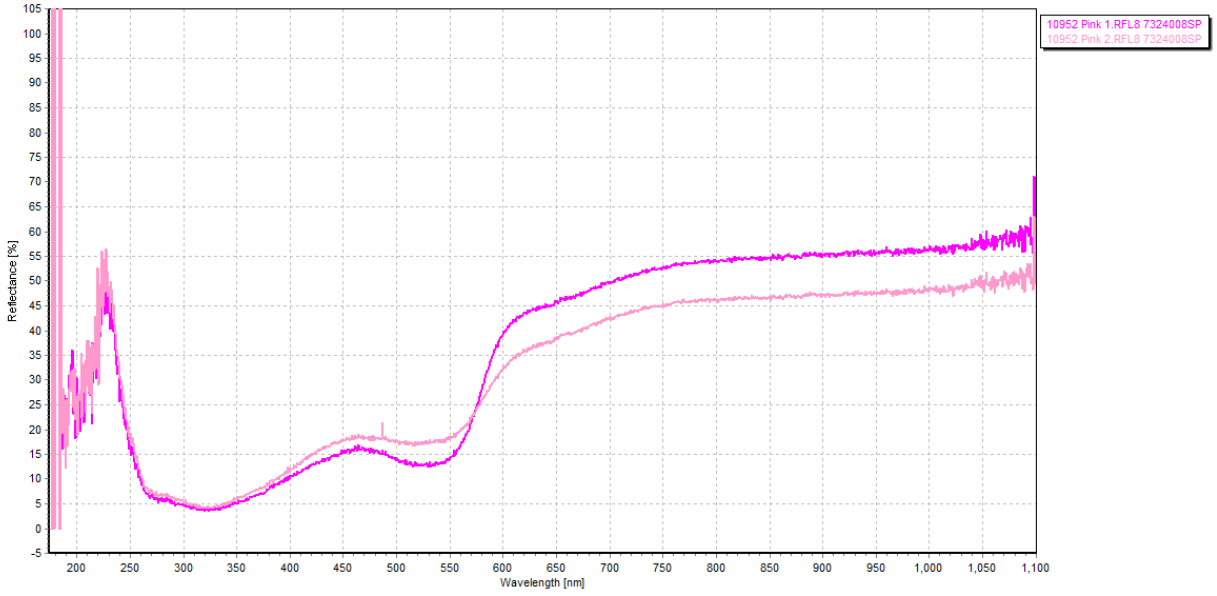
10952

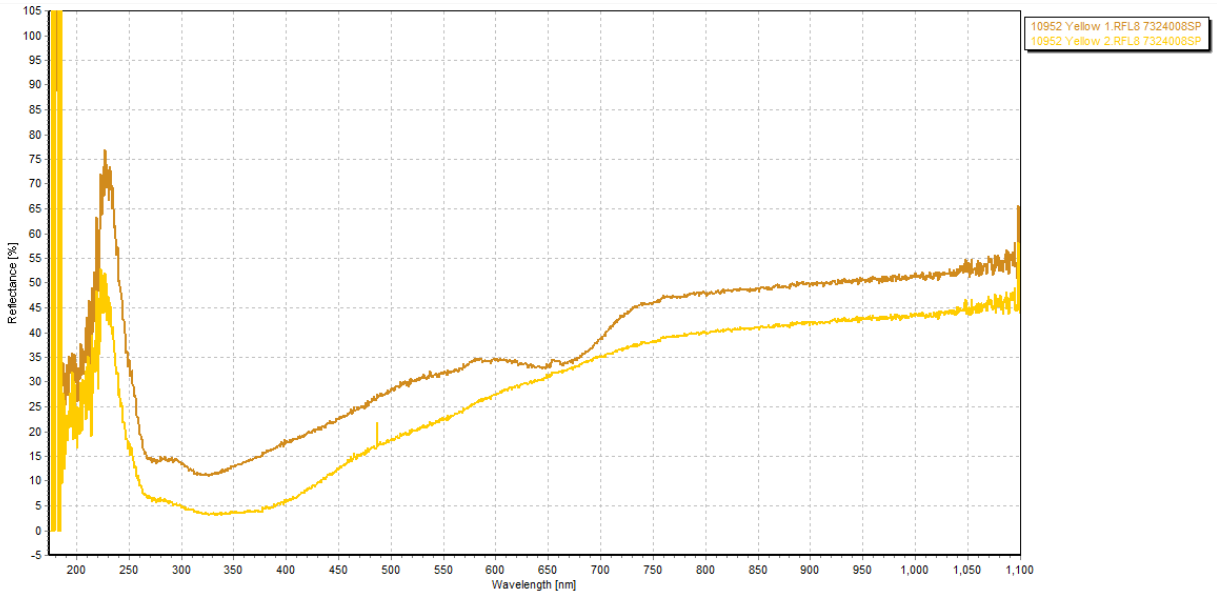

10952 Blue 1.RFL8 7324008SP
10952 Blue 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]


10952 Green 1.RFL8 7324008SP
10952 Green 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

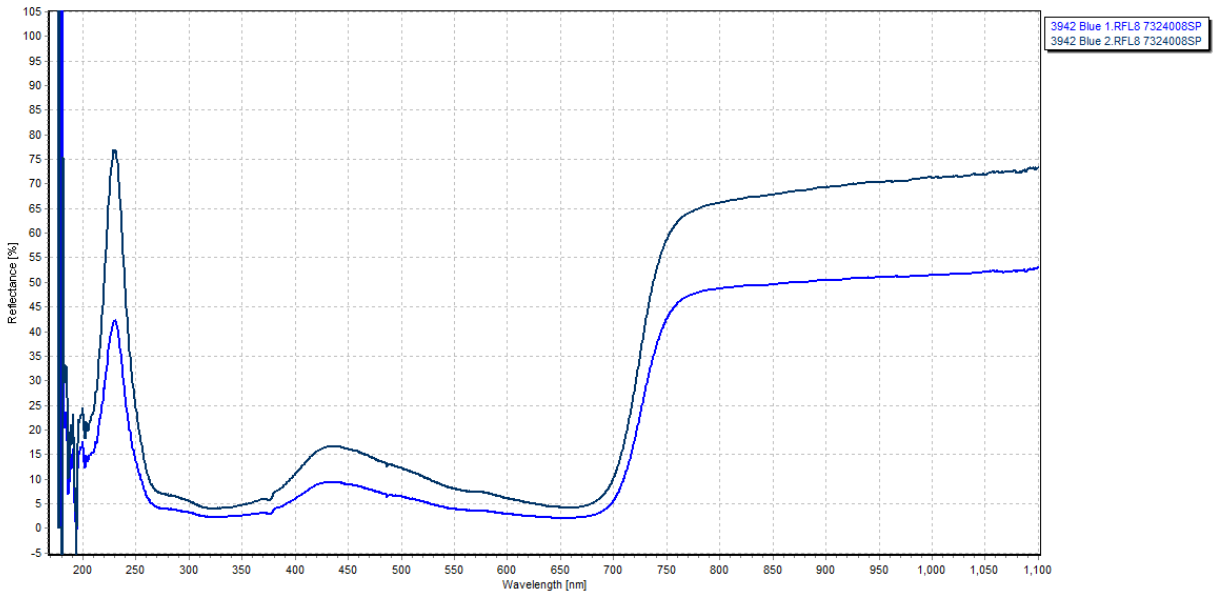

10952 Ground 1.RFL8 7324008SP
10952 Ground 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

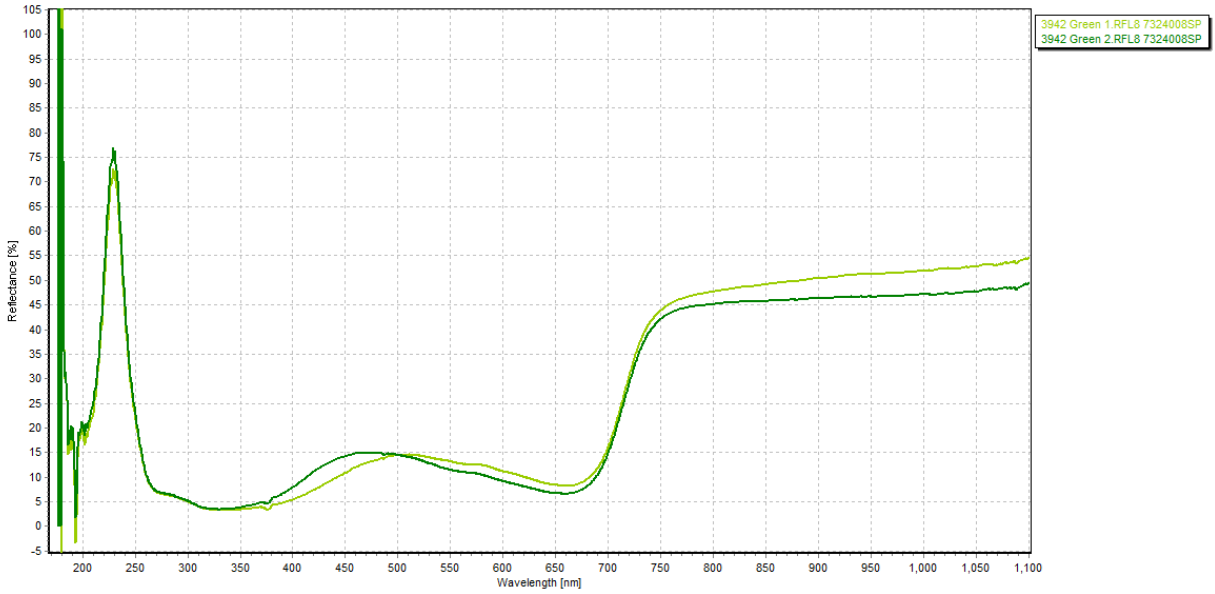

10952 Orange 2.RFL8 7324008SP
10952 Orange.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

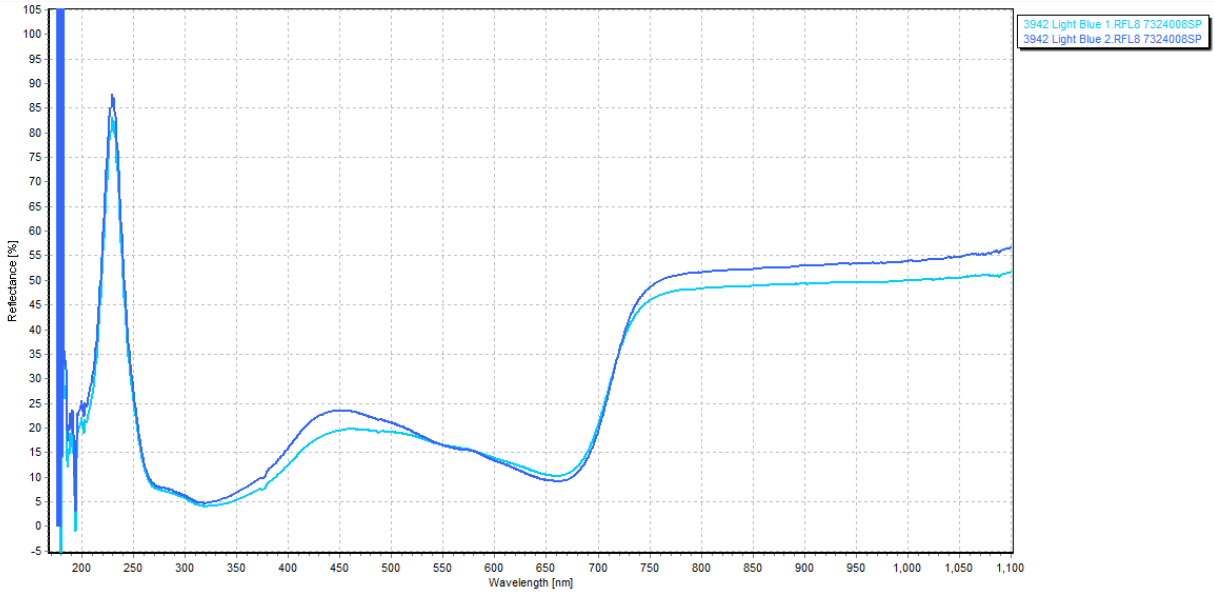

10952 Pink 1.RFL8 7324008SP
10952 Pink 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

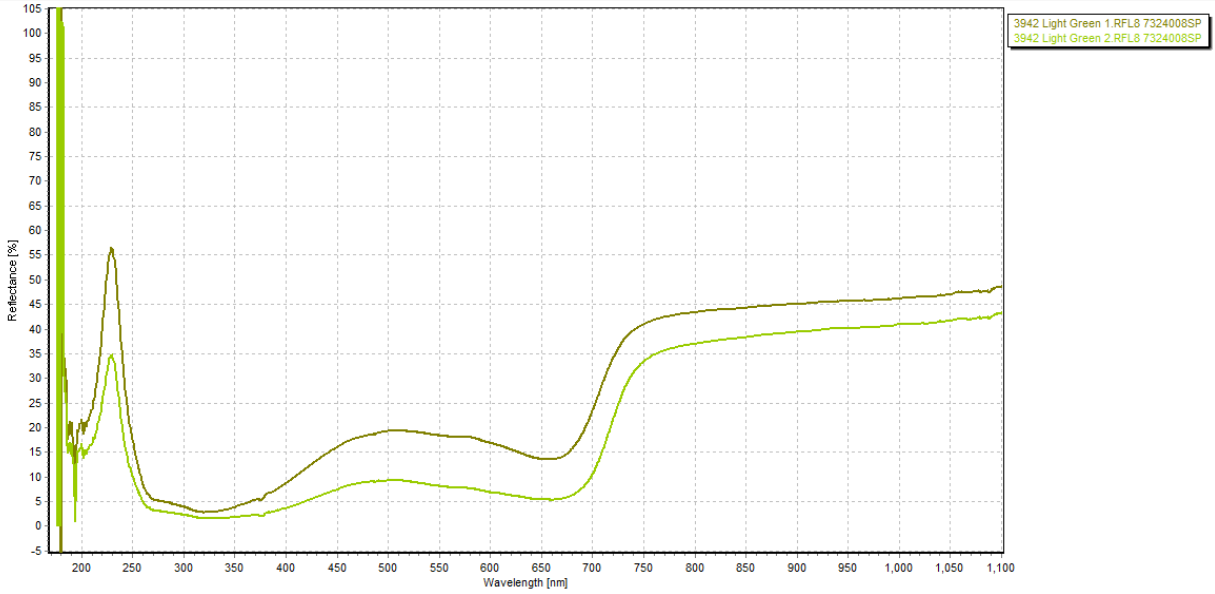

10952 Yellow 1.RFL8 7324008SP
10952 Yellow 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

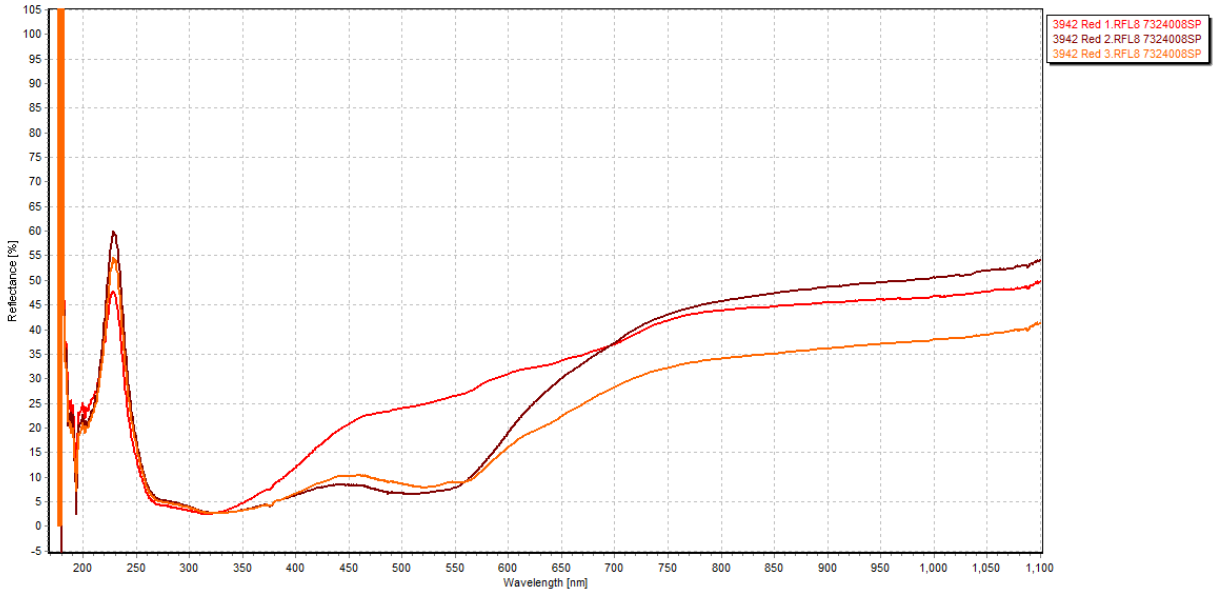
3942

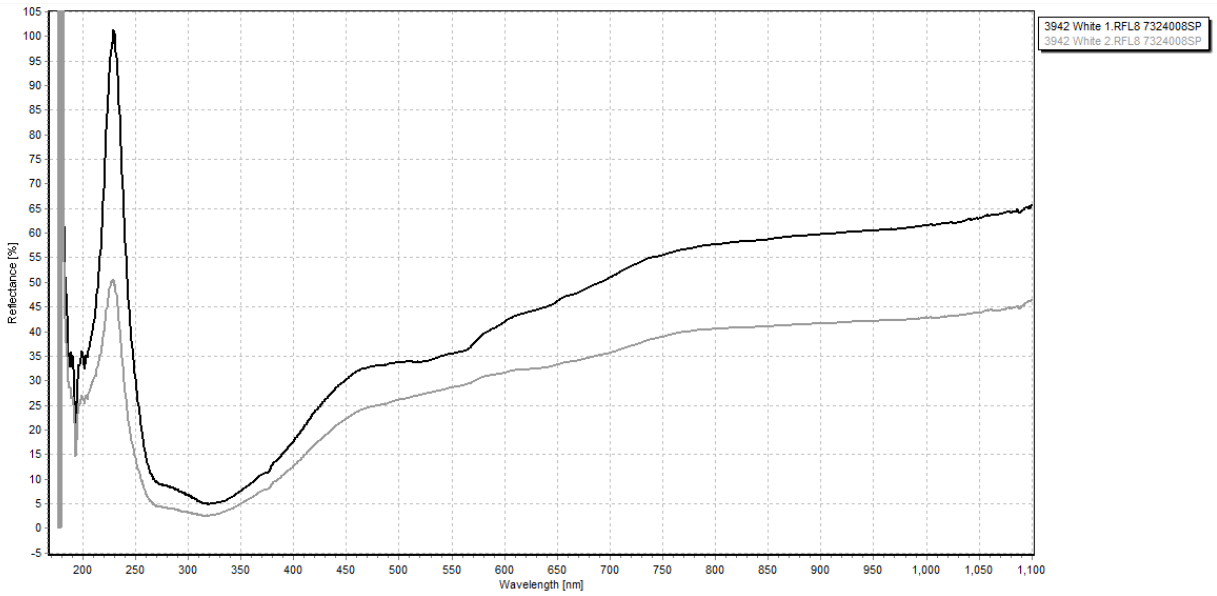

3942 Blue 1.RFL8 7324008SP
3942 Blue 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

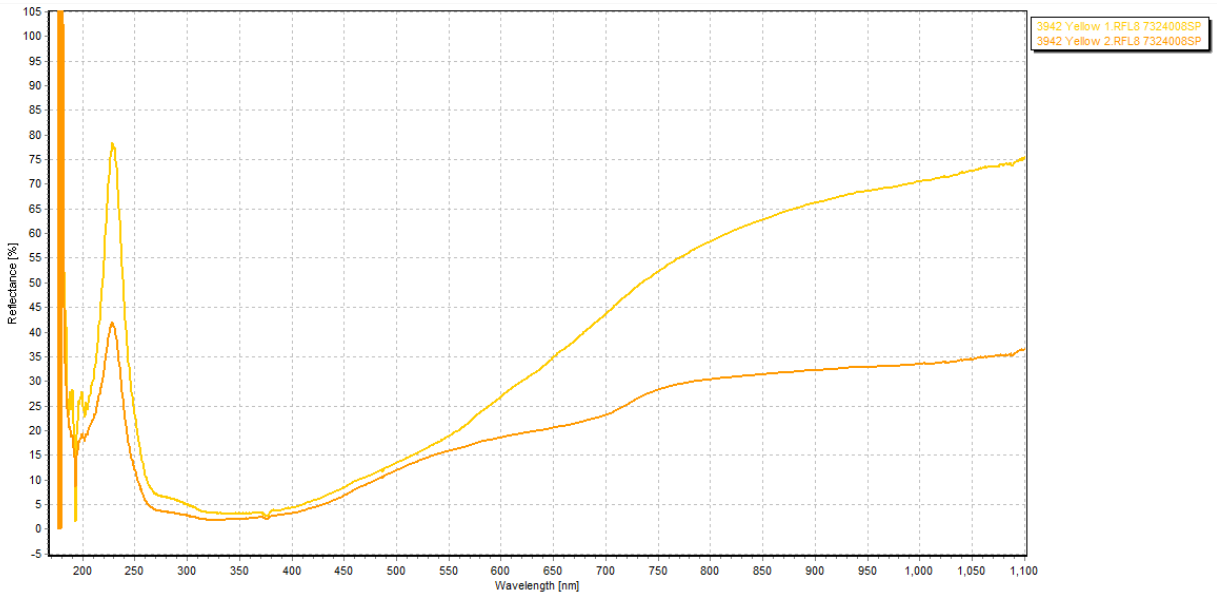

3942 Green 1.RFL8 7324008SP
3942 Green 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]


3942 Light Blue 1.RFL8 7324008SP
3942 Light Blue 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

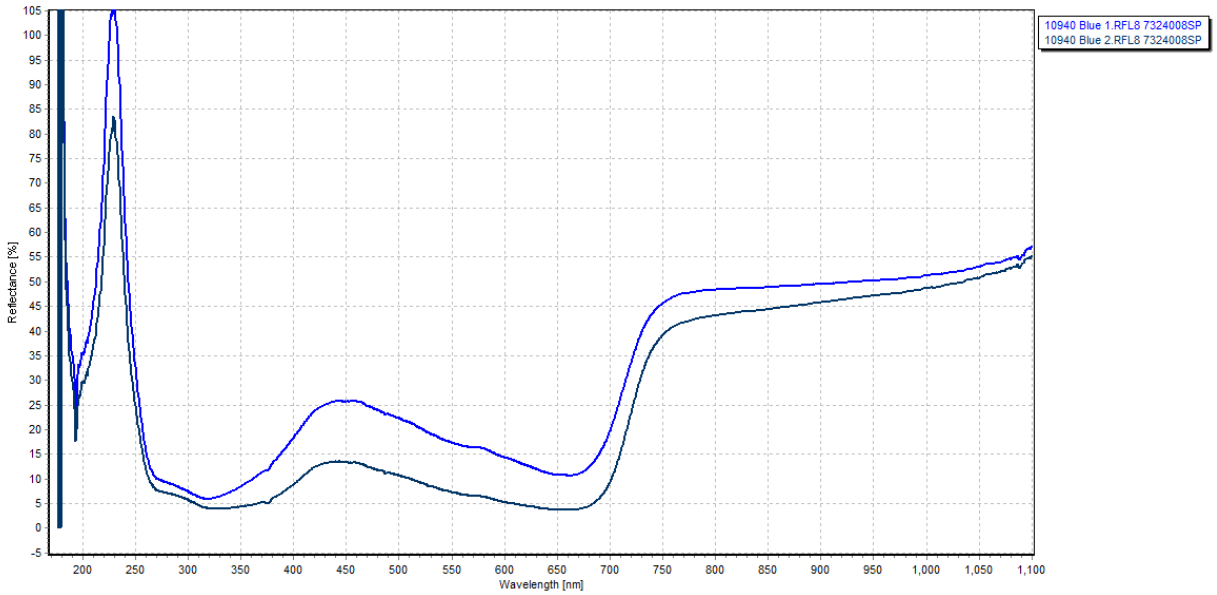

3942 Light Green 1.RFL8 7324008SP
3942 Light Green 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

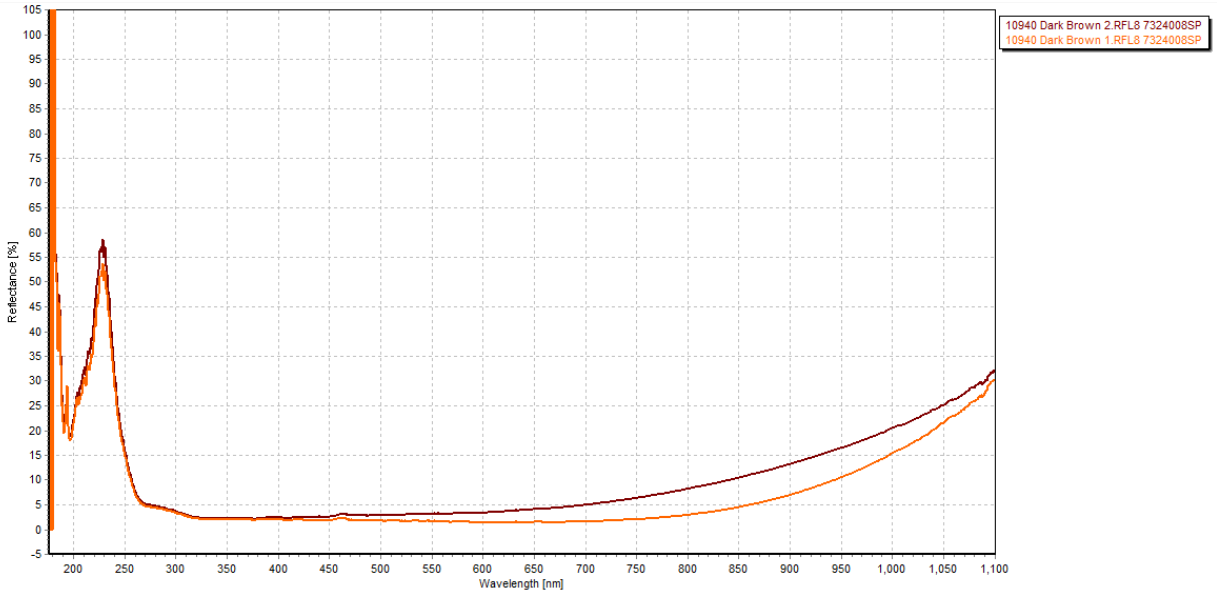

3942 Red 1.RFL8 7324008SP
3942 Red 2.RFL8 7324008SP
3942 Red 3.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

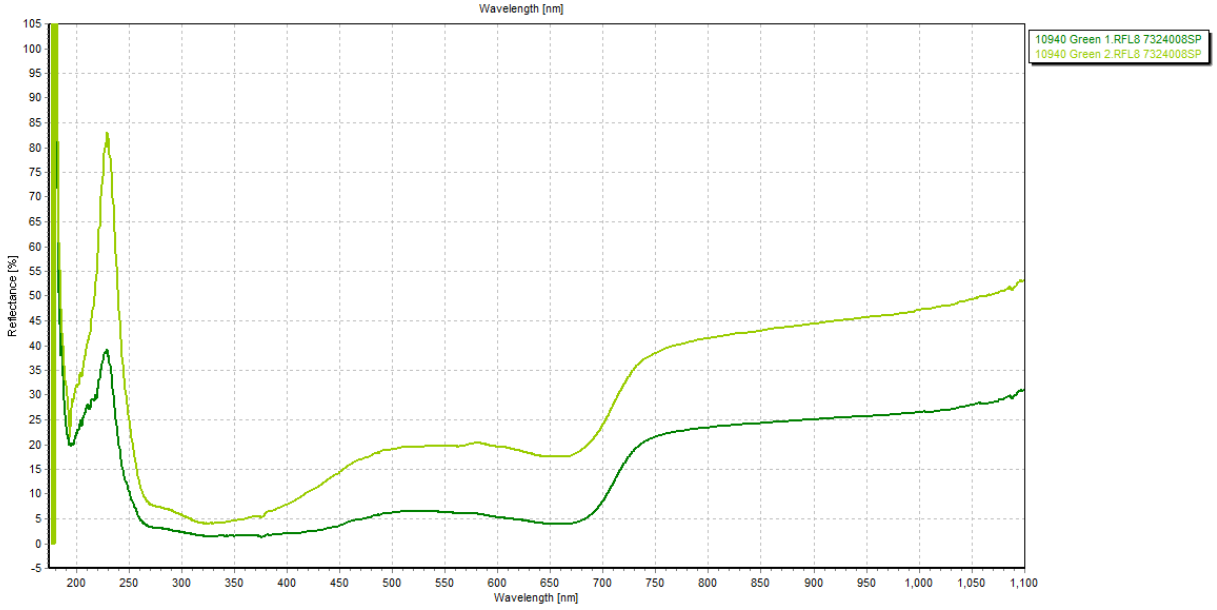

3942 White 1.RFL8 7324008SP
3942 White 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

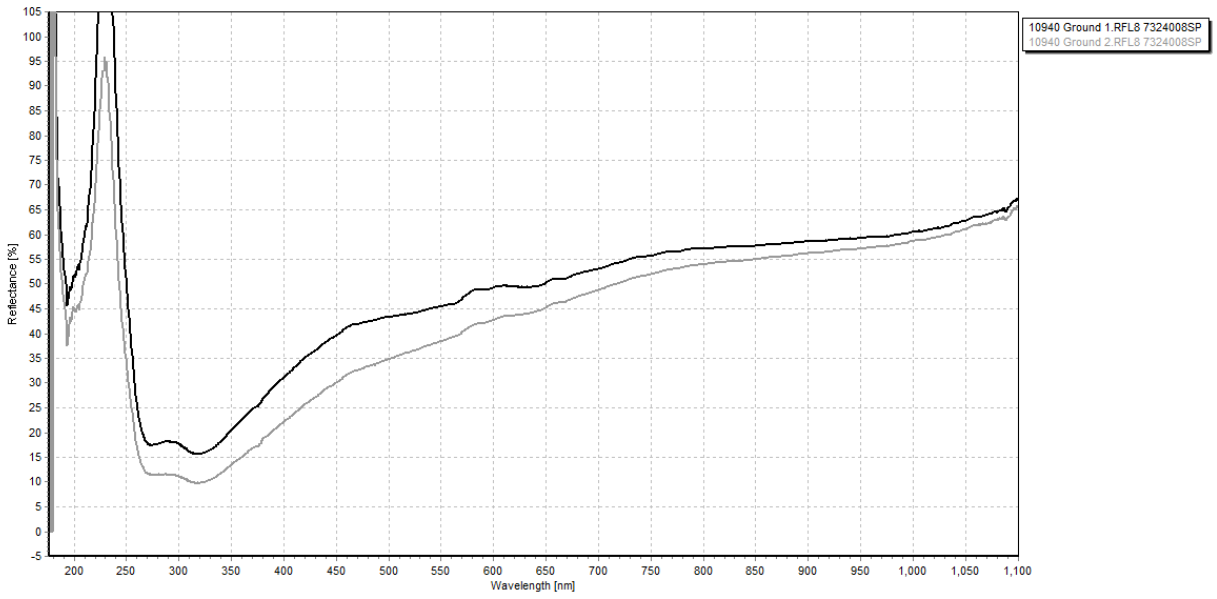

3942 Yellow 1.RFL8 7324008SP
3942 Yellow 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

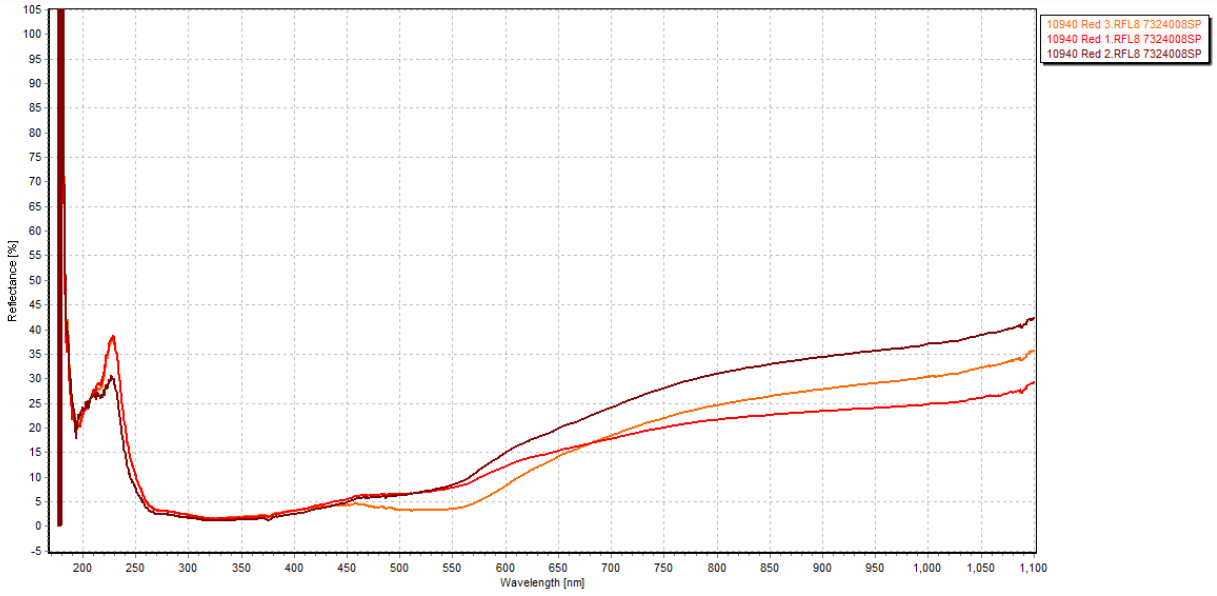
10940

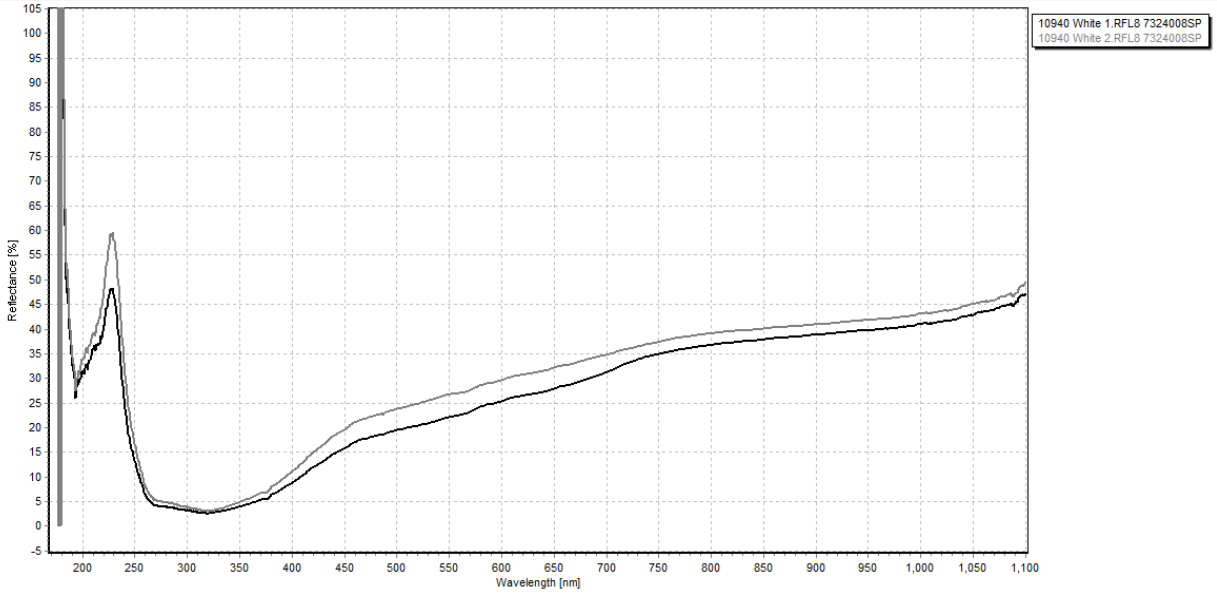

10940 Blue 1.RFL8 7324008SP
10940 Blue 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

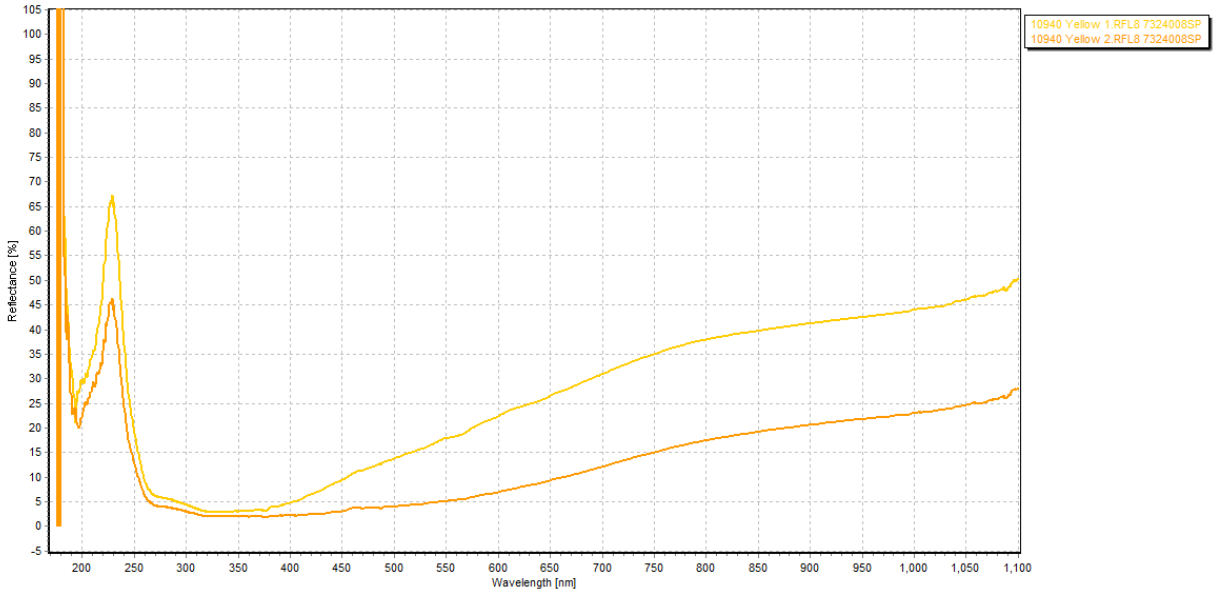

10940 Dark Brown 2.RFL8 7324008SP
10940 Dark Brown 1.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]


10940 Green 1.RFL8 7324008SP
10940 Green 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

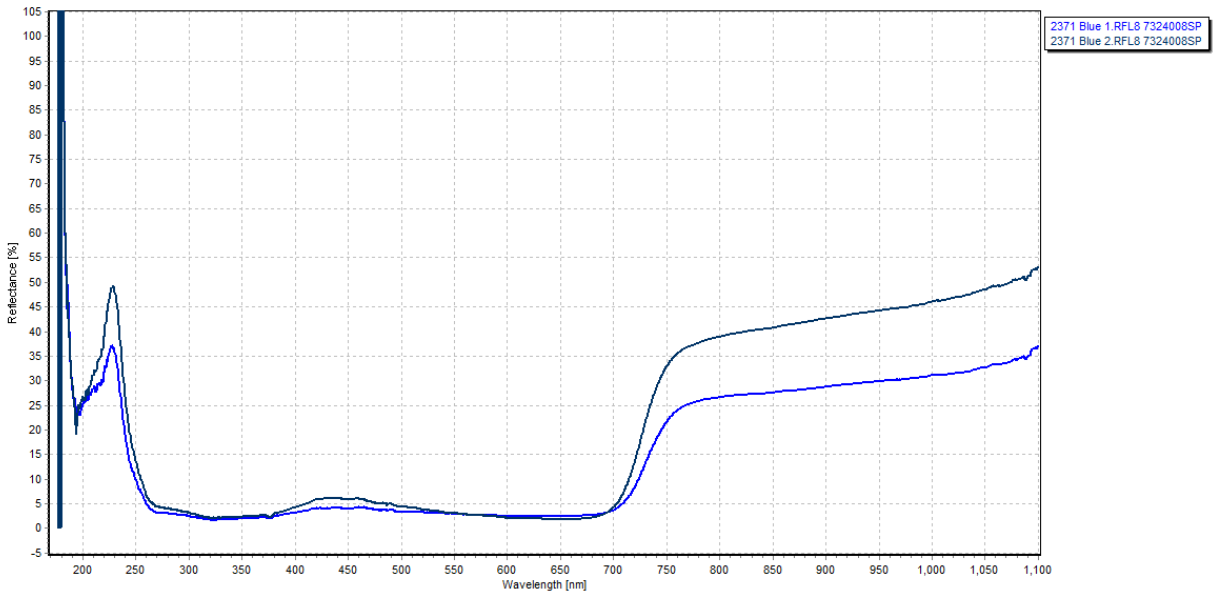

10940 Ground 1.RFL8 7324008SP
10940 Ground 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

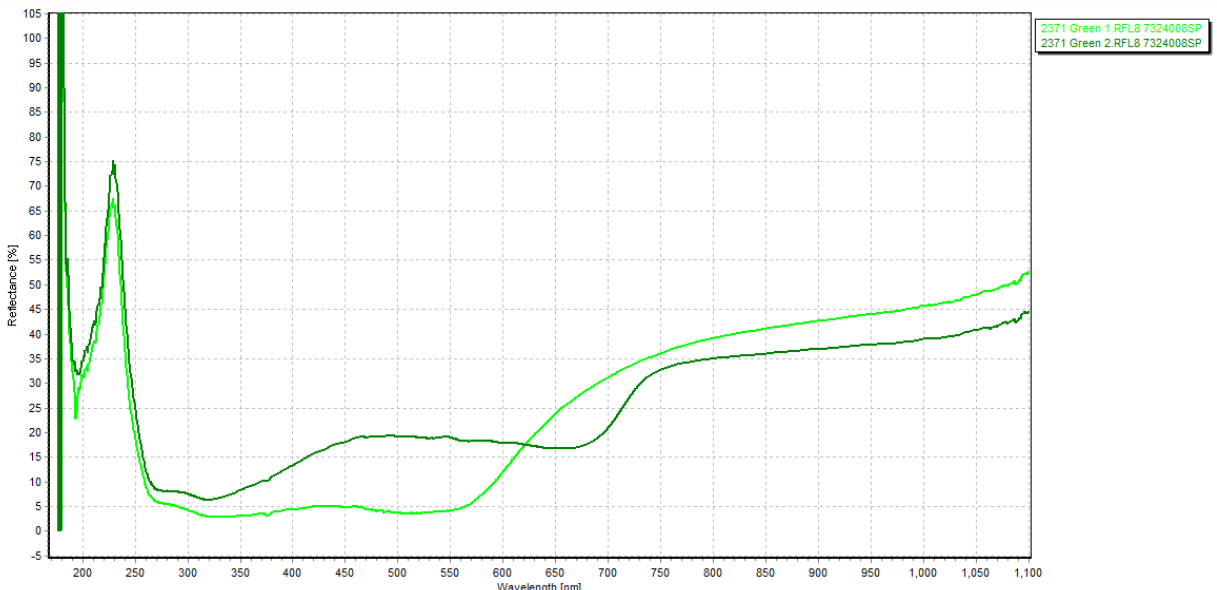

10940 Red 3.RFL8 7324008SP
10940 Red 1.RFL8 7324008SP
10940 Red 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

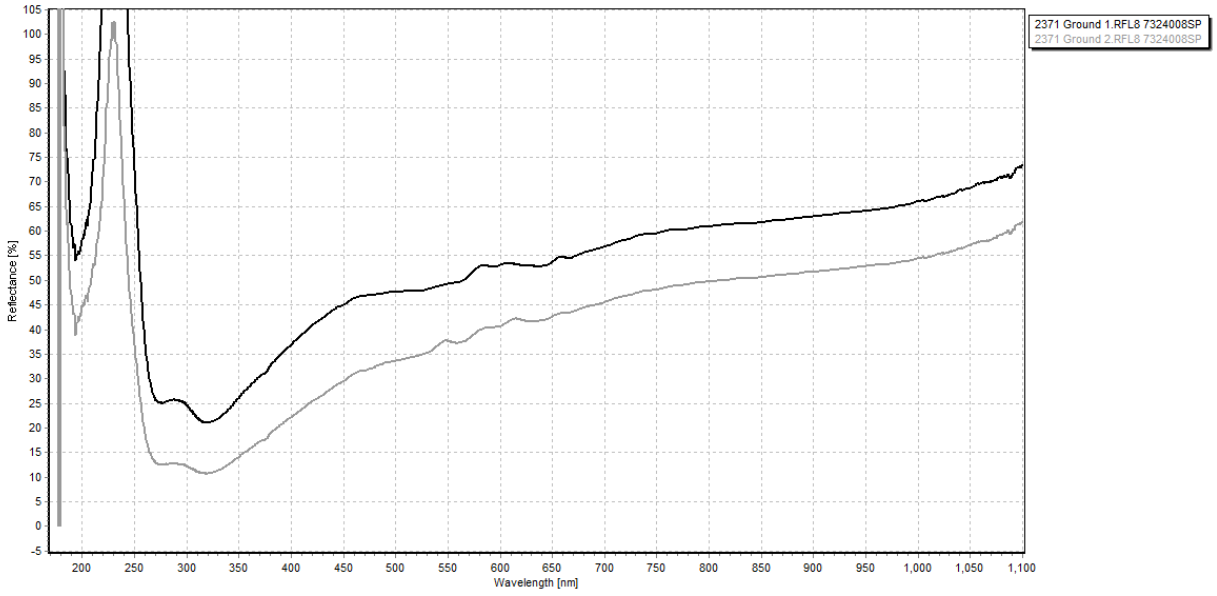

10940 White 1.RFL8 7324008SP
10940 White 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

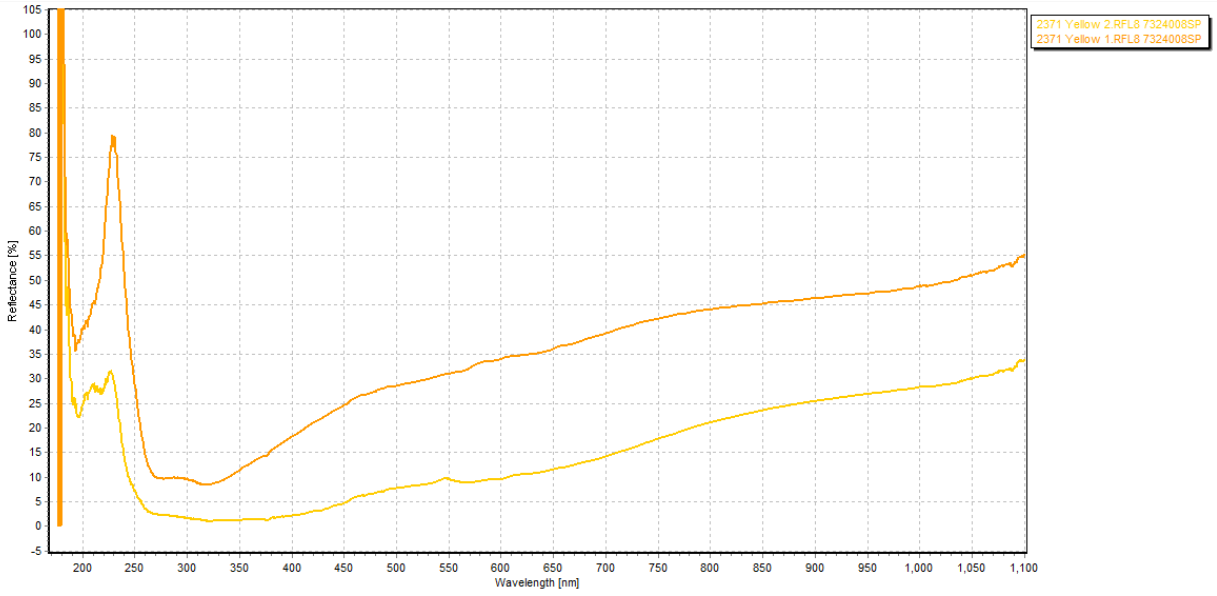

10940 Yellow 1.RFL8 7324008SP
10940 Yellow 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

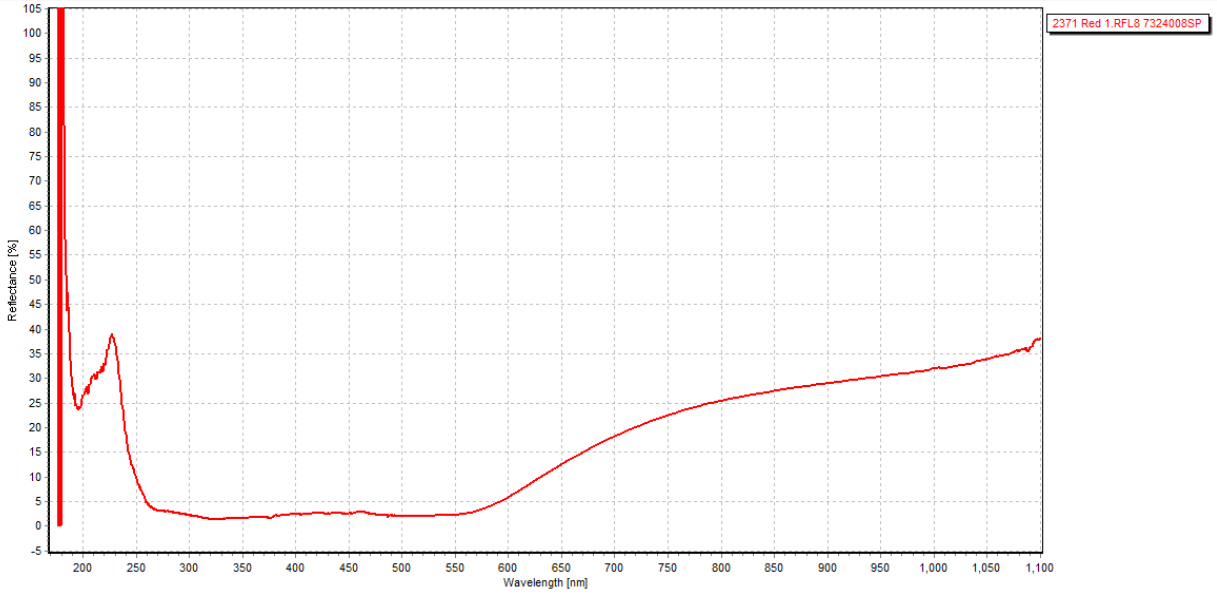
2371


2371 Blue 1.RFL8 7324008SP
2371 Blue 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

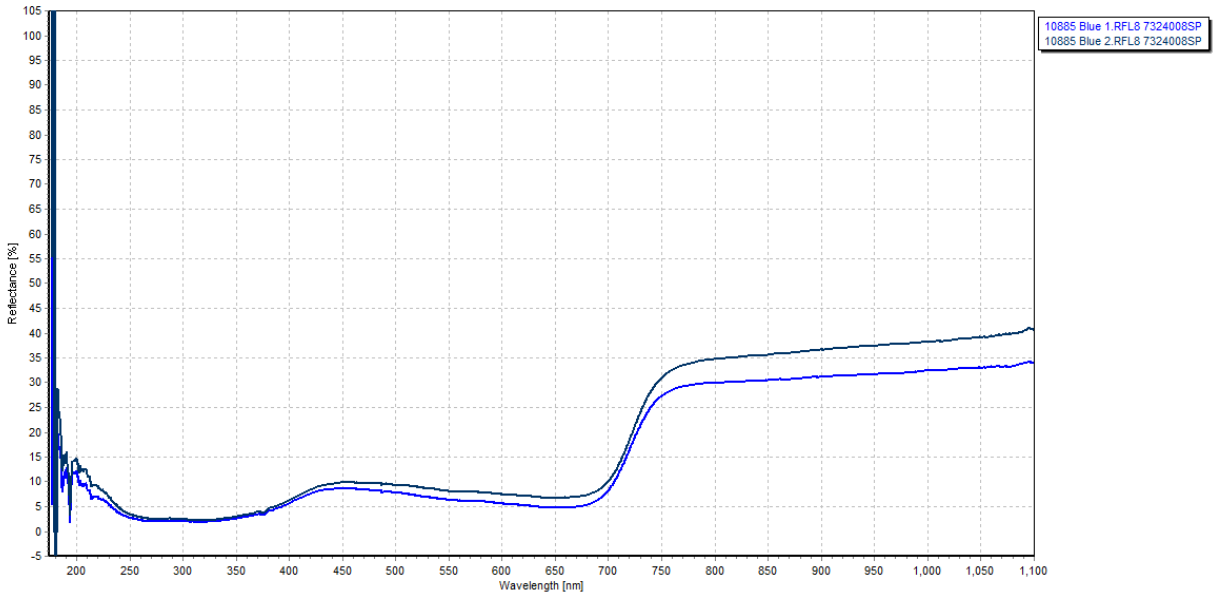

2371 Green 1.RFL8 7324008SP
2371 Green 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

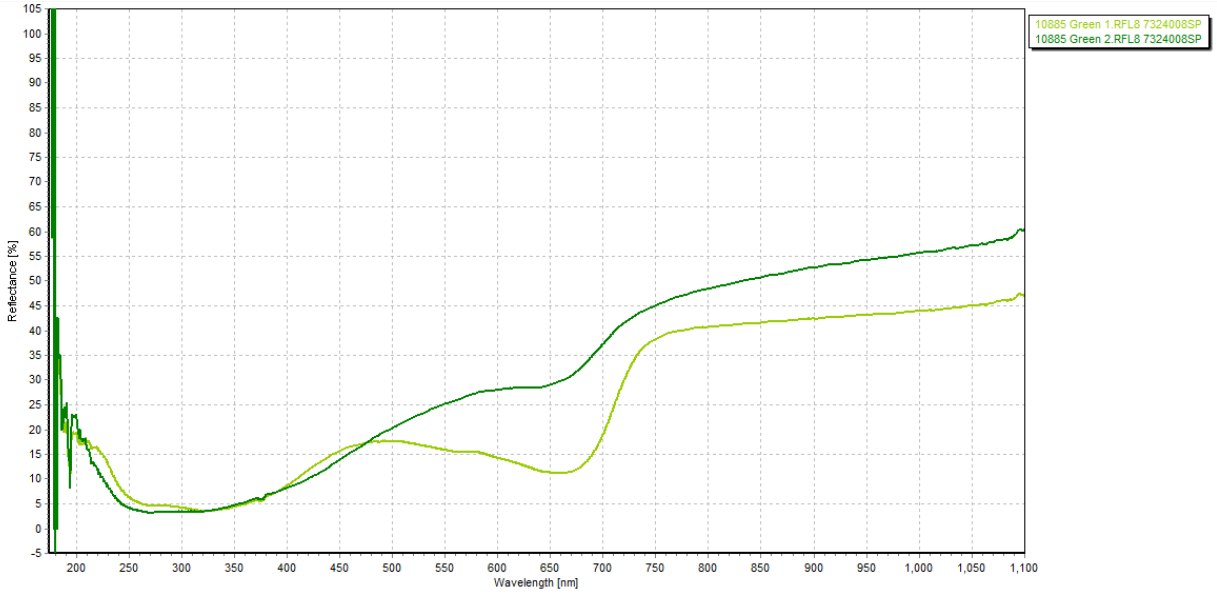

2371 Ground 1.RFL8 7324008SP
2371 Ground 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

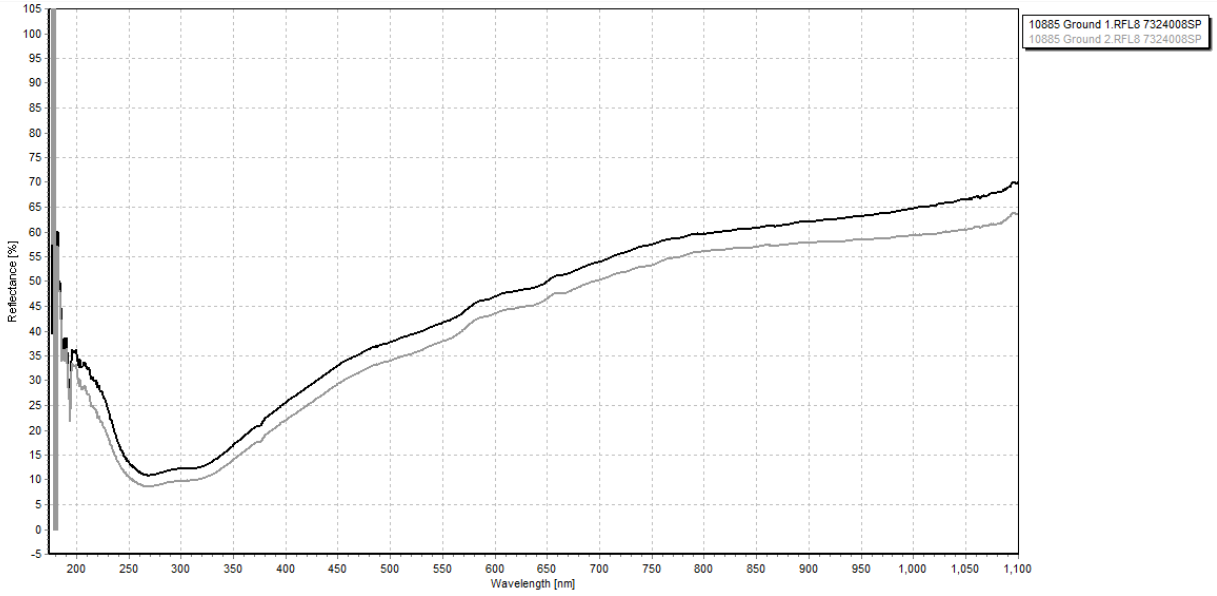

2371 Yellow 2.RFL8 7324008SP
2371 Yellow 1.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

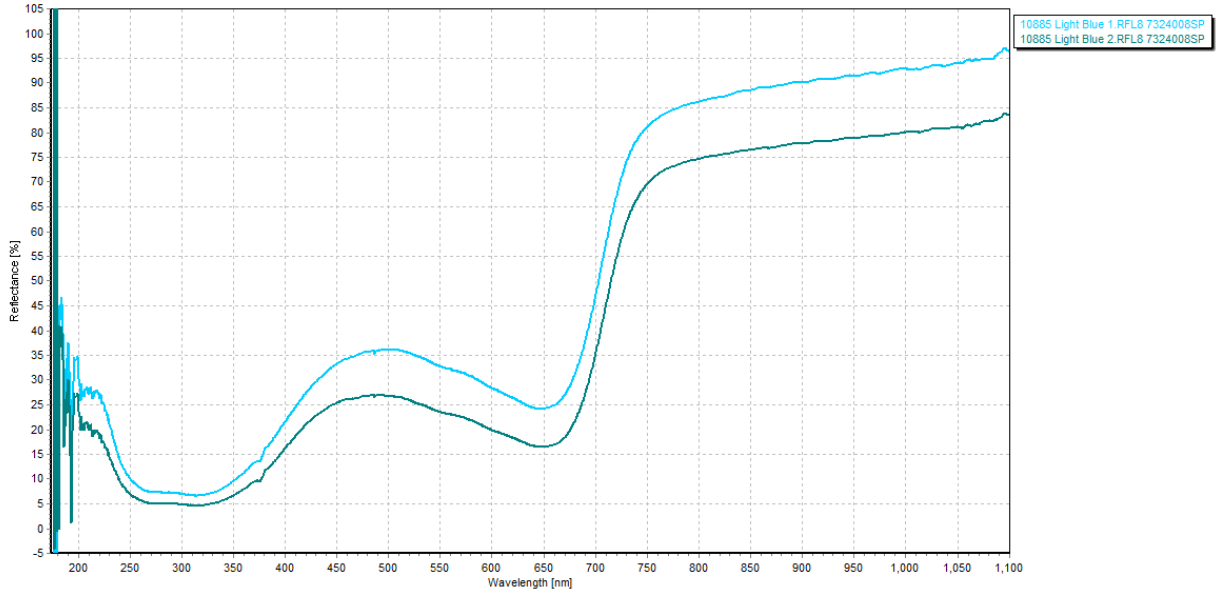

2371 Red 1.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

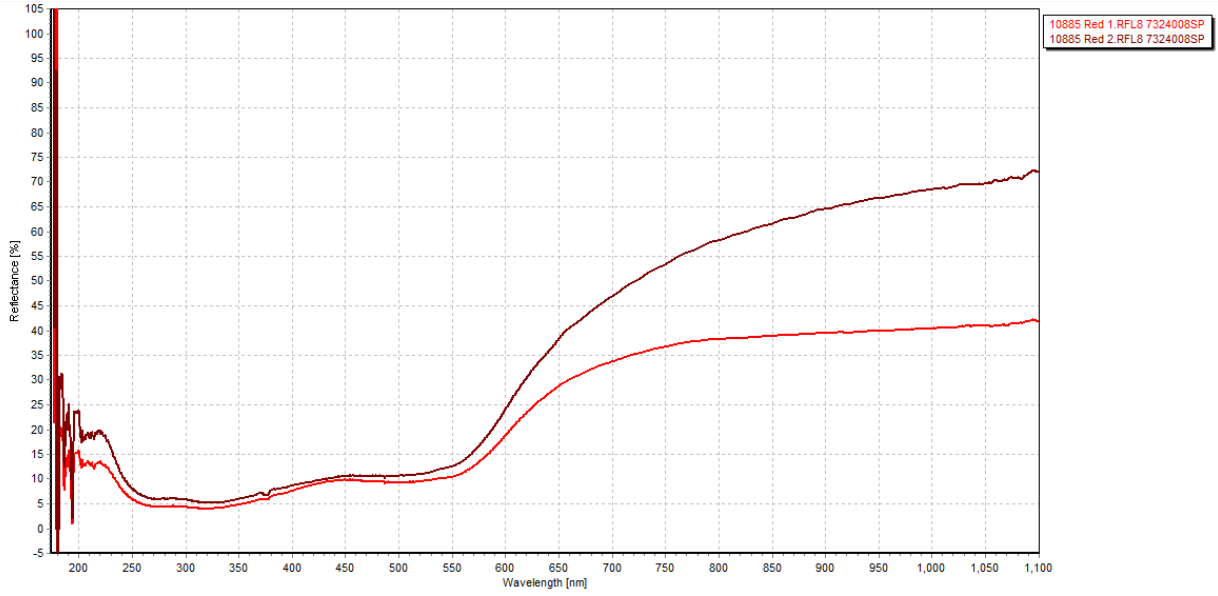
10885

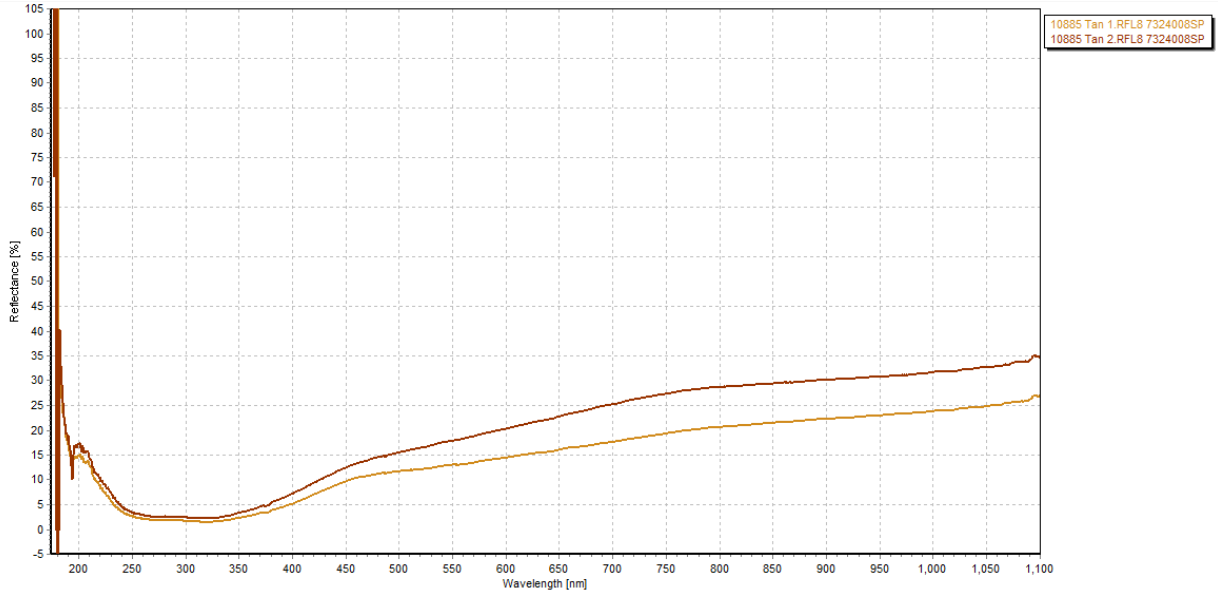

10885 Blue 1.RFL8 7324008SP
10885 Blue 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

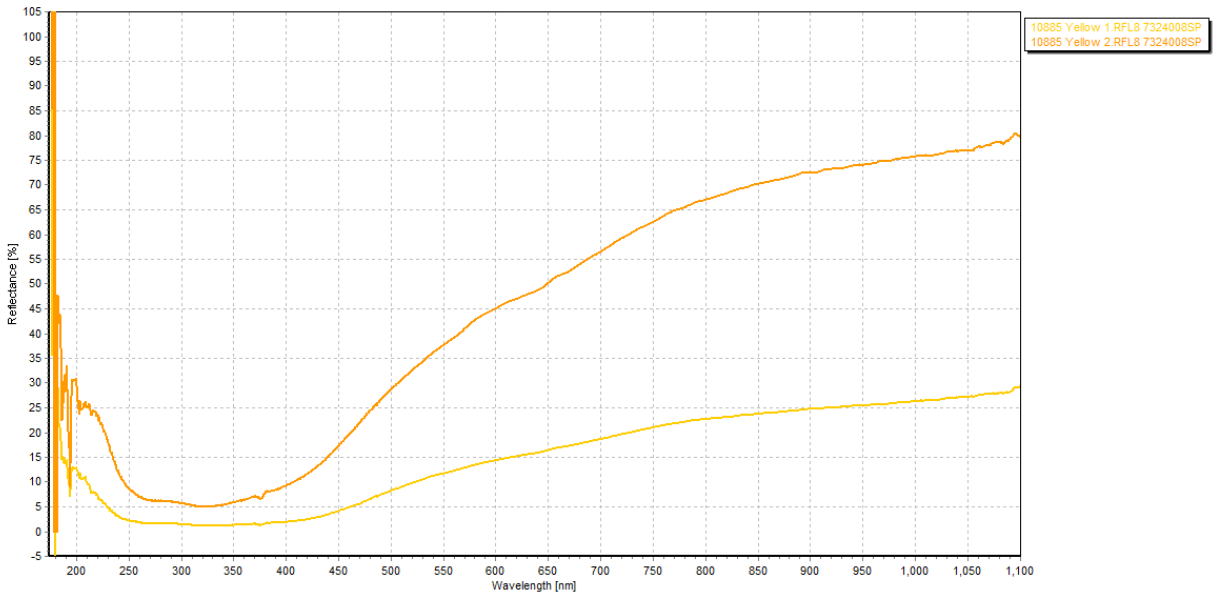

10885 Green 1.RFL8 7324008SP
10885 Green 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]


10885 Ground 1.RFL8 7324008SP
10885 Ground 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

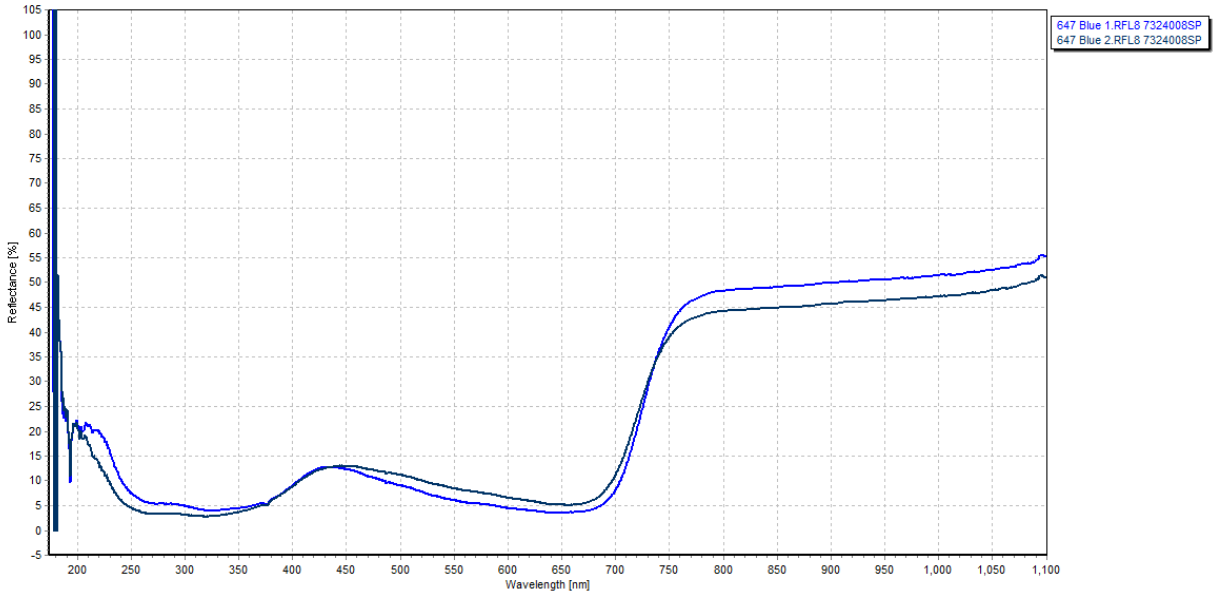

10885 Light Blue 1.RFL8 7324008SP
10885 Light Blue 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

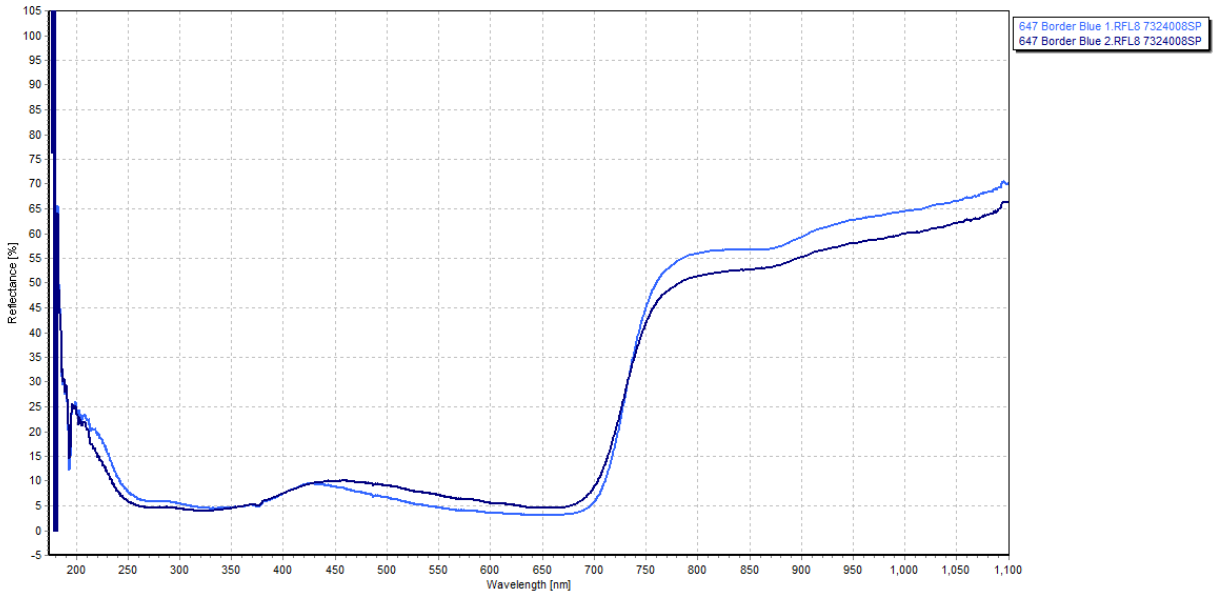

10885 Red 1.RFL8 7324008SP
10885 Red 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

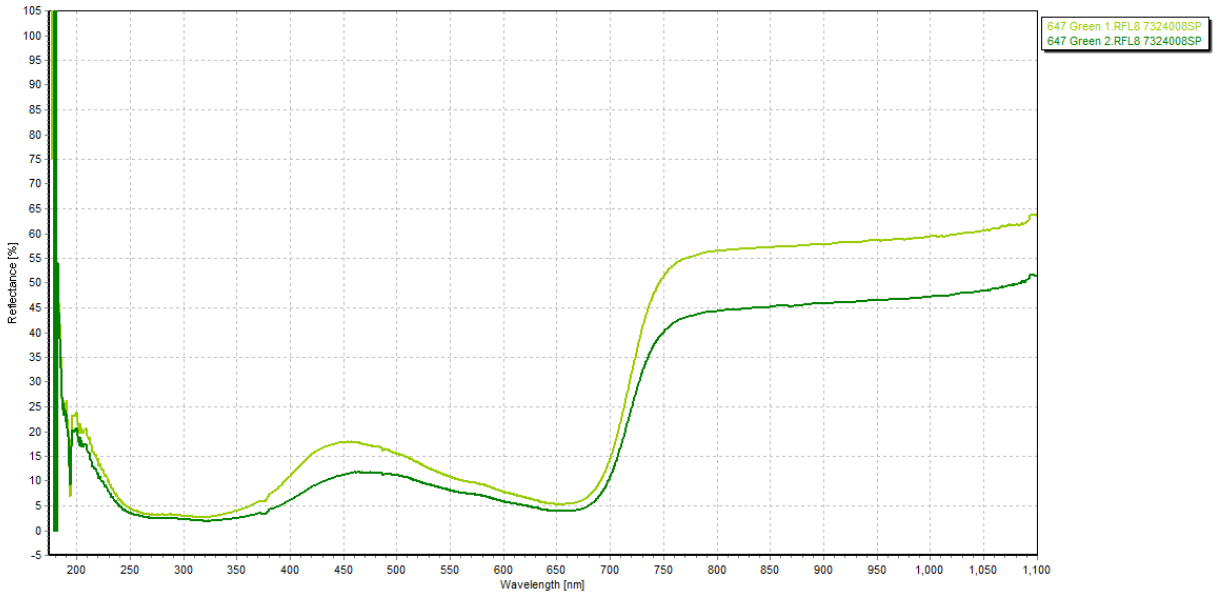

10885 Tan 1.RFL8 7324008SP
10885 Tan 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

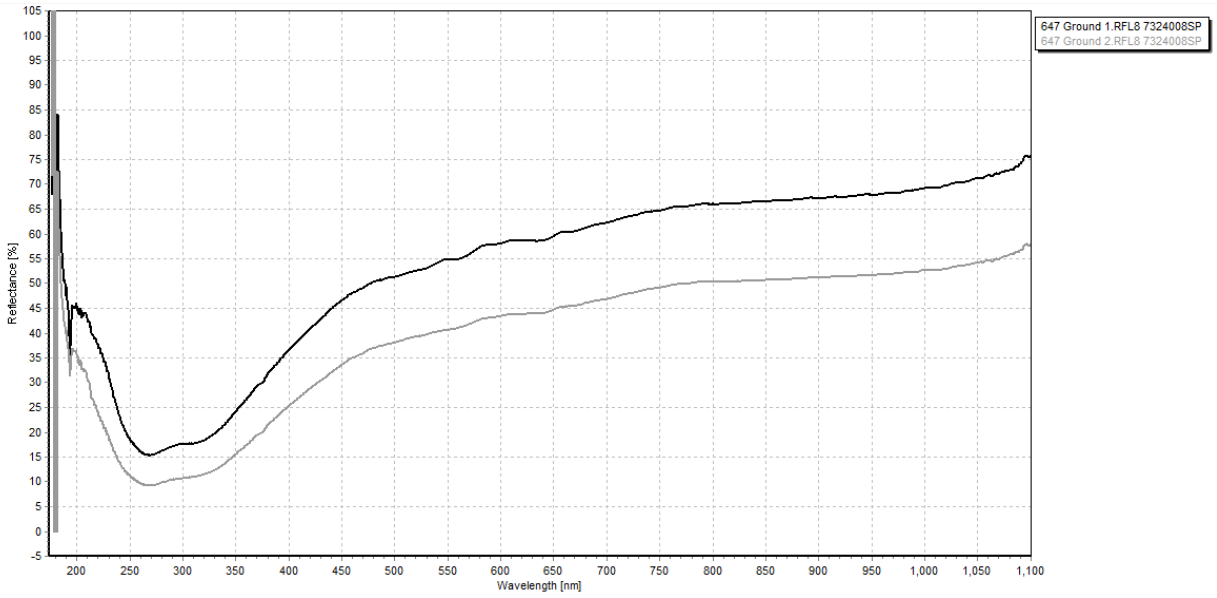

10685 Yellow 1.RFL8 7324008SP
10685 Yellow 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

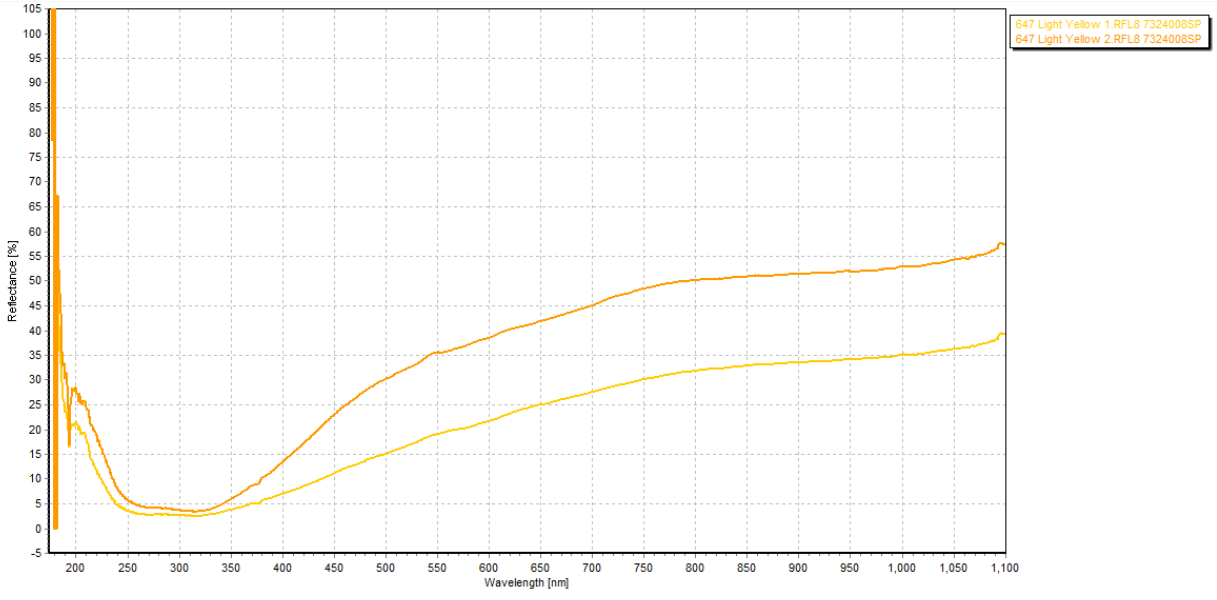
647

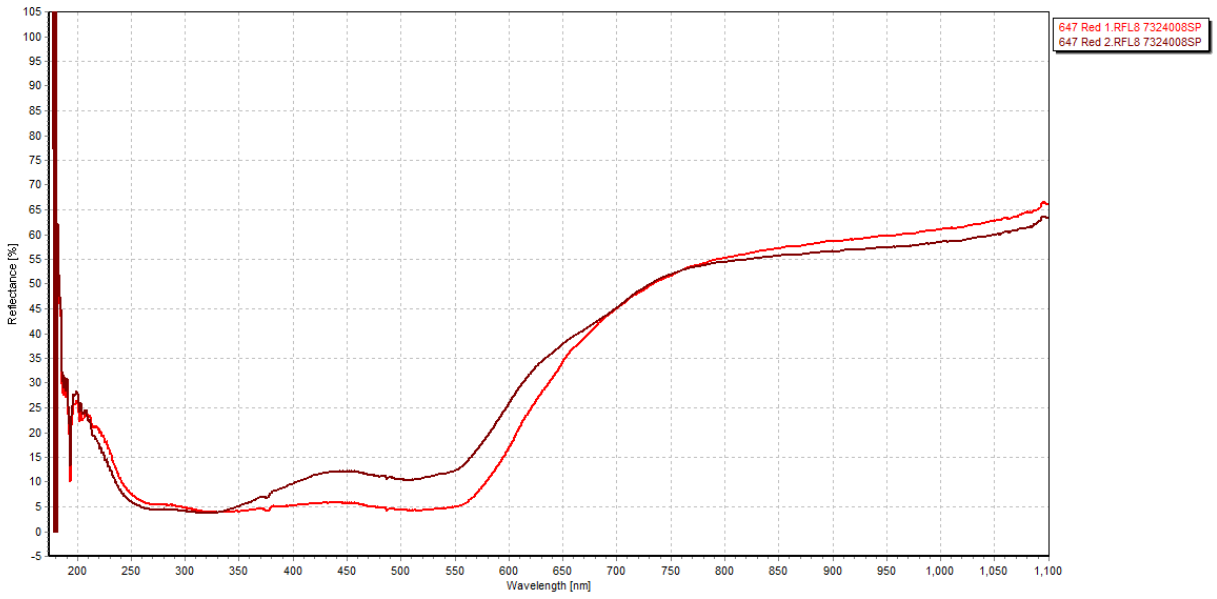

647 Blue 1.RFL8 7324008SP
647 Blue 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

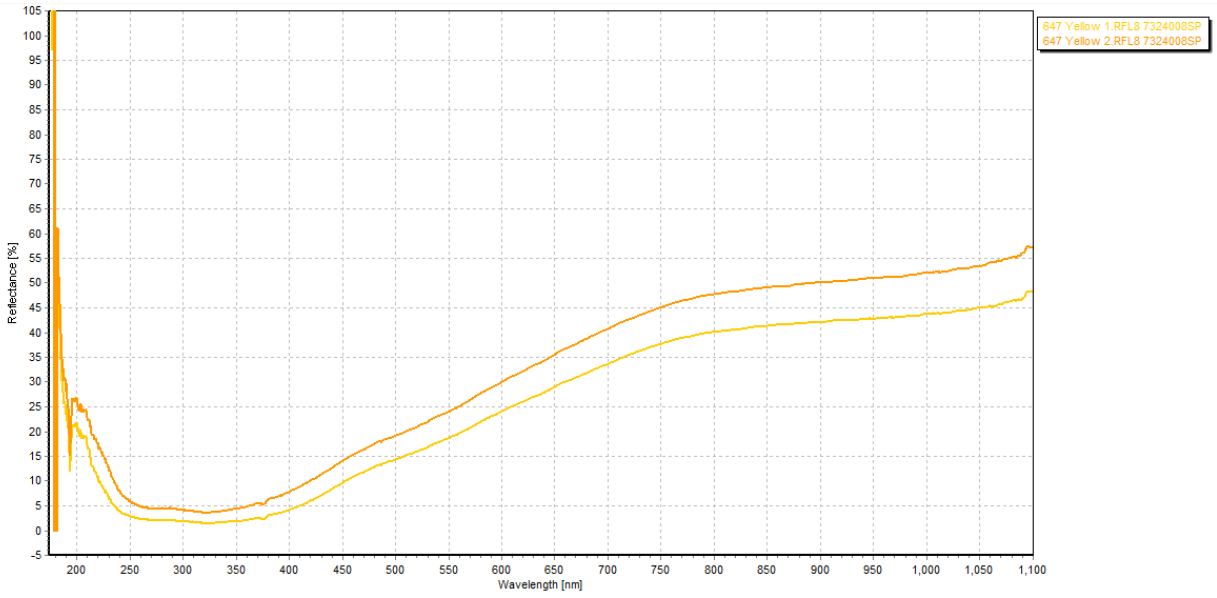

647 Border Blue 1.RFL8 7324008SP
647 Border Blue 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]


647 Green 1.RFL8 7324008SP
647 Green 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

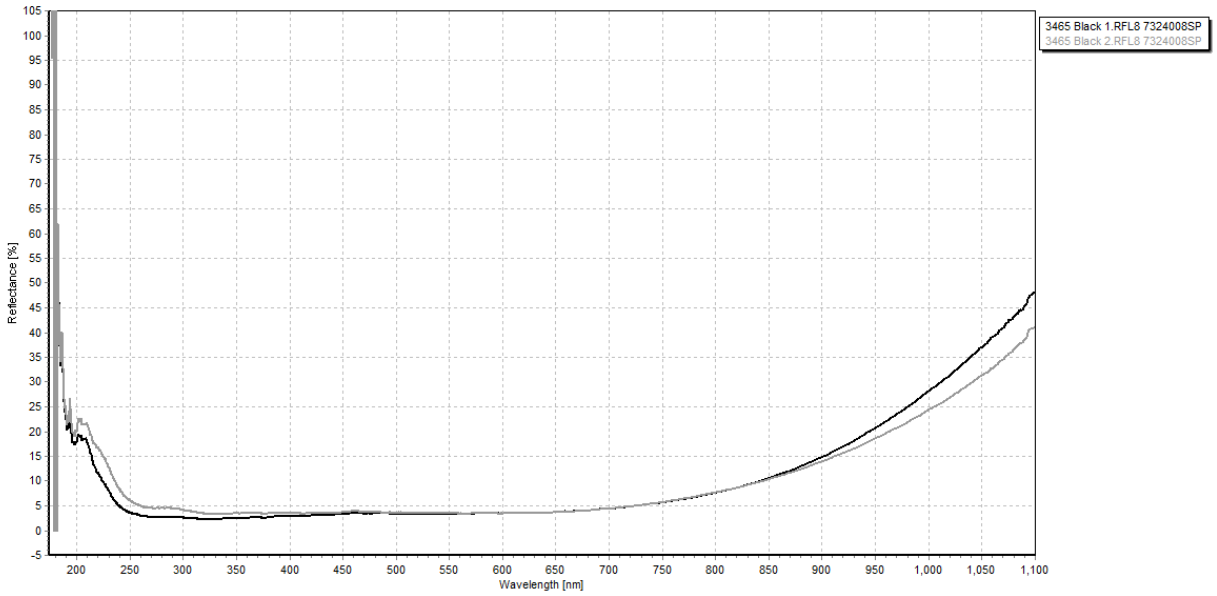

647 Ground 1.RFL8 7324008SP
647 Ground 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

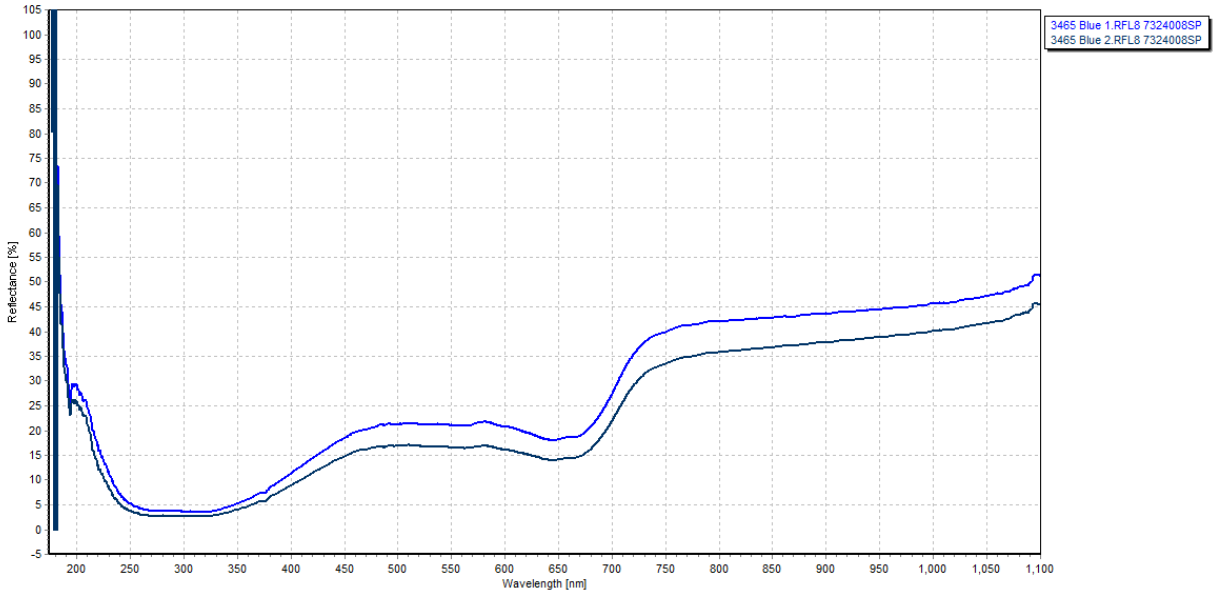

647 Light Yellow 1.RFL8 7324008SP
647 Light Yellow 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

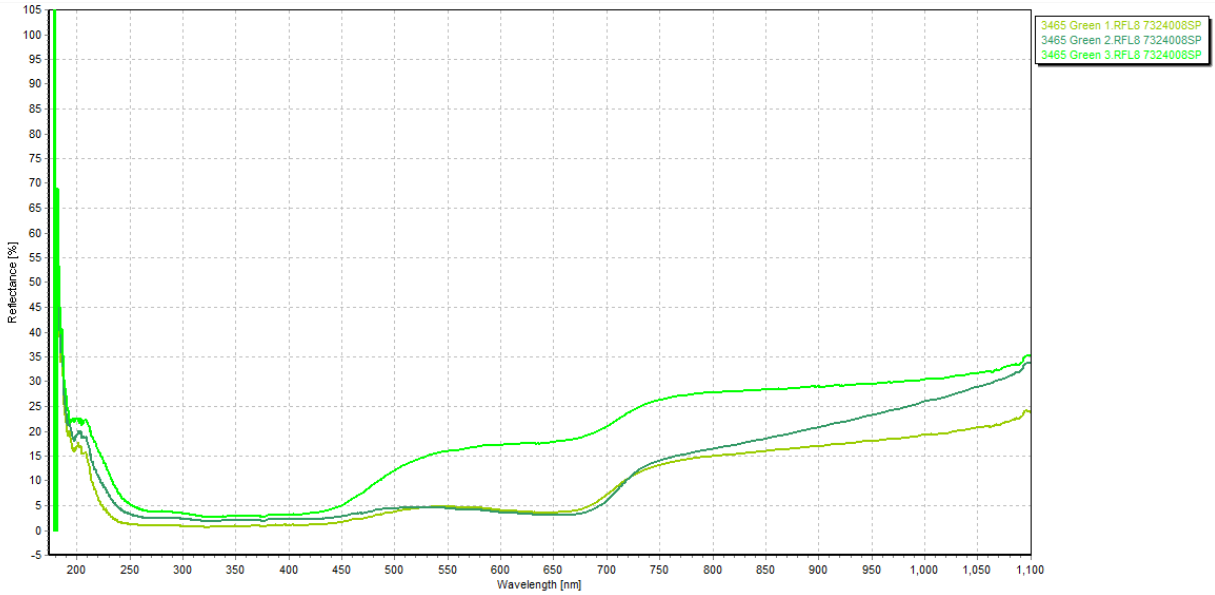

647 Red 1.RFL8 7324008SP
647 Red 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

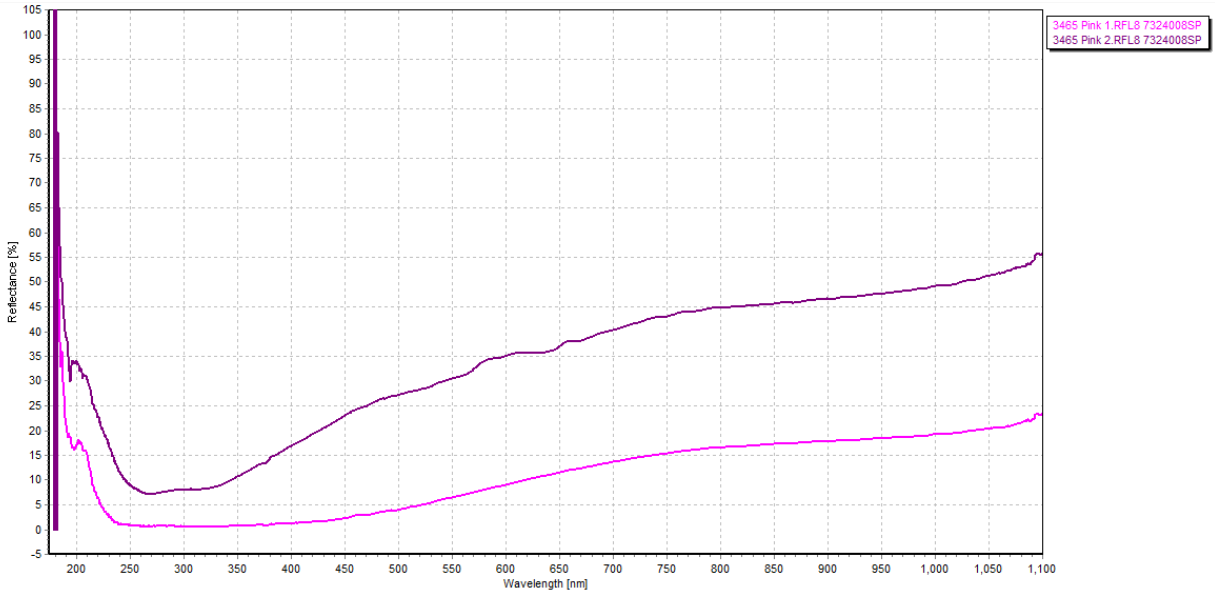

647 Yellow 1.RFL8 7324008SP
647 Yellow 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

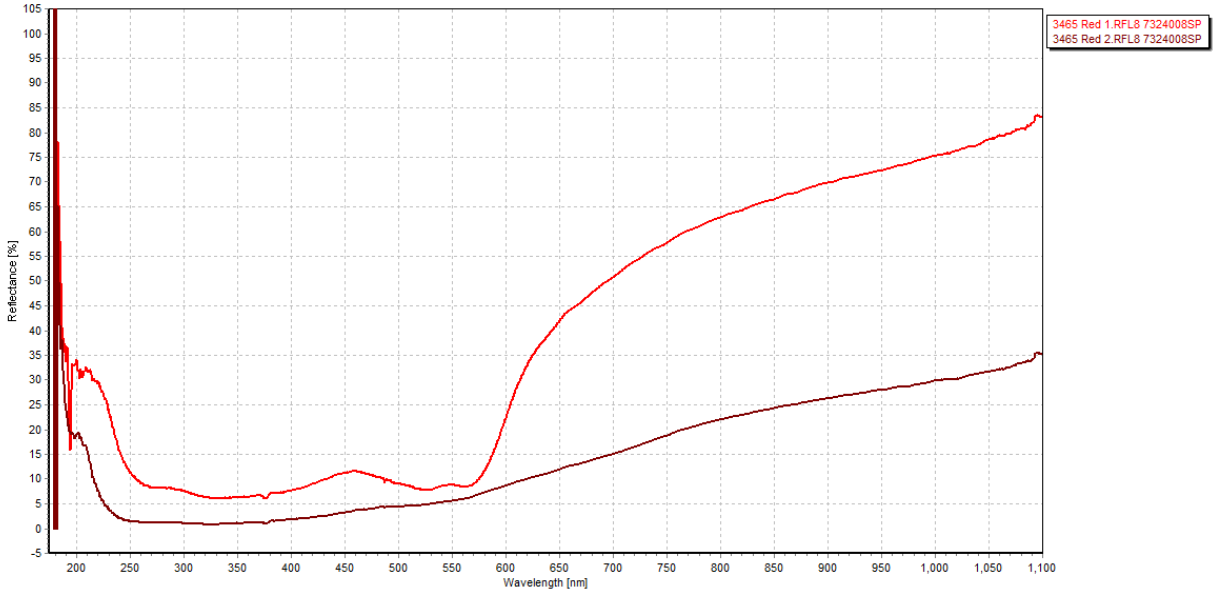
3465

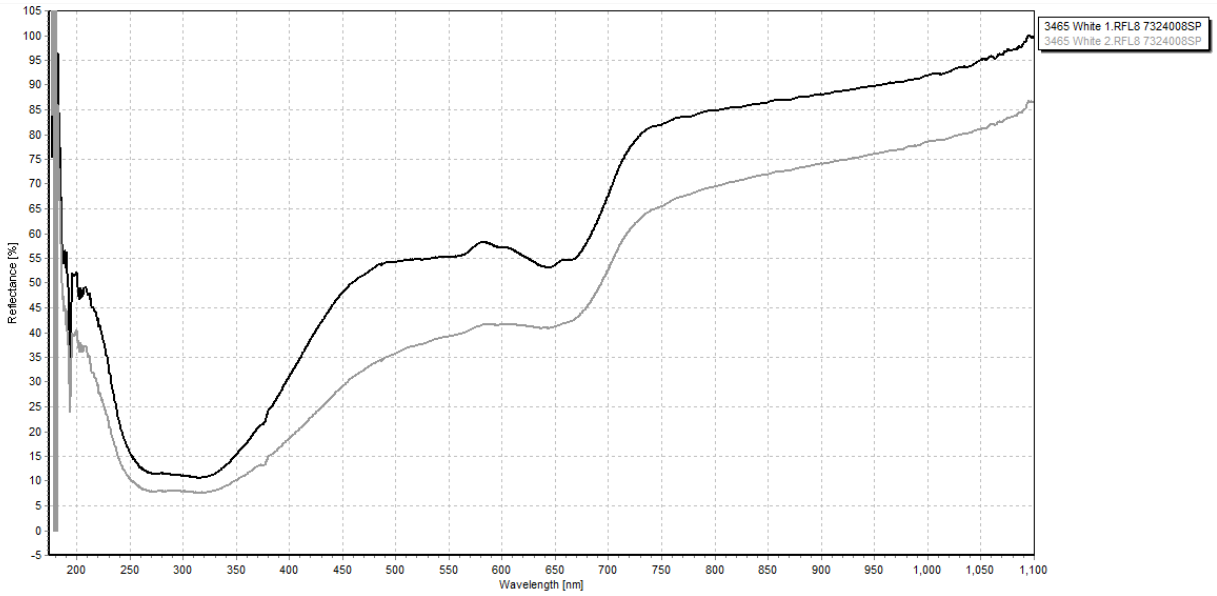

3465 Black 1.RFL8 7324008SP
3465 Black 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

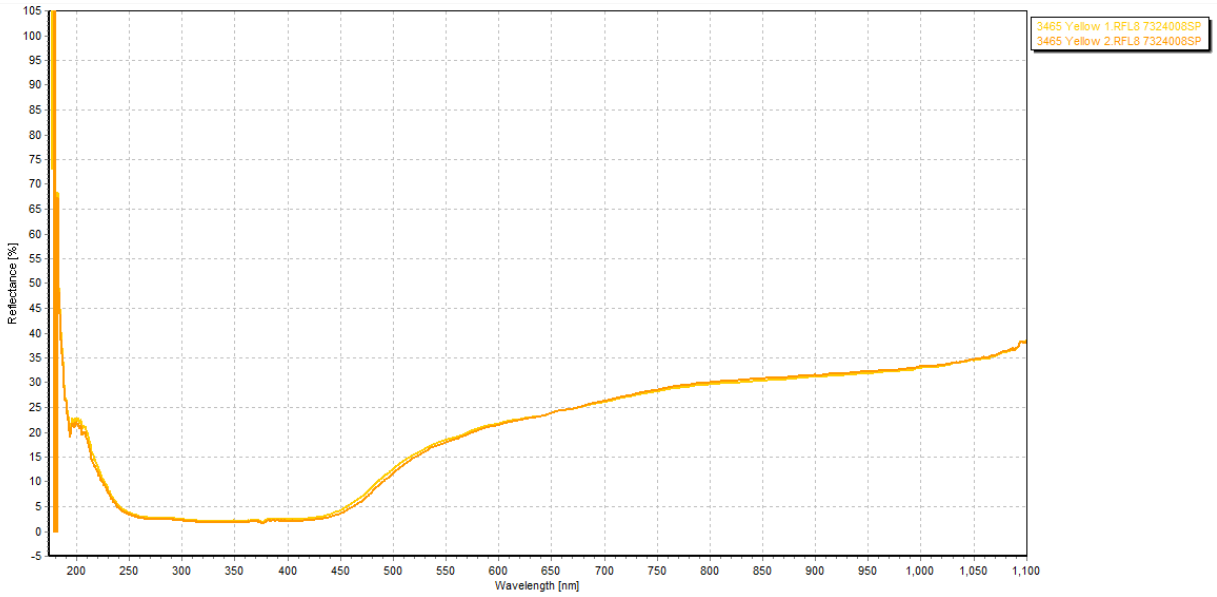

3465 Blue 1.RFL8 7324008SP
3465 Blue 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]


3465 Green 1.RFL8 7324008SP
3465 Green 2.RFL8 7324008SP
3465 Green 3.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

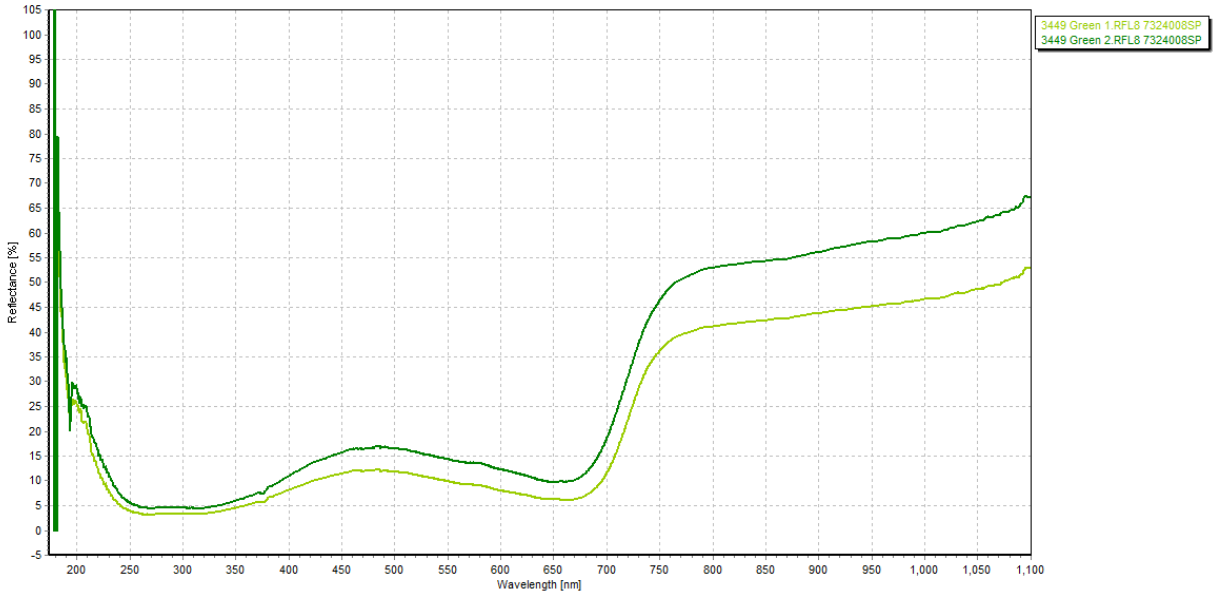

3465 Pink 1.RFL8 7324008SP
3465 Pink 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

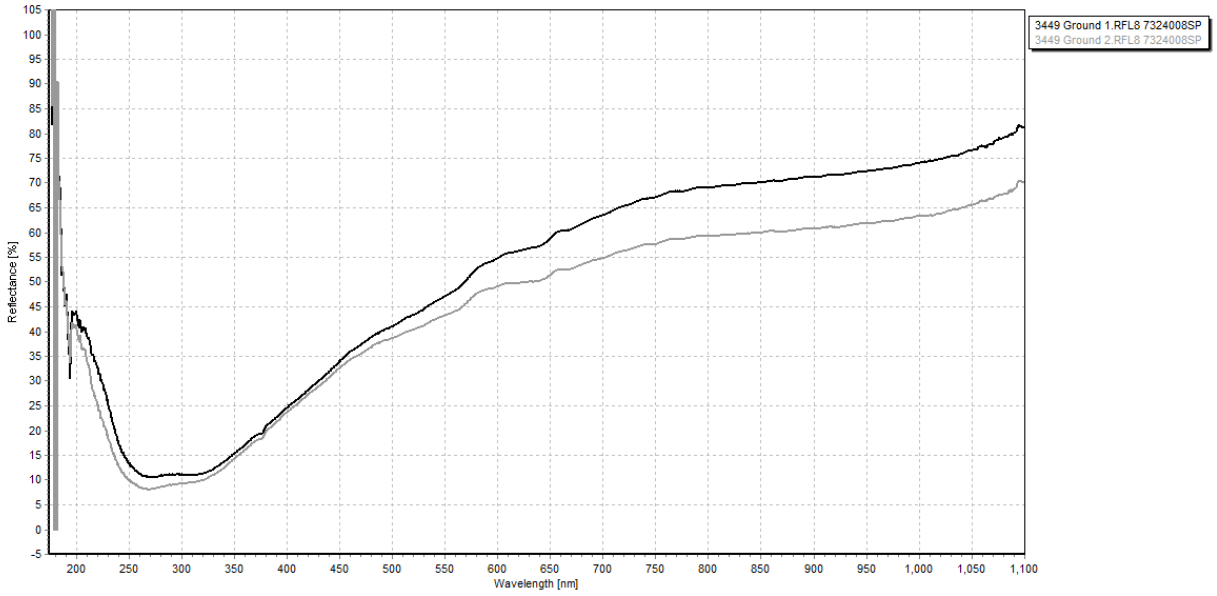

3465 Red 1.RFL8 7324008SP
3465 Red 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

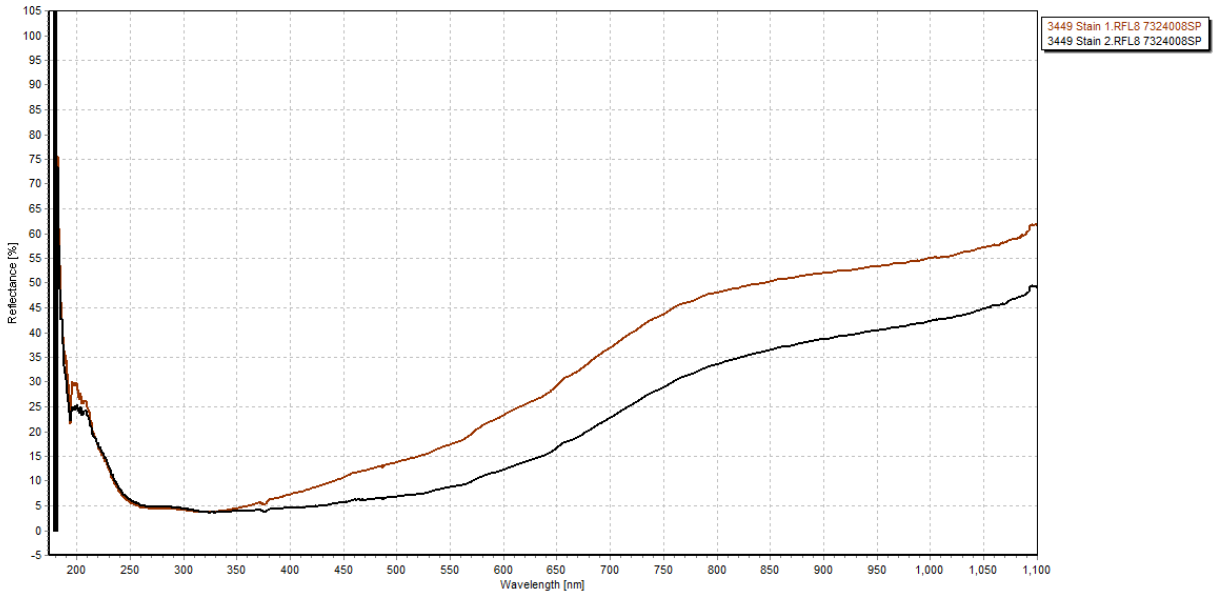

3465 White 1.RFL8 7324008SP
3465 White 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]


3465 Yellow 1.RFL8 7324008SP
3465 Yellow 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

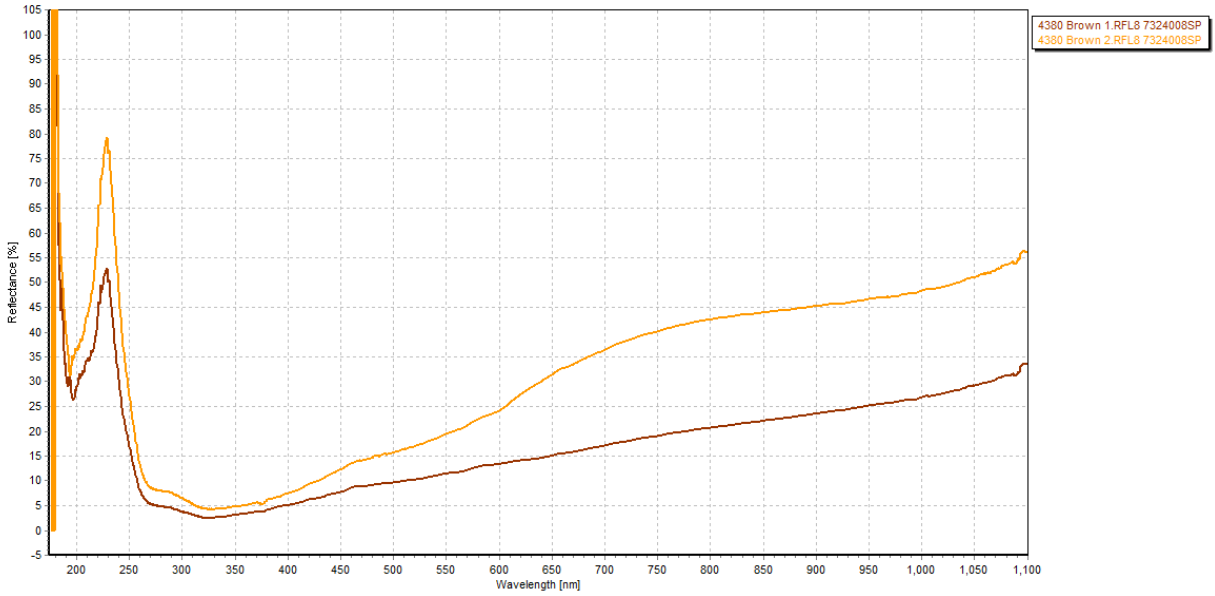
3449

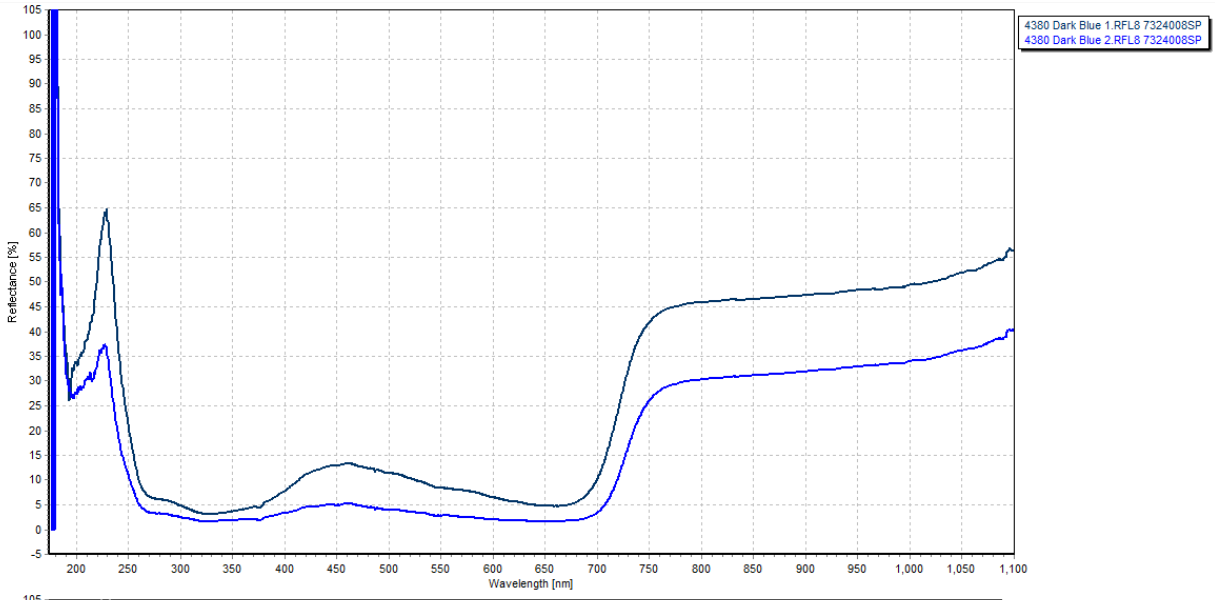

3449 Green 1.RFL8 7324008SP
3449 Green 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

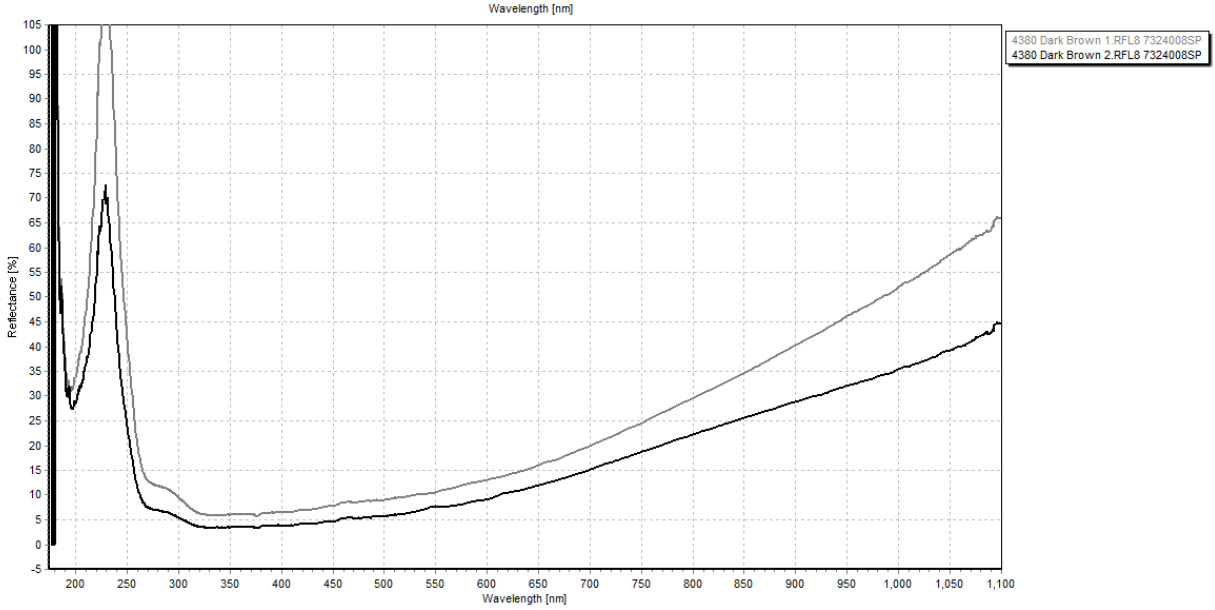

3449 Ground 1.RFL8 7324008SP
3449 Ground 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

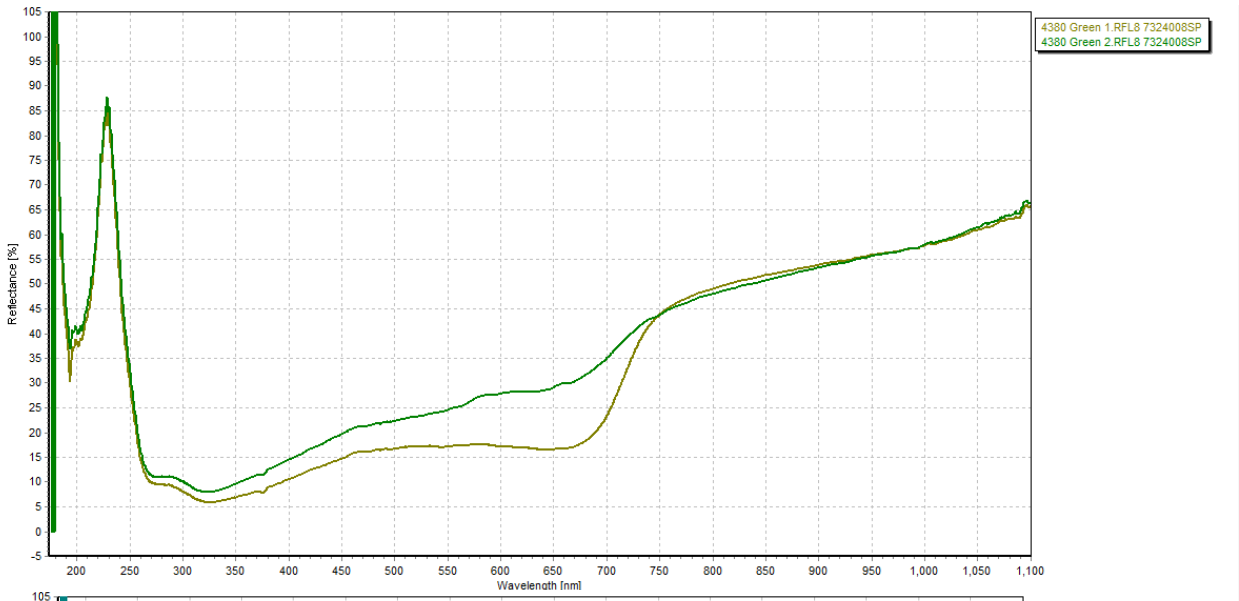

3449 Stain 1.RFL8 7324008SP
3449 Stain 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

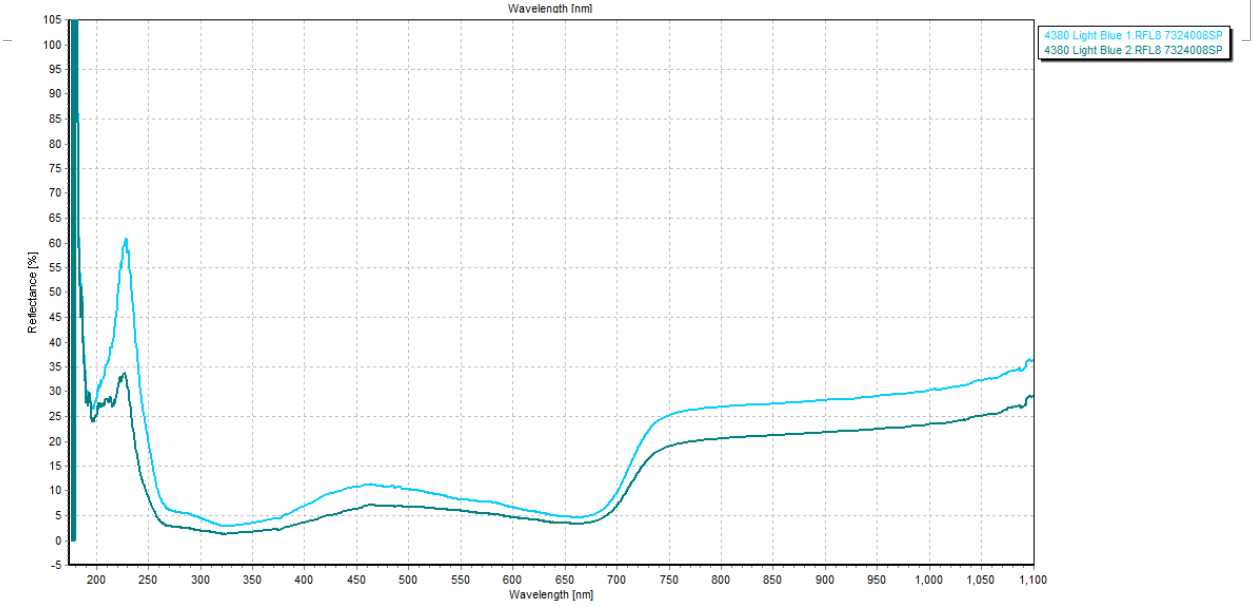
4380

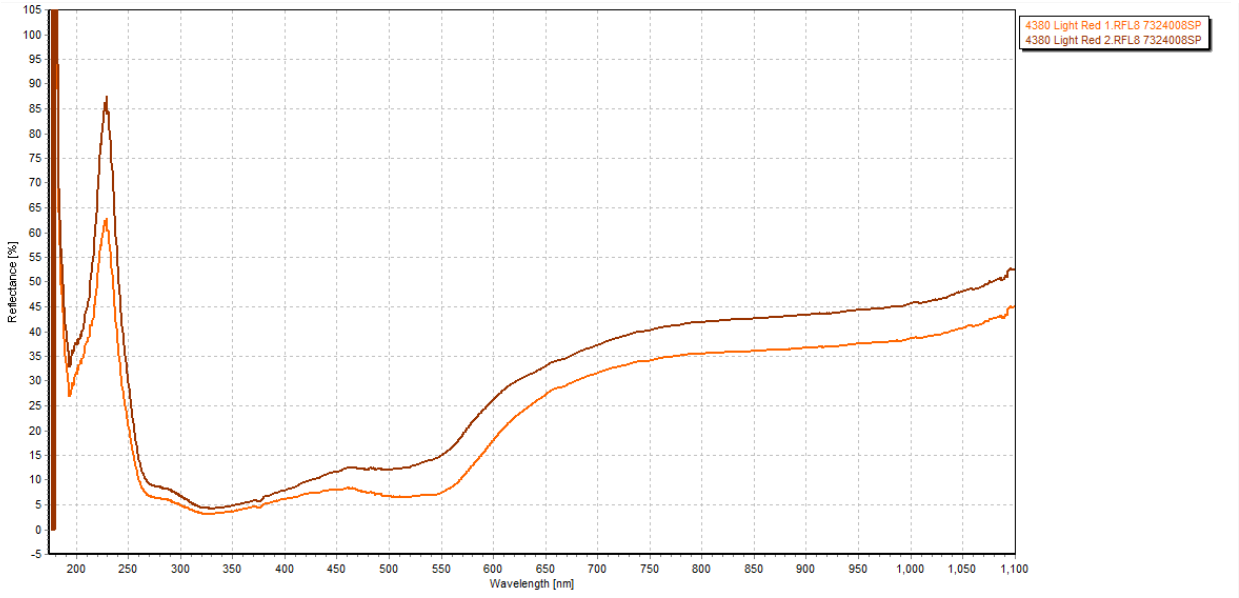

4380 Brown 1.RFL8 7324008SP
4380 Brown 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

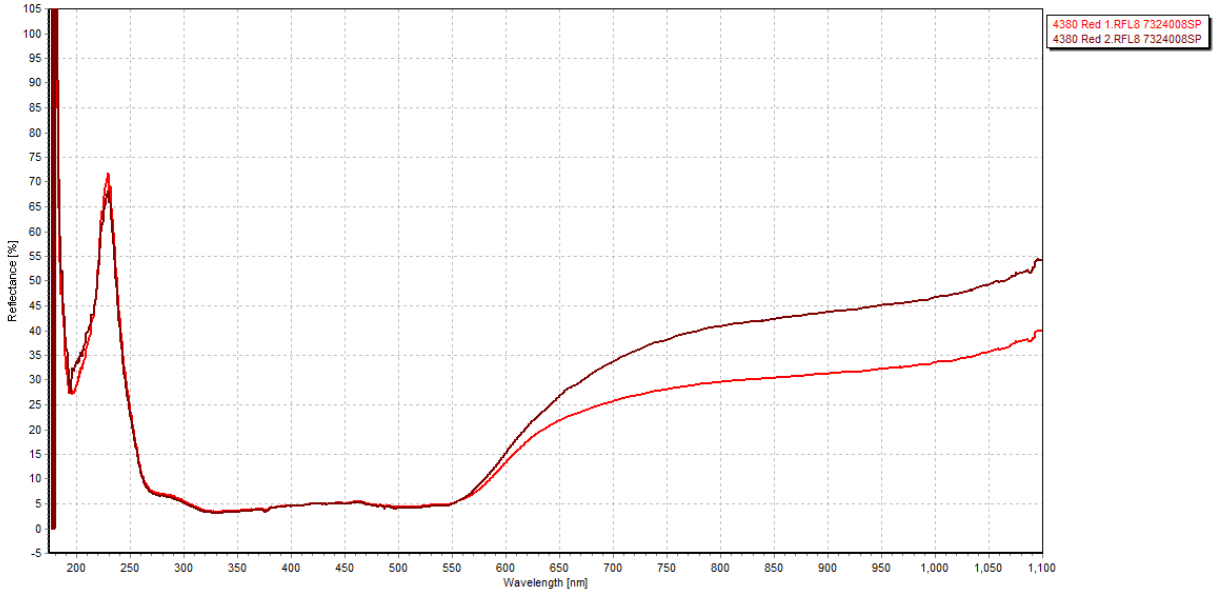

4380 Dark Blue 1.RFL8 7324008SP
4380 Dark Blue 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

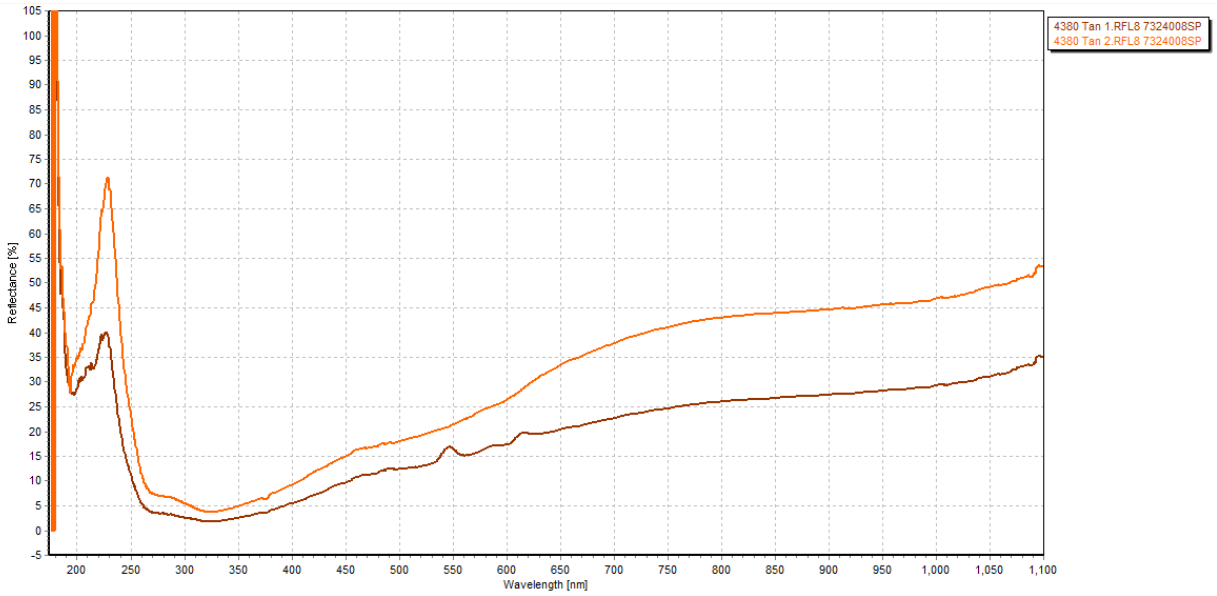

4380 Dark Brown 1.RFL8 7324008SP
4380 Dark Brown 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

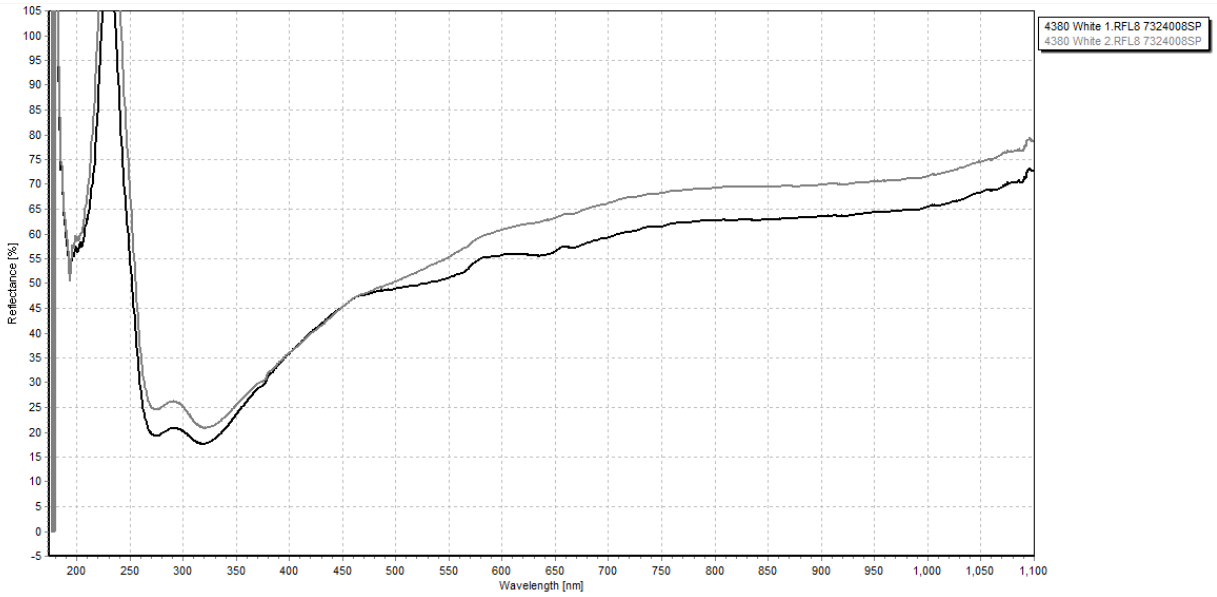

4380 Green 1.RFL8 7324008SP
4380 Green 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

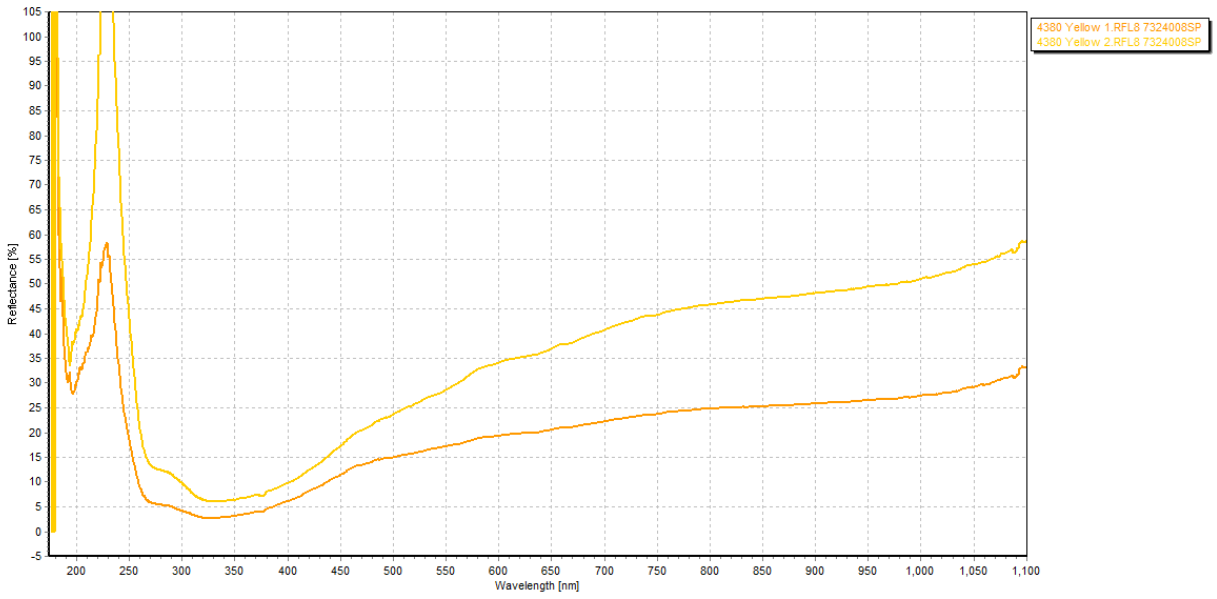

4380 Light Blue 1.RFL8 7324008SP
4380 Light Blue 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]


4380 Light Red 1.RFL8 7324008SP
4380 Light Red 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

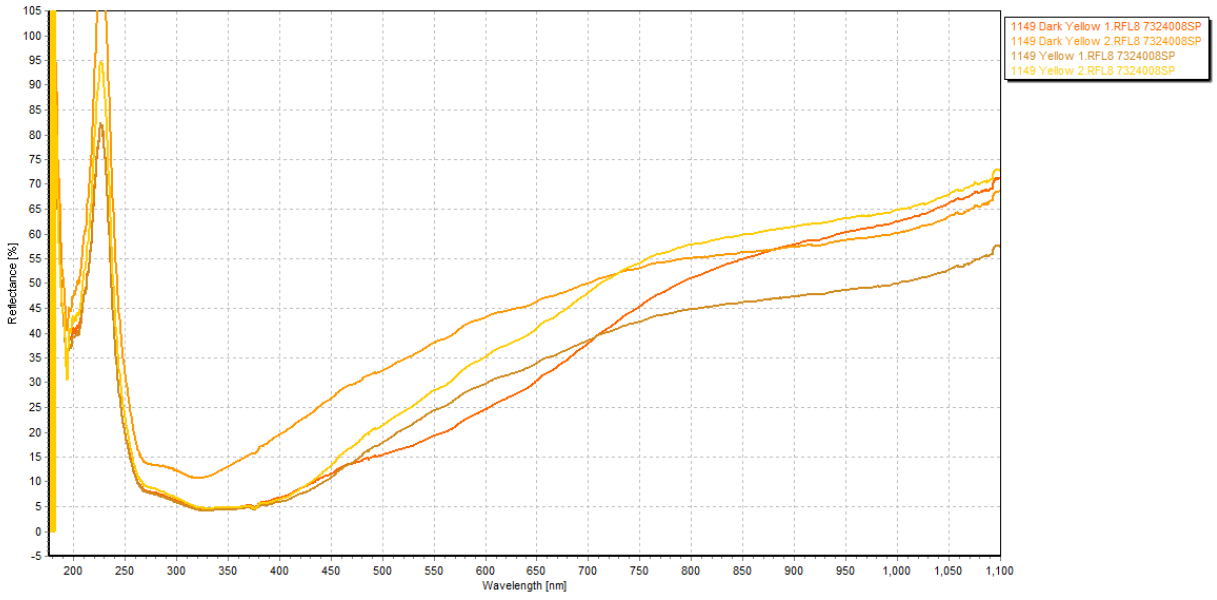

4380 Red 1.RFL8 7324008SP
4380 Red 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

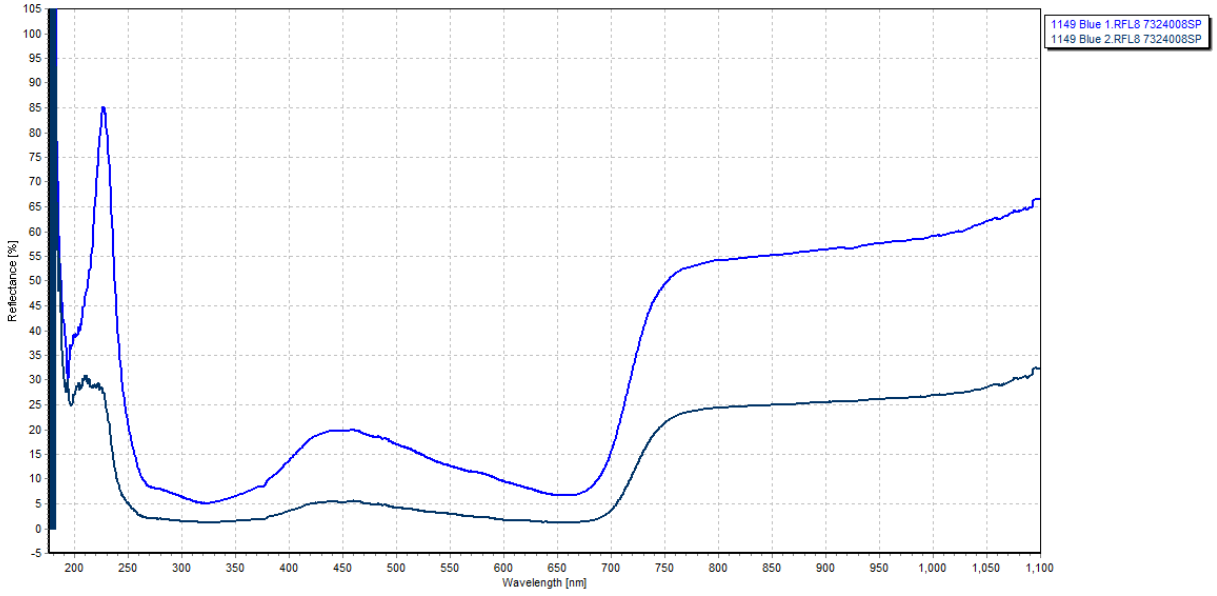

4380 Tan 1.RFL8 7324008SP
4380 Tan 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

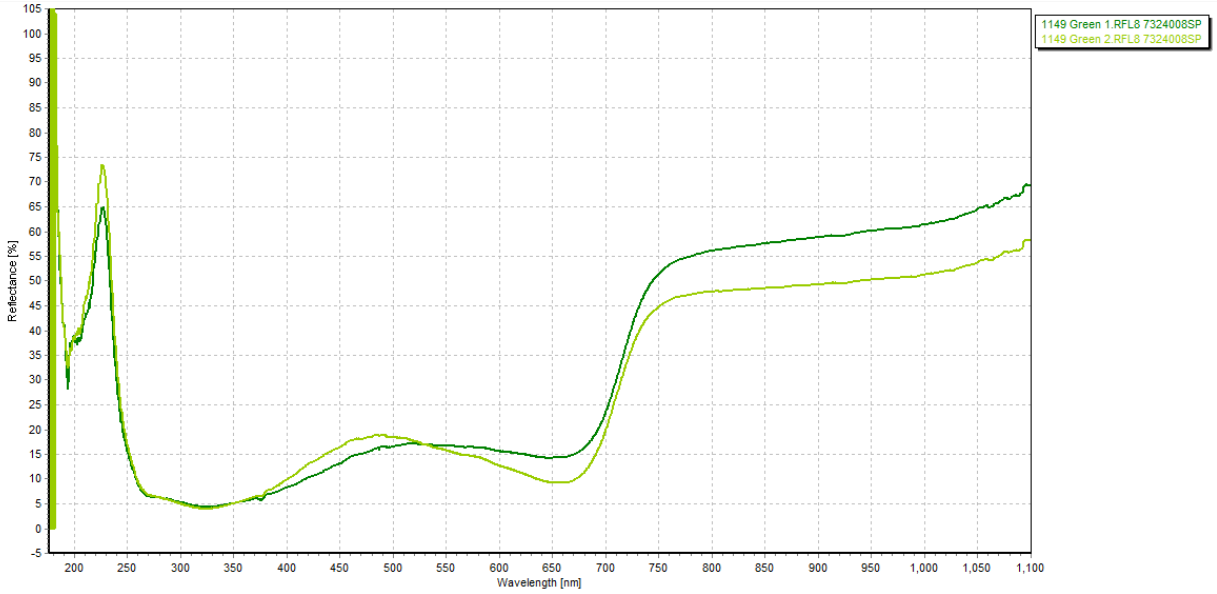

4380 White 1.RFL8 7324008SP
4380 White 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

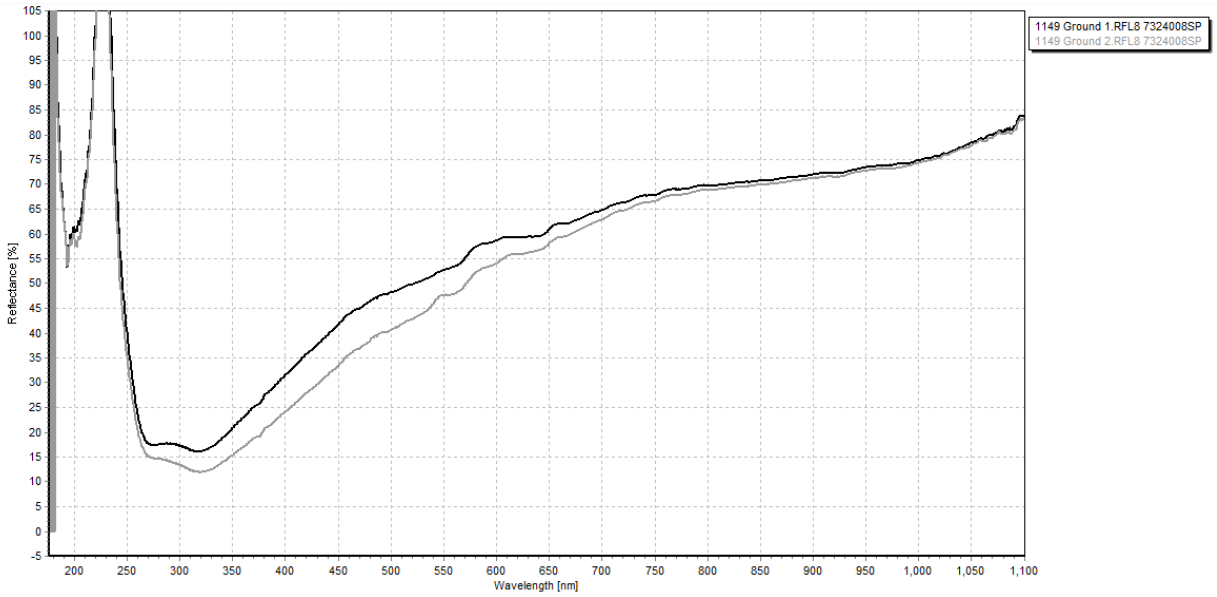

4380 Yellow 1.RFL8 7324008SP
4380 Yellow 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

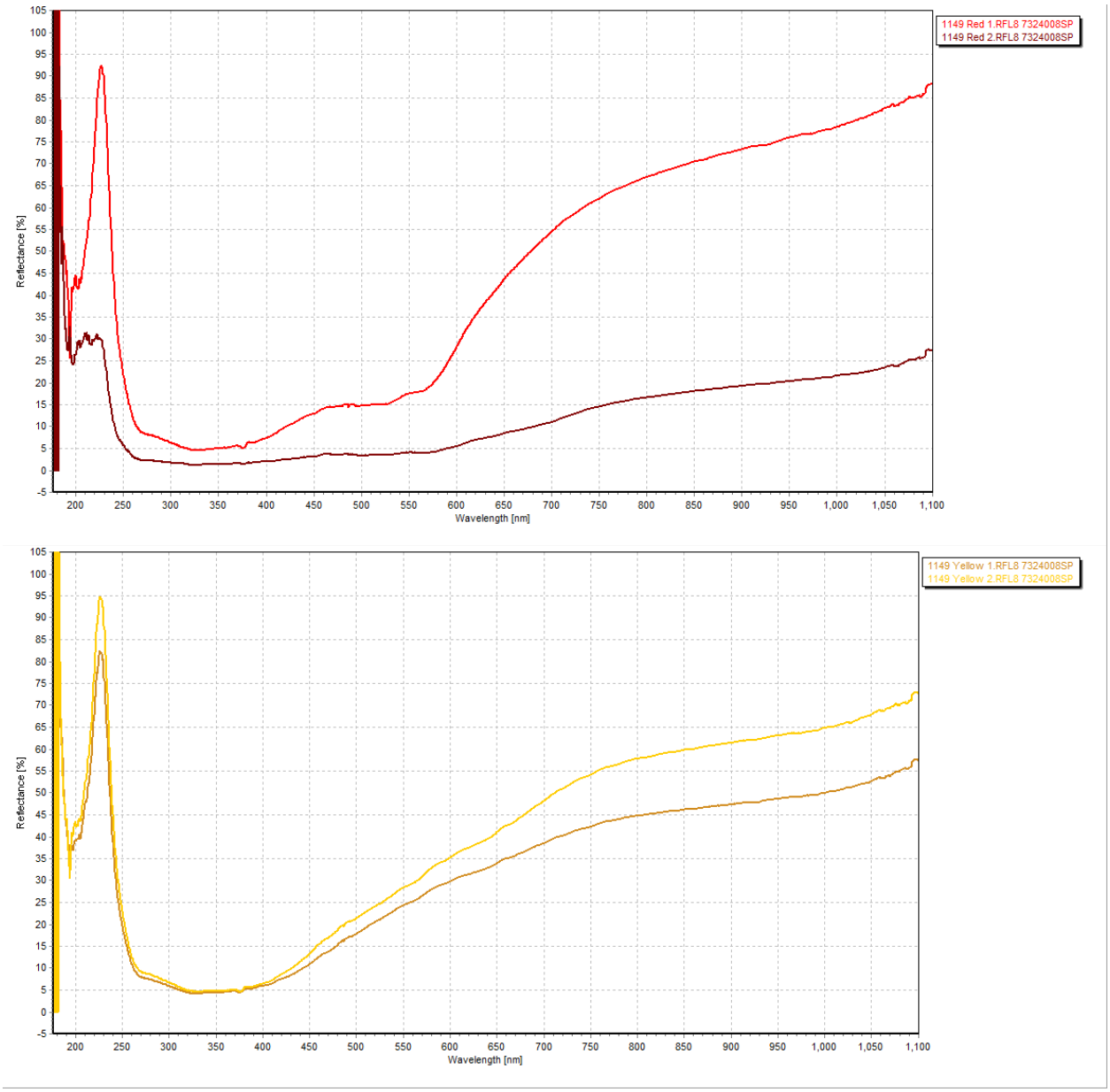
1149


1149 Dark Yellow 1.RFL8 7324008SP
1149 Dark Yellow 2.RFL8 7324008SP
1149 Yellow 1.RFL8 7324008SP
1149 Yellow 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

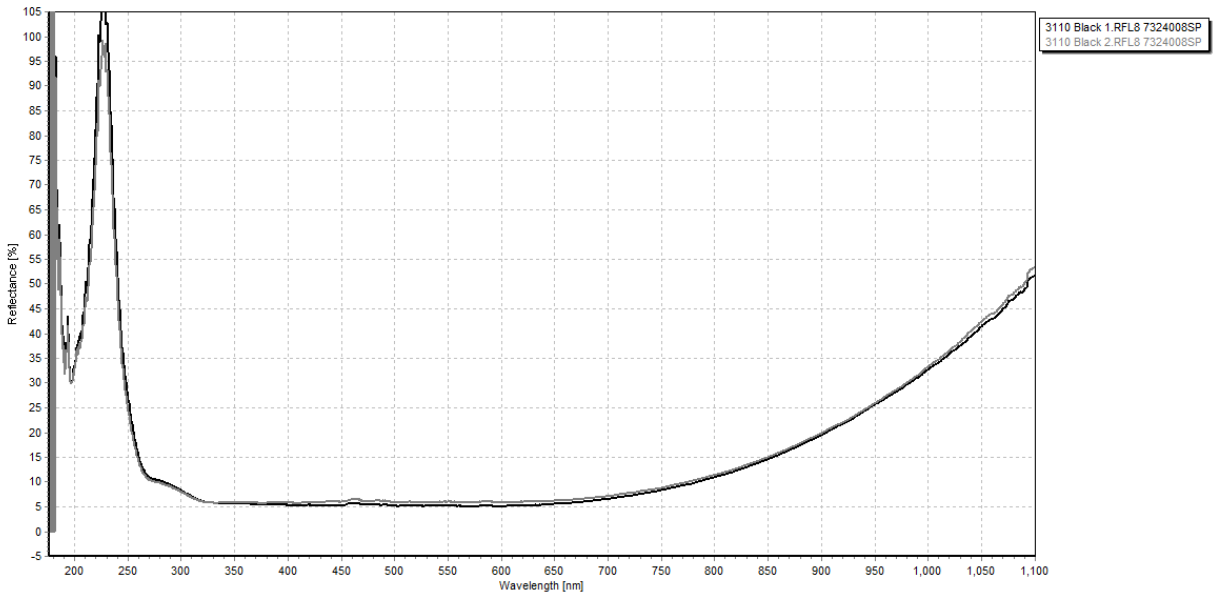

1149 Blue 1.RFL8 7324008SP
1149 Blue 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

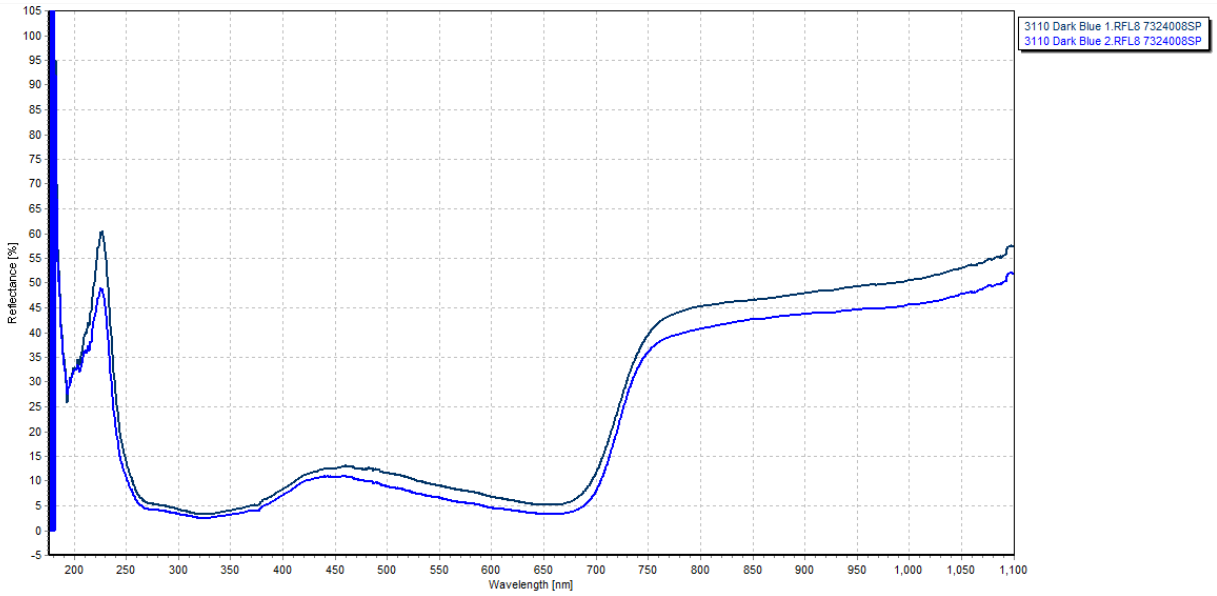

1149 Green 1.RFL8 7324008SP
1149 Green 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

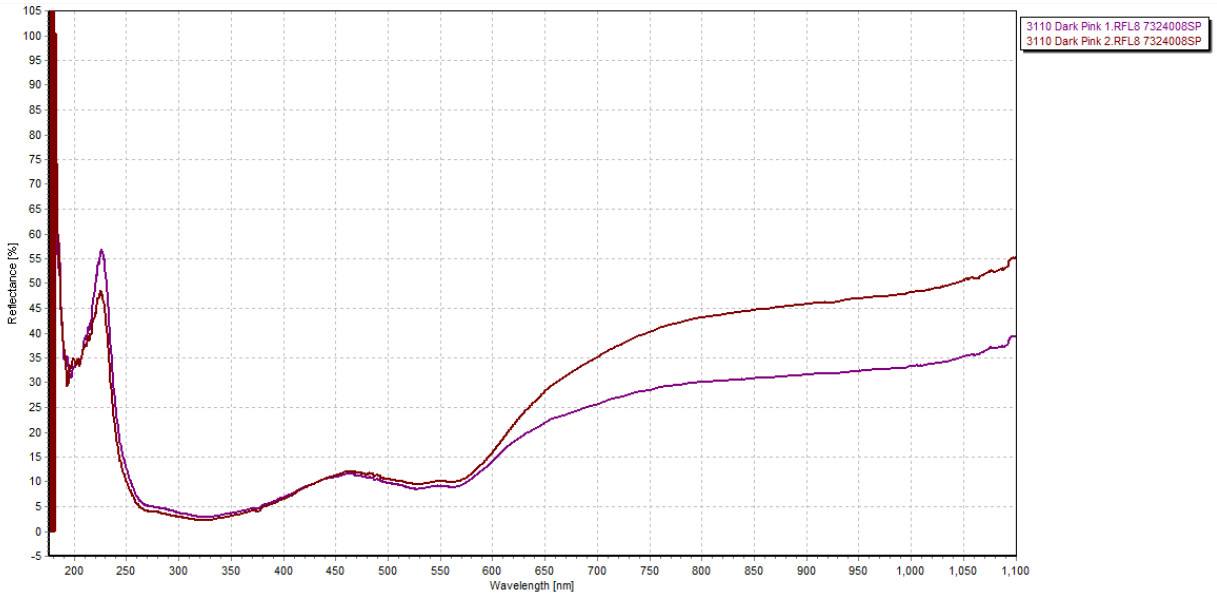

1149 Ground 1.RFL8 7324008SP
1149 Ground 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

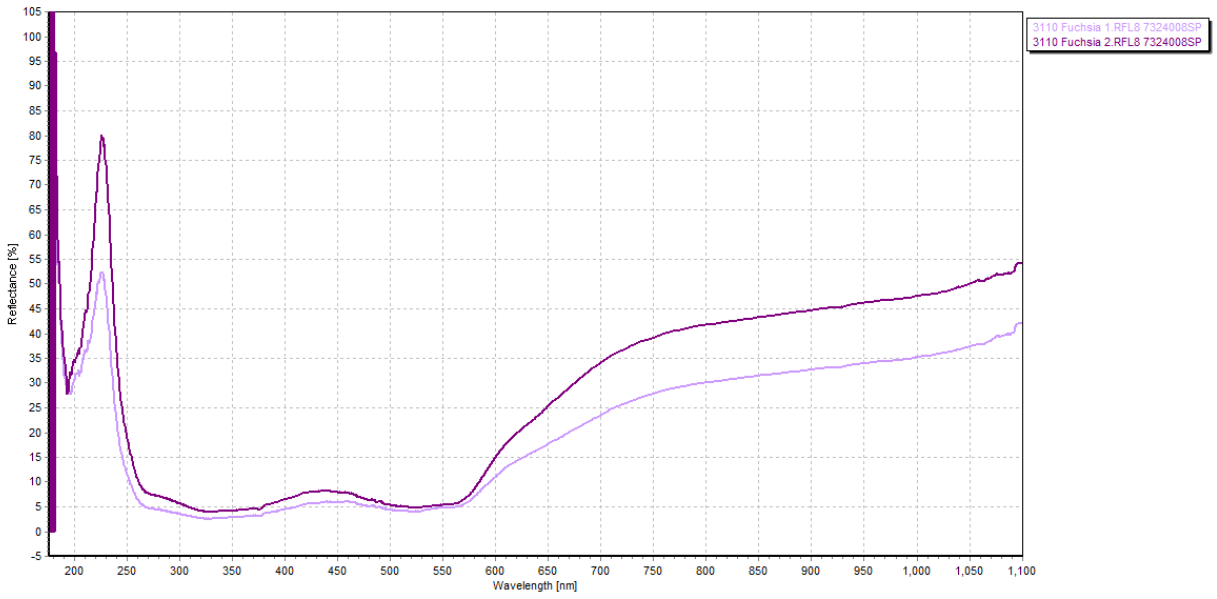

1149 Red 1.RFL8 7324008SP
1149 Red 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]
1149 Yellow 1.RFL8 7324008SP
1149 Yellow 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

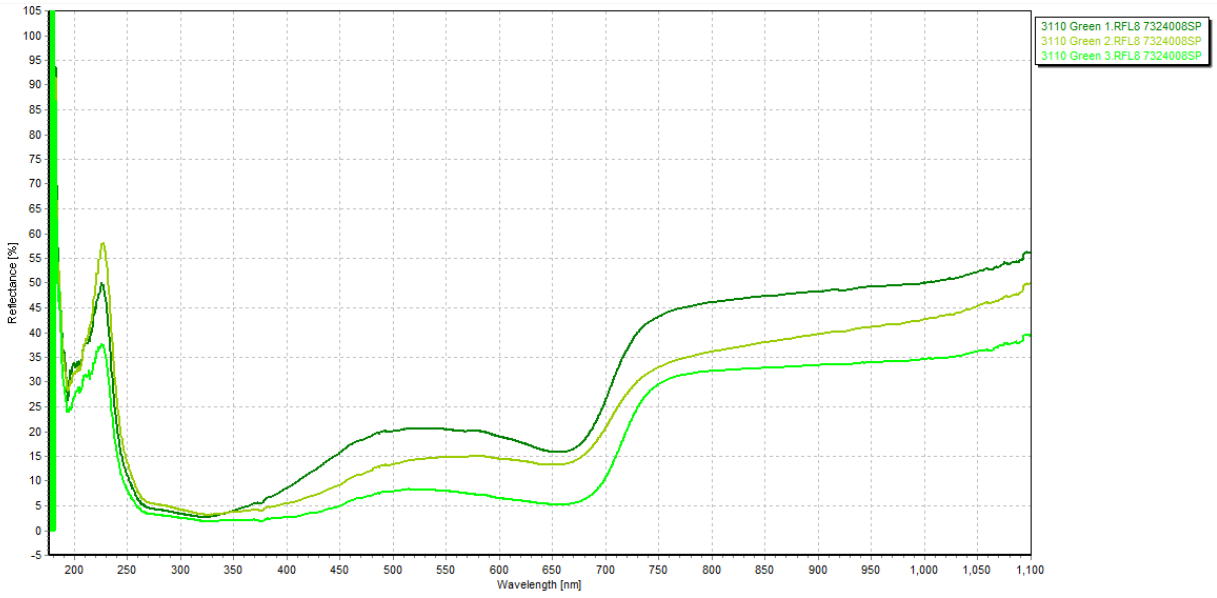
3110

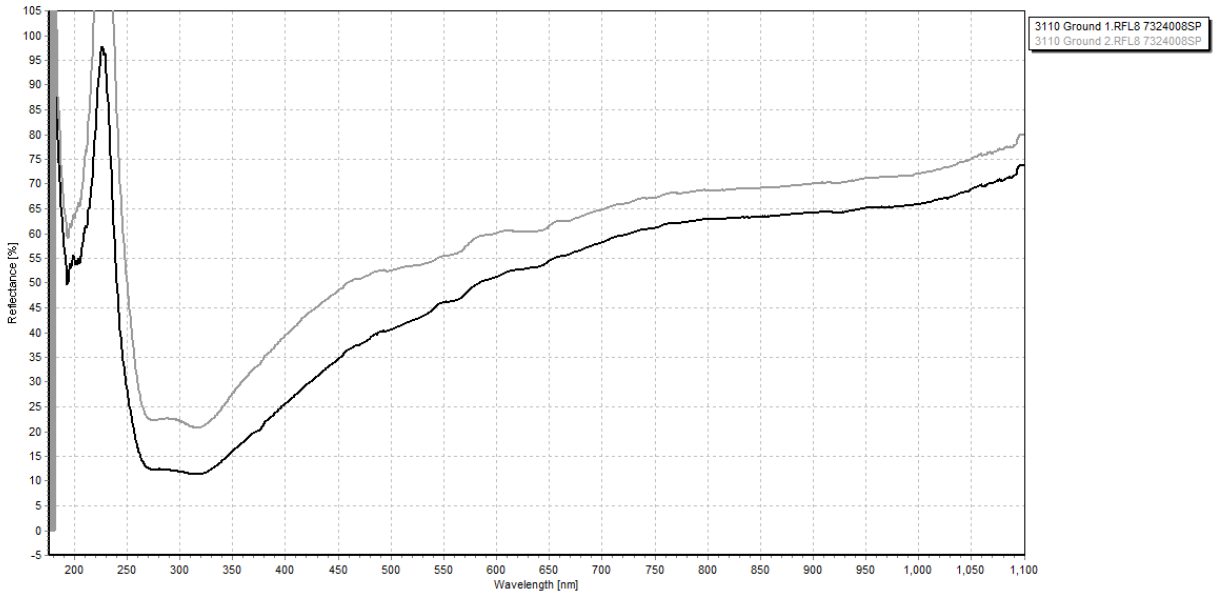

3110 Black 1.RFL8 7324008SP
3110 Black 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

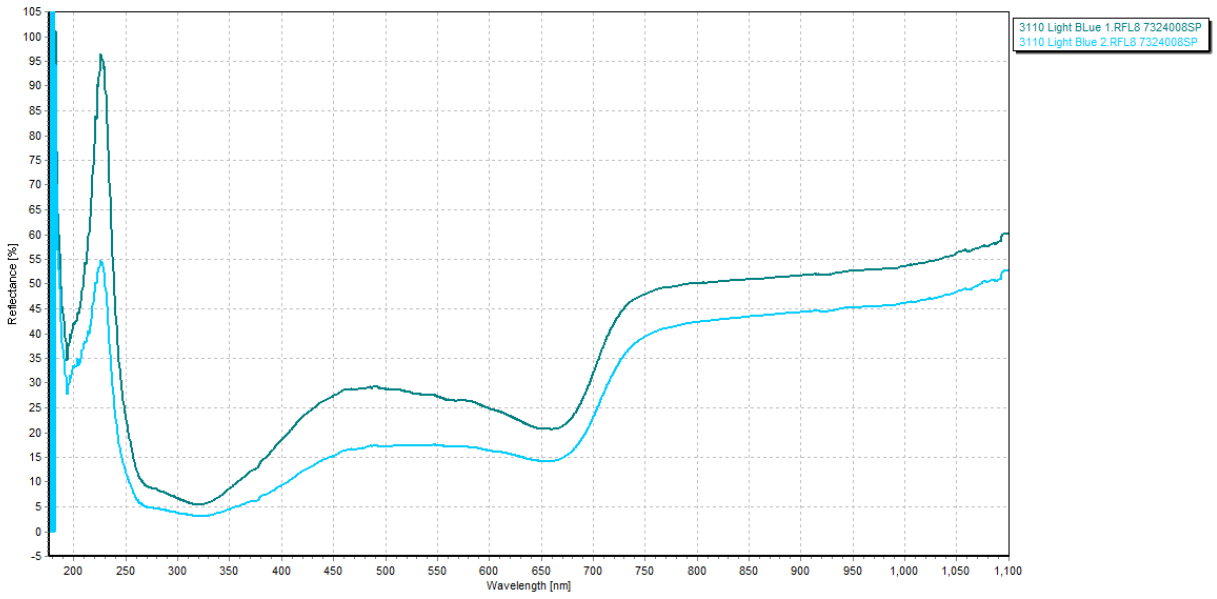

3110 Dark Blue 1.RFL8 7324008SP
3110 Dark Blue 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

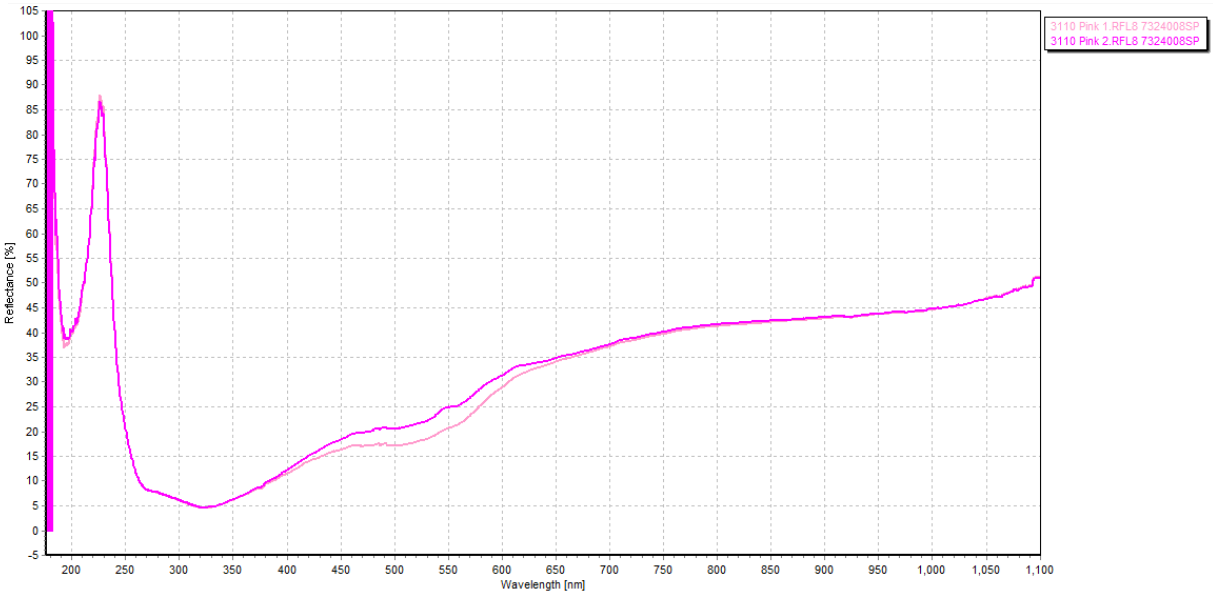

3110 Dark Pink 1.RFL8 7324008SP
3110 Dark Pink 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

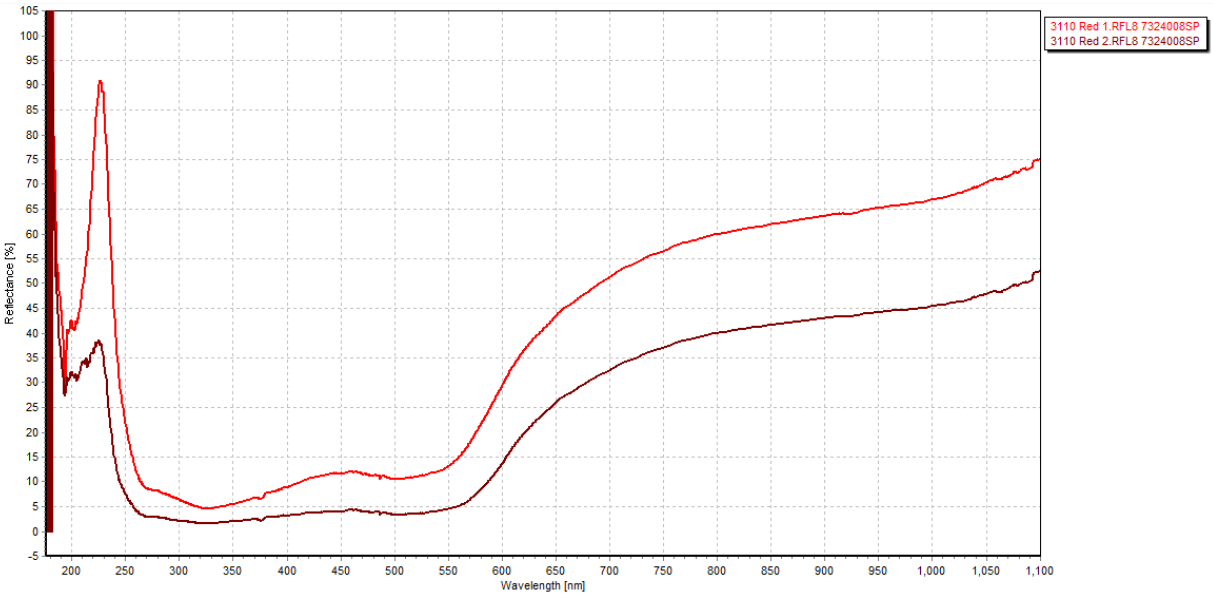

3110 Fuchsia 1.RFL8 7324008SP
3110 Fuchsia 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

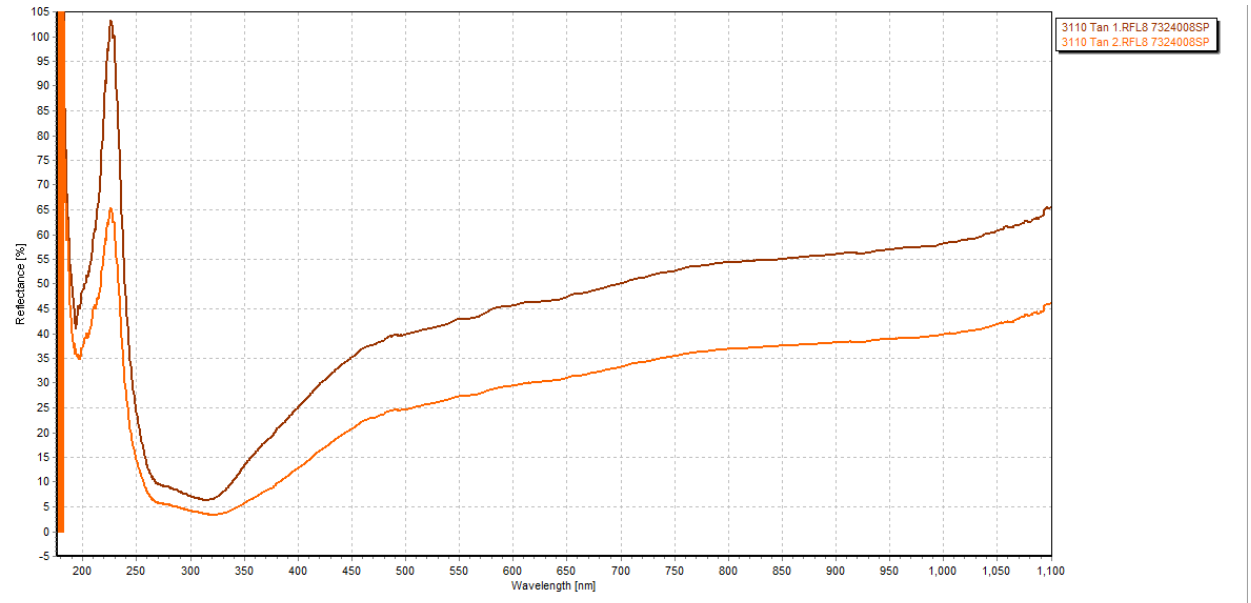

3110 Green 1.RFL8 7324008SP
3110 Green 2.RFL8 7324008SP
3110 Green 3.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

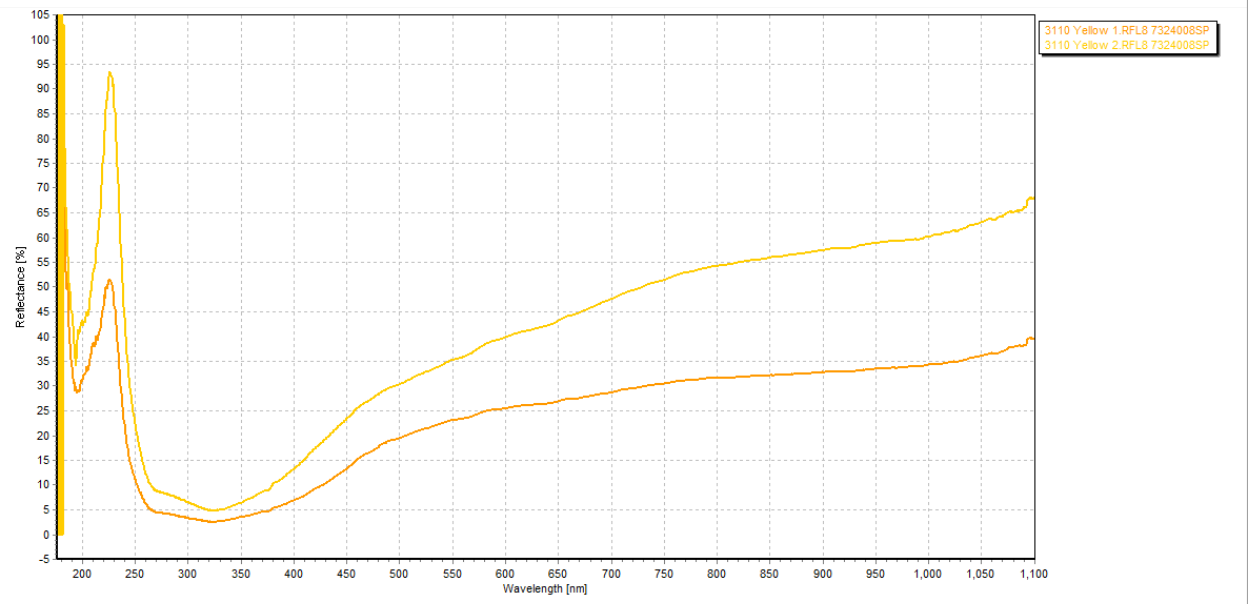

3110 Ground 1.RFL8 7324008SP
3110 Ground 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]


3110 Light BLue 1.RFL8 7324008SP
3110 Light Blue 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

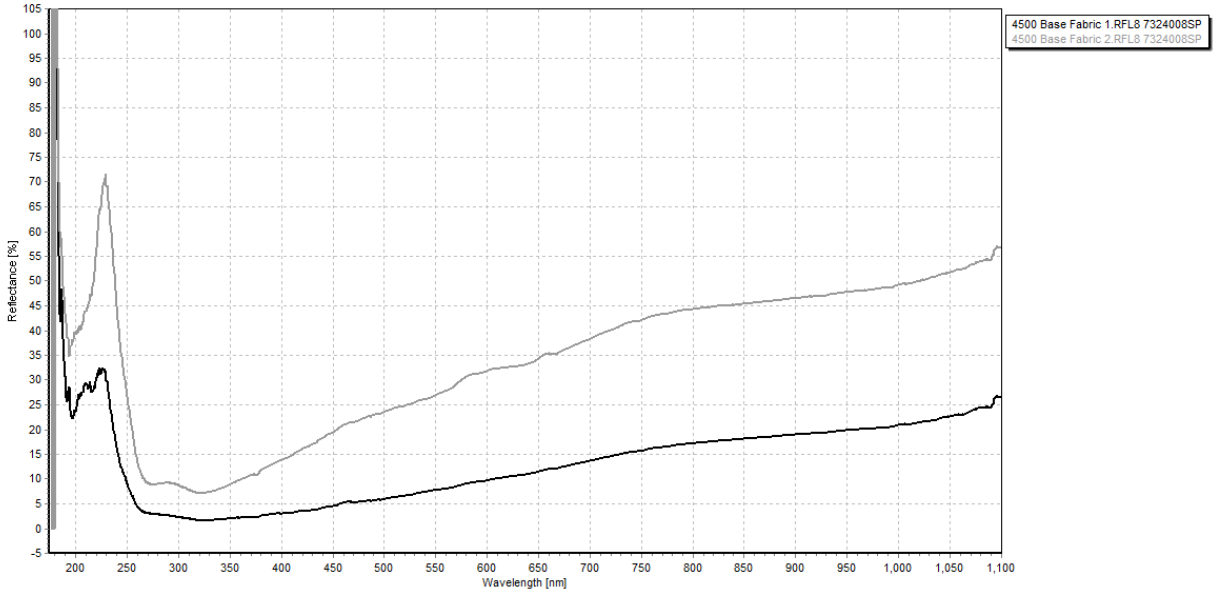

3110 Pink 1.RFL8 7324008SP
3110 Pink 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

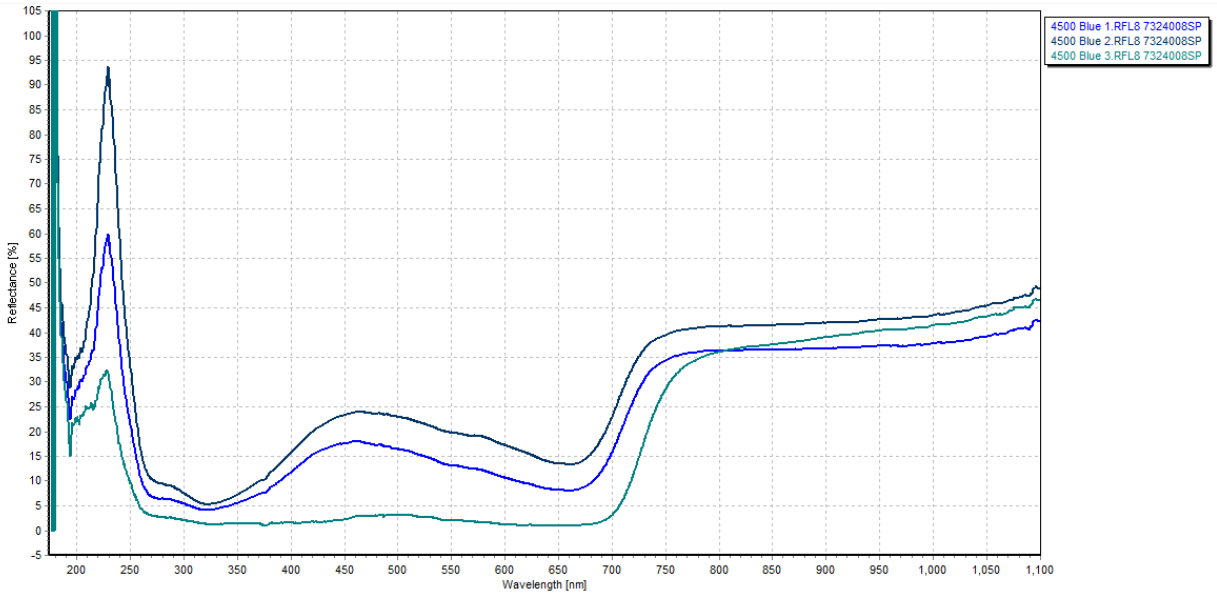

3110 Red 1.RFL8 7324008SP
3110 Red 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

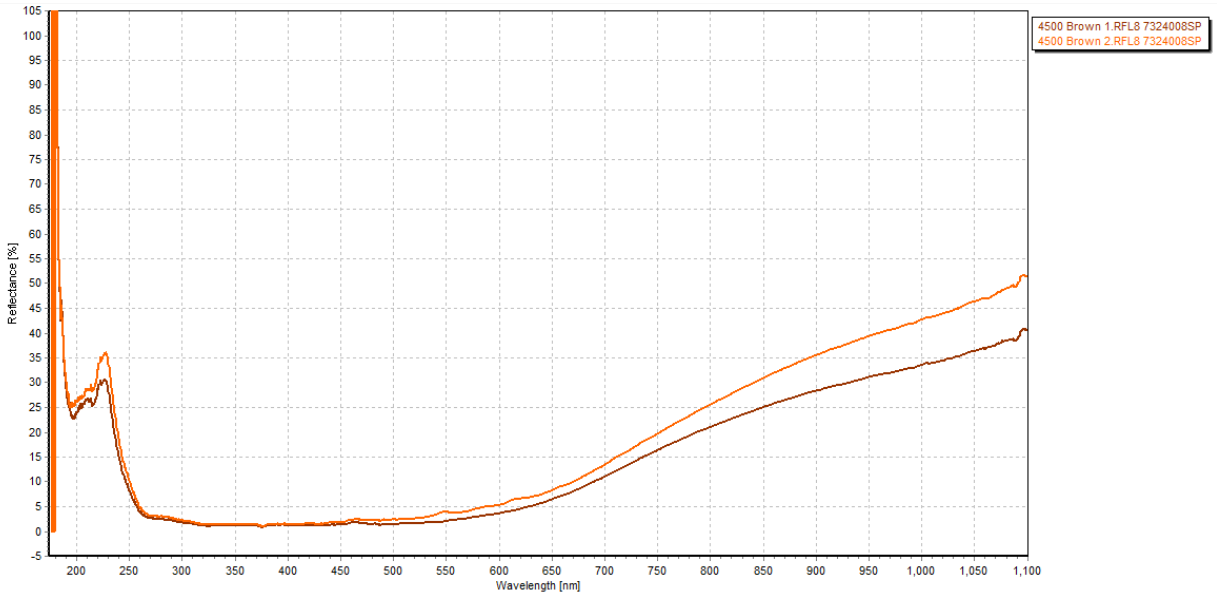

3110 Tan 1.RFL8 7324008SP
3110 Tan 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

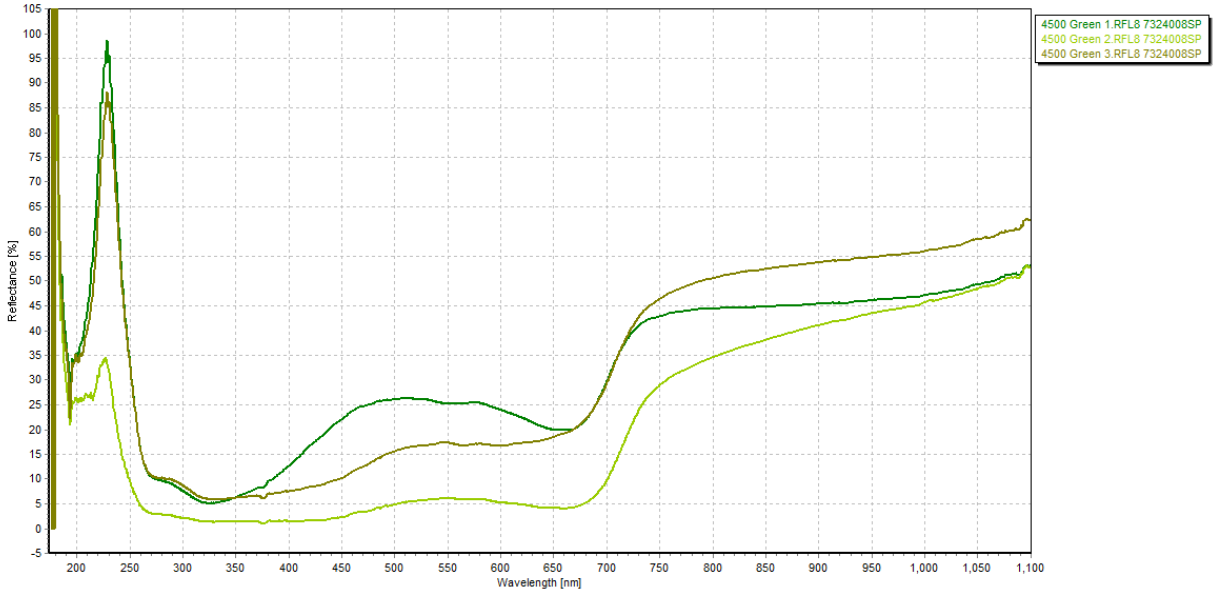

3110 Yellow 1.RFL8 7324008SP
3110 Yellow 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

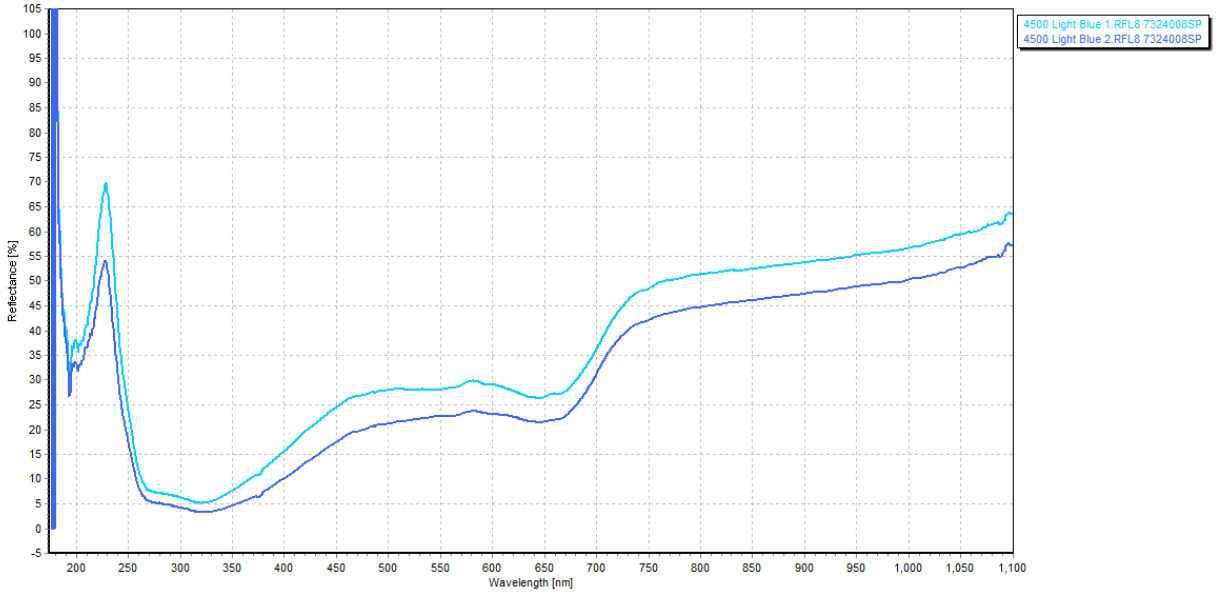
4500

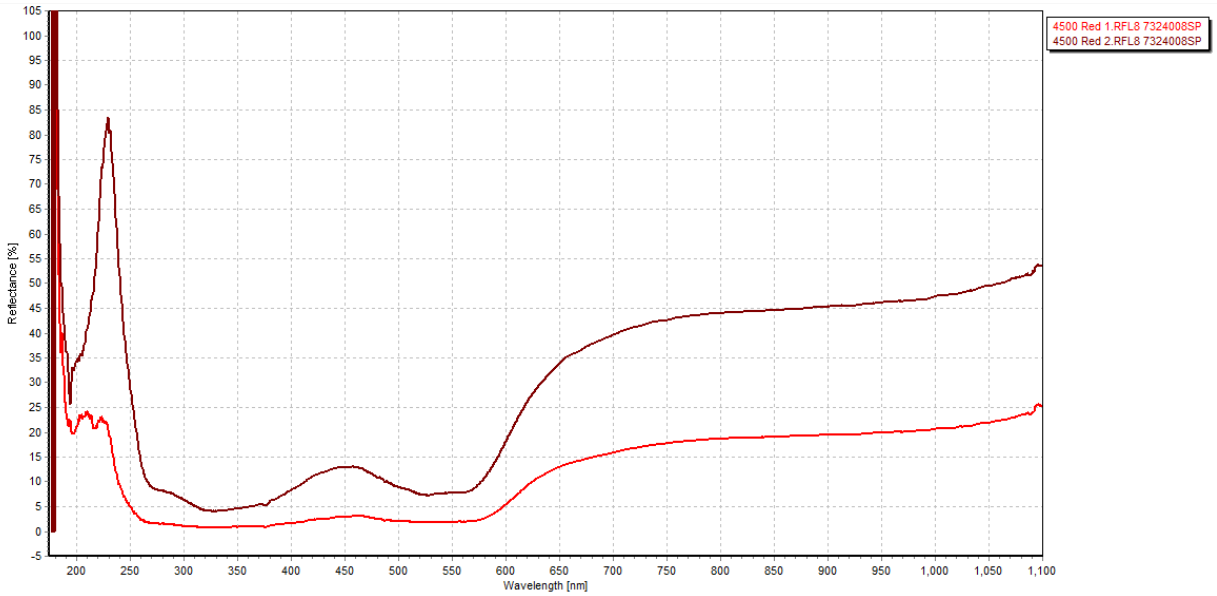

4500 Base Fabric 1.RFL8 7324008SP
4500 Base Fabric 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

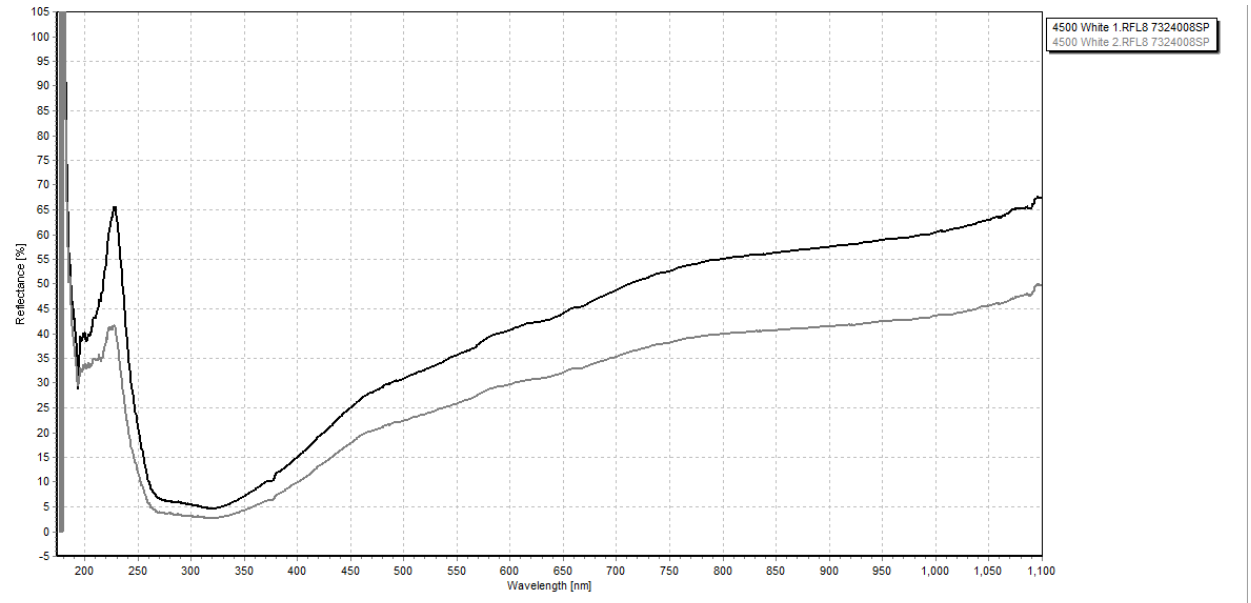

4500 Blue 1.RFL8 7324008SP
4500 Blue 2.RFL8 7324008SP
4500 Blue 3.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

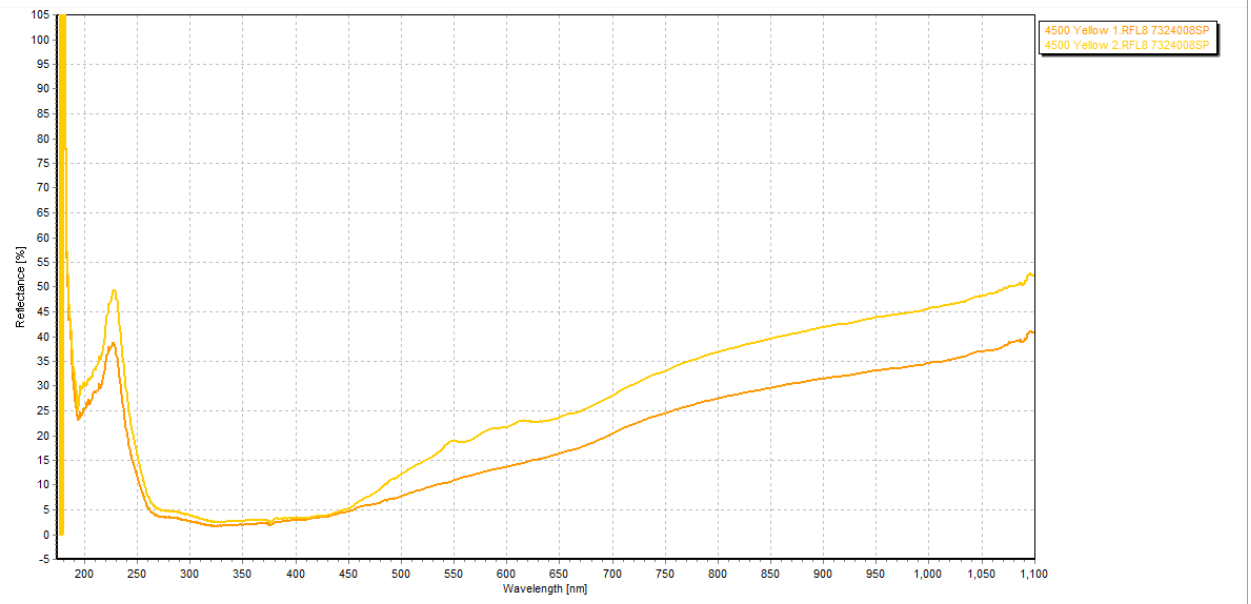

4500 Brown 1.RFL8 7324008SP
4500 Brown 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]


4500 Green 1.RFL8 7324008SP
4500 Green 2.RFL8 7324008SP
4500 Green 3.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

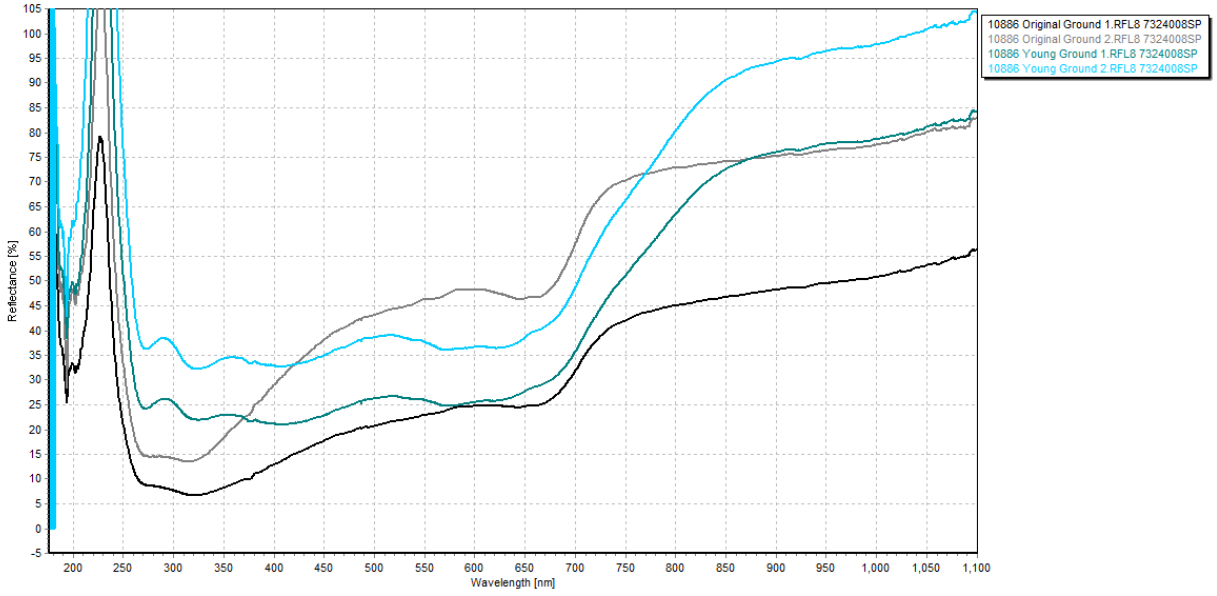

4500 Light Blue 1.RFL8 7324008SP
4500 Light Blue 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

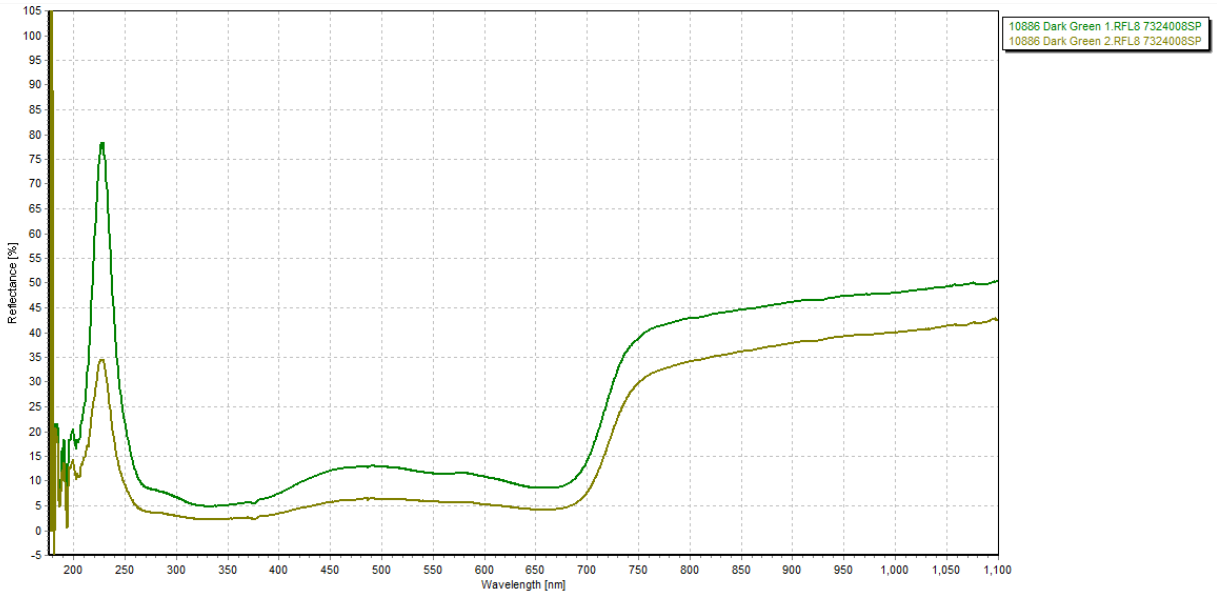

4500 Red 1.RFL8 7324008SP
4500 Red 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

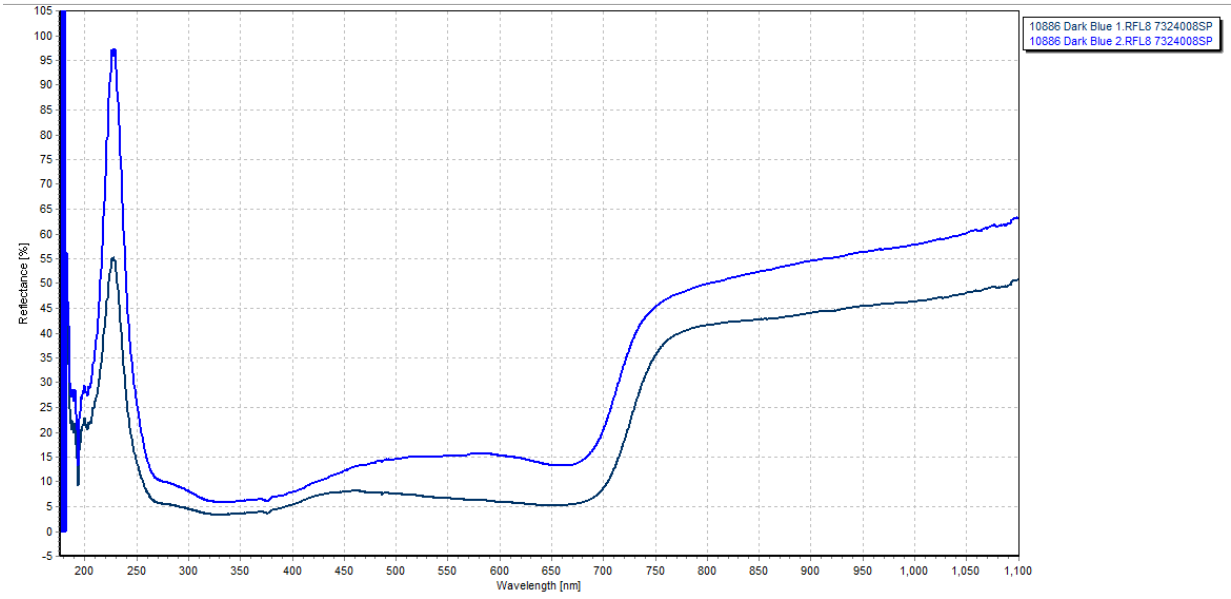

4500 White 1.RFL8 7324008SP
4500 White 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

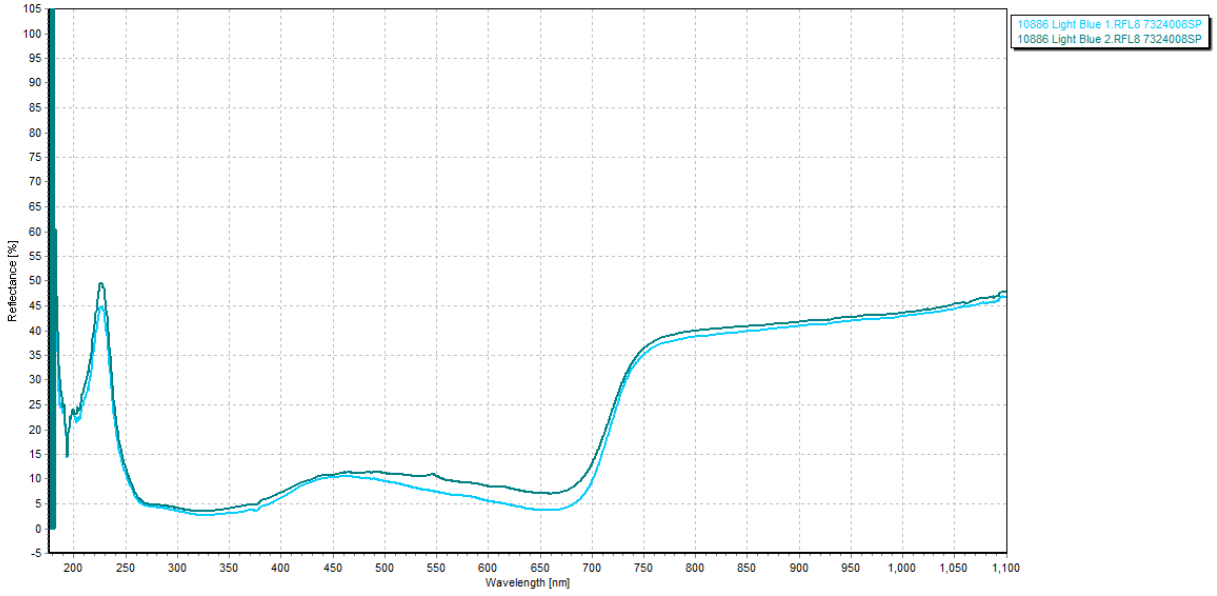

4500 Yellow 1.RFL8 7324008SP
4500 Yellow 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

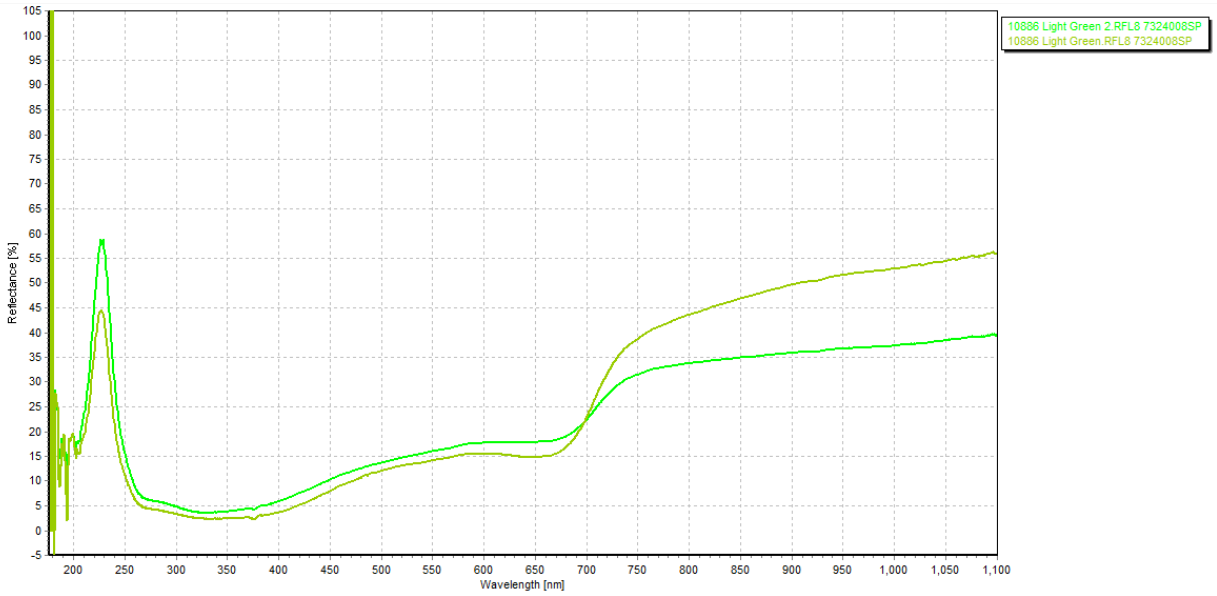
10866

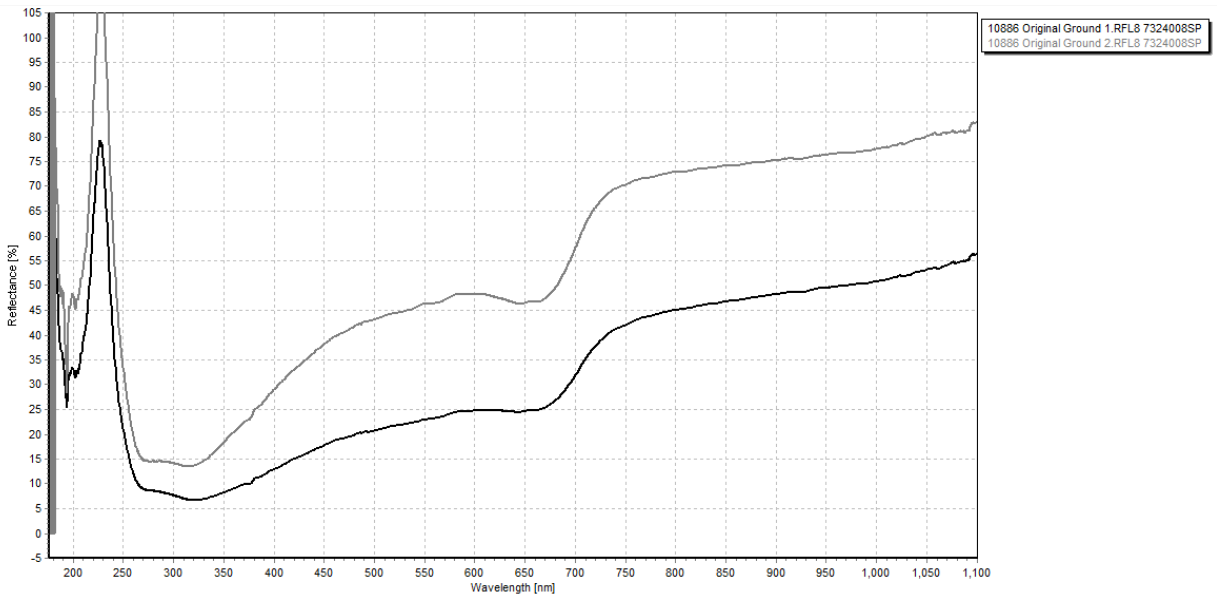

10886 Original Ground 1.RFL8 7324008SP
10886 Original Ground 2.RFL8 7324008SP
10886 Young Ground 1.RFL8 7324008SP
10886 Young Ground 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

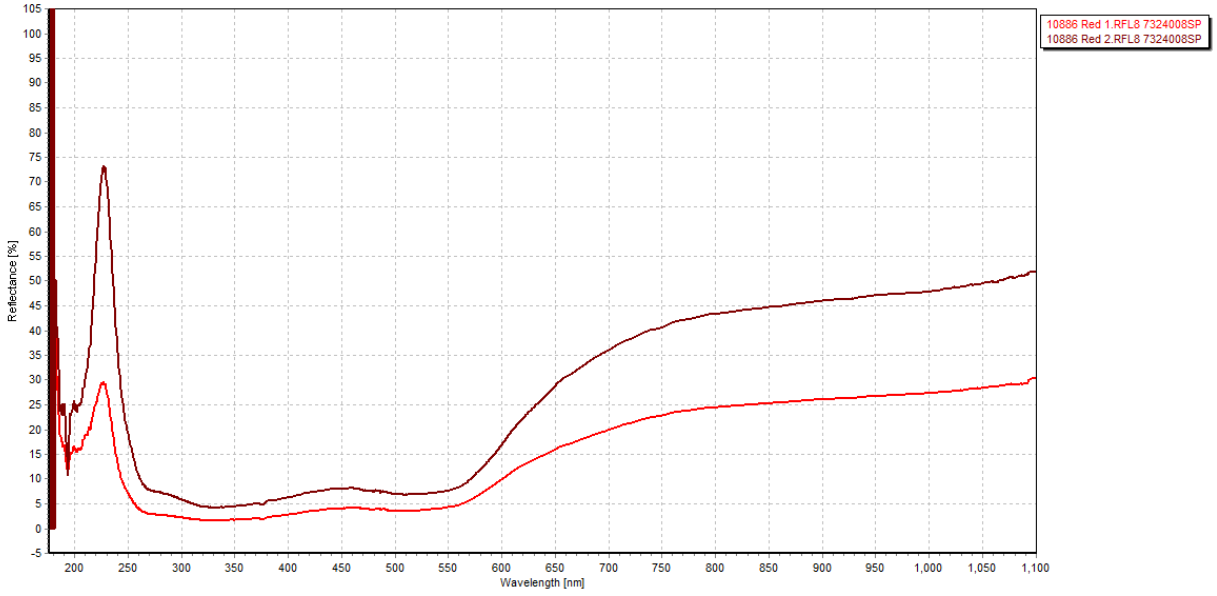

10886 Dark Green 1.RFL8 7324008SP
10886 Dark Green 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

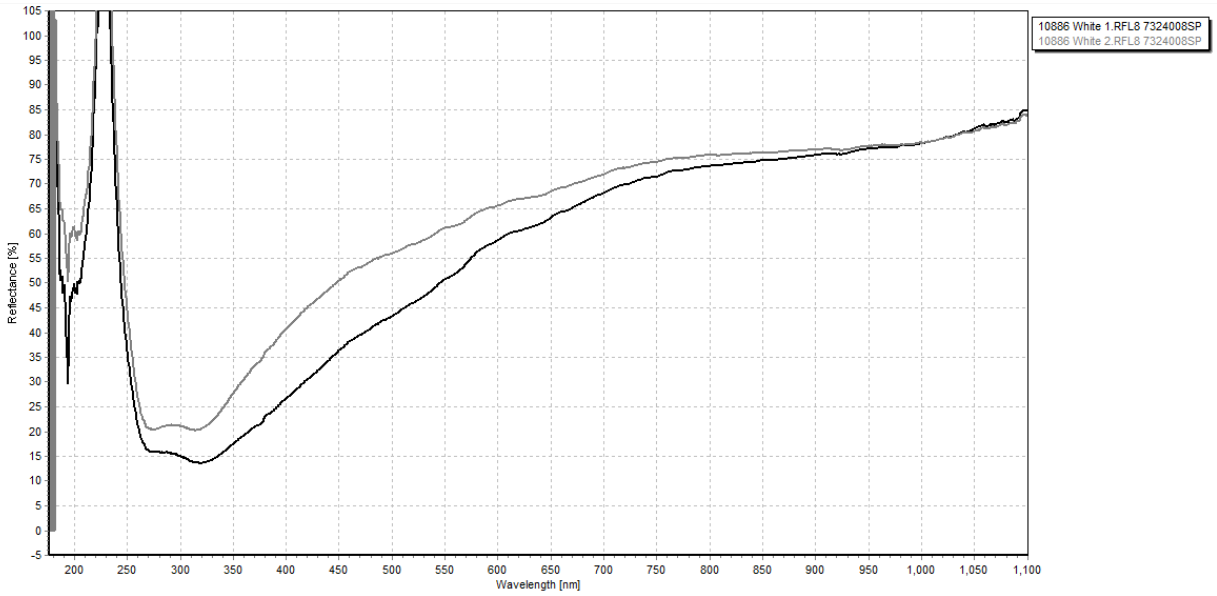

10886 Dark Blue 1.RFL8 7324008SP
10886 Dark Blue 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

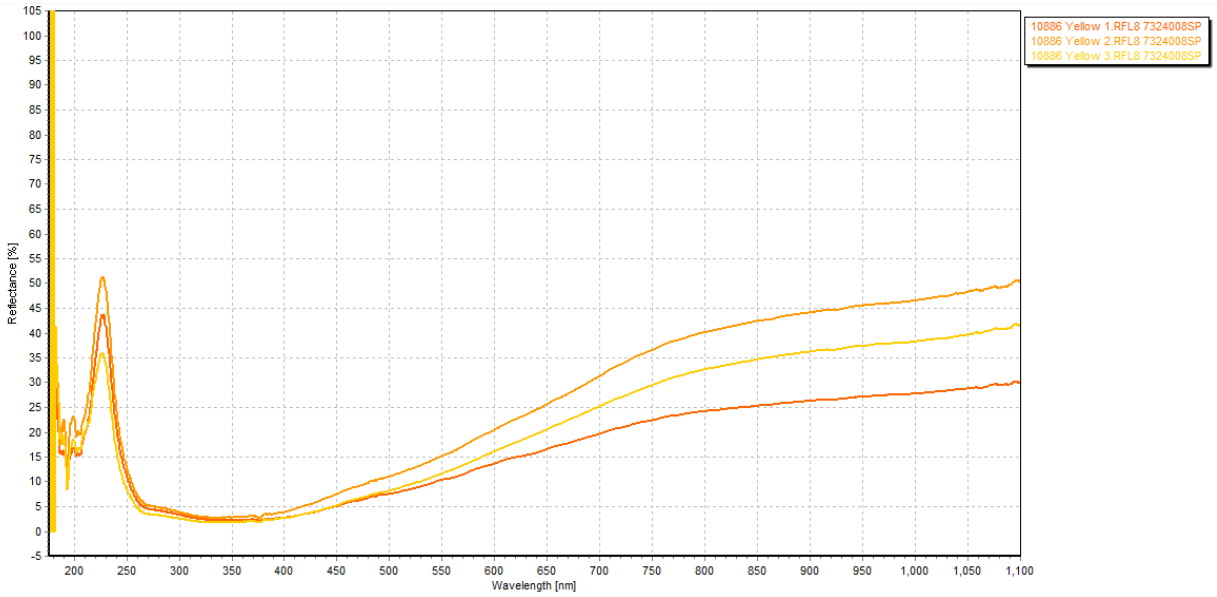

10886 Light Blue 1.RFL8 7324008SP
10886 Light Blue 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

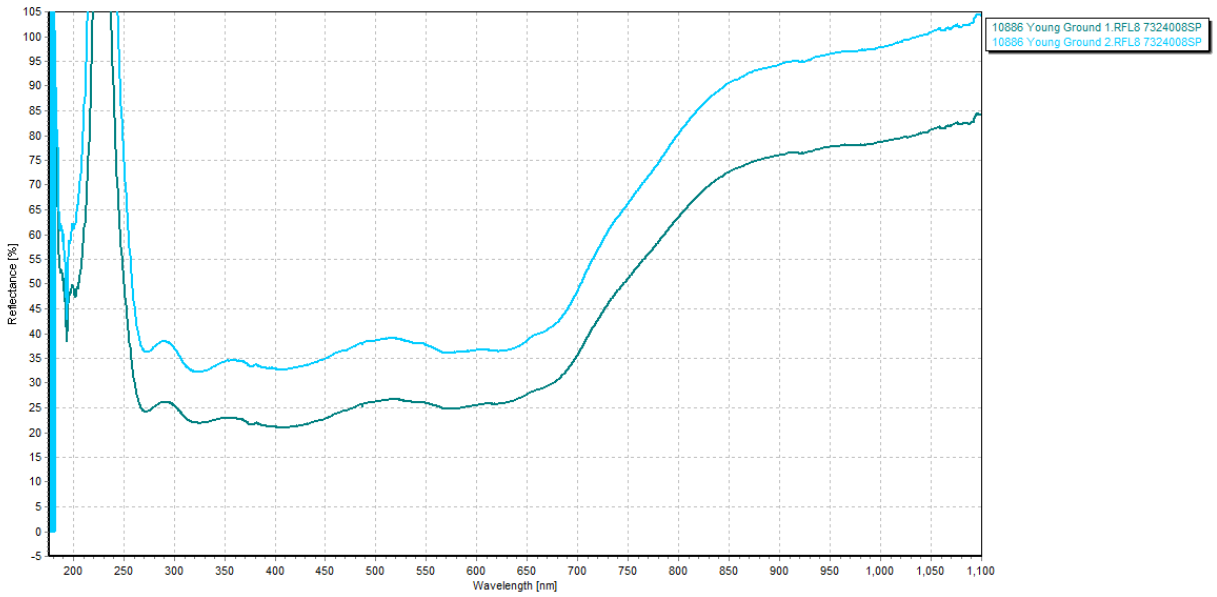

10886 Light Green 2.RFL8 7324008SP
10886 Light Green.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]


10886 Original Ground 1.RFL8 7324008SP
10886 Original Ground 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

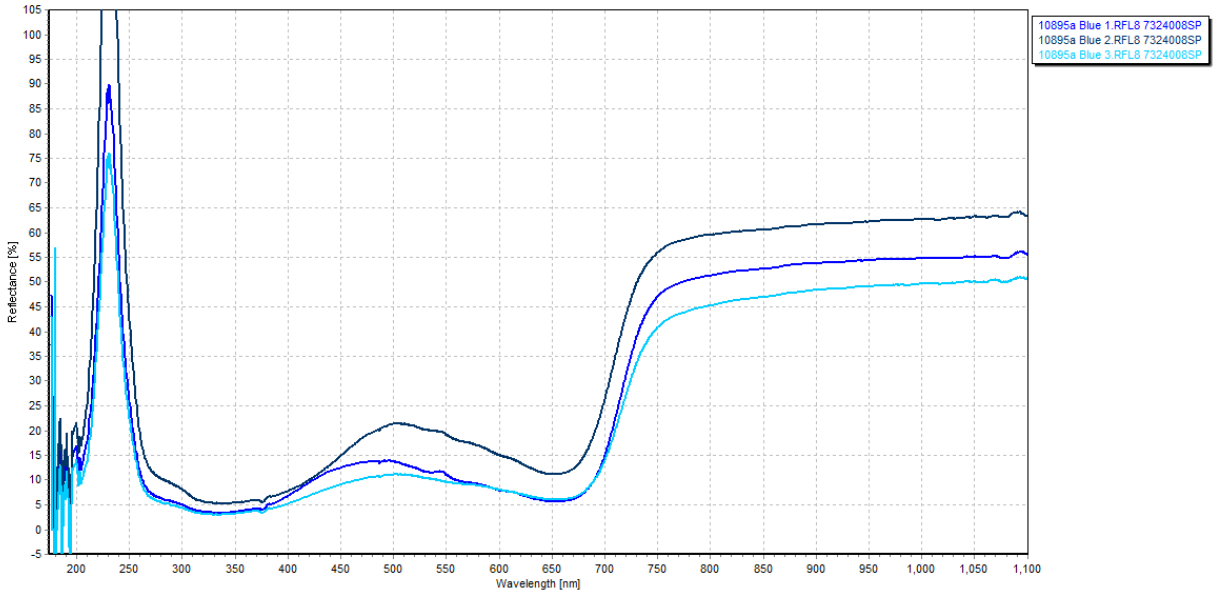

10886 Red 1.RFL8 7324008SP
10886 Red 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

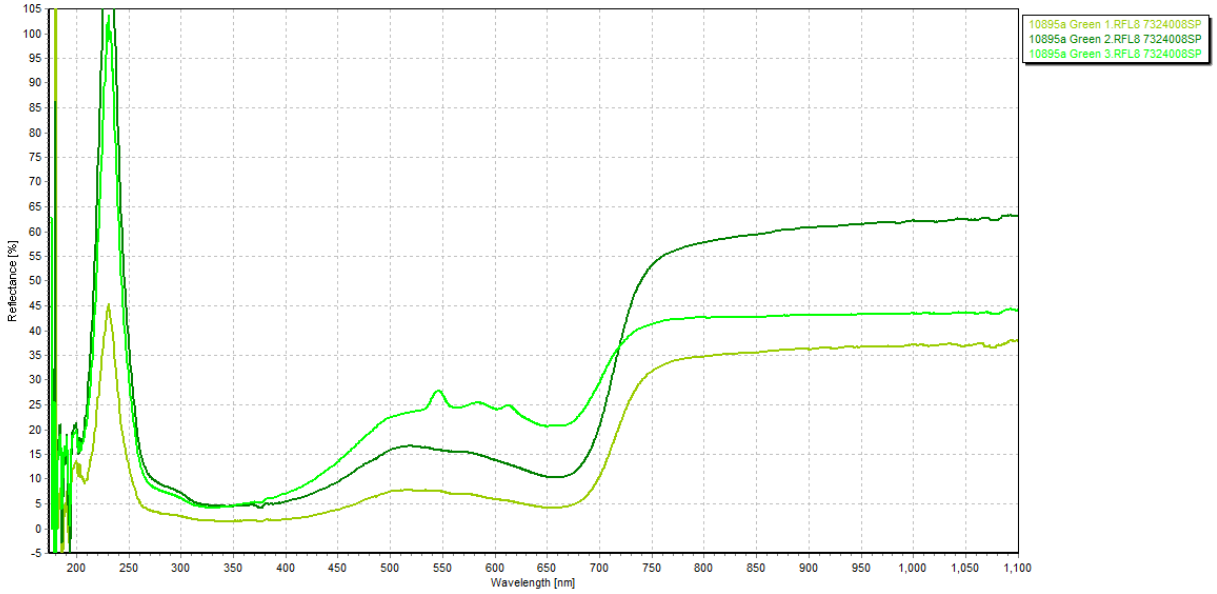

10886 White 1.RFL8 7324008SP
10886 White 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

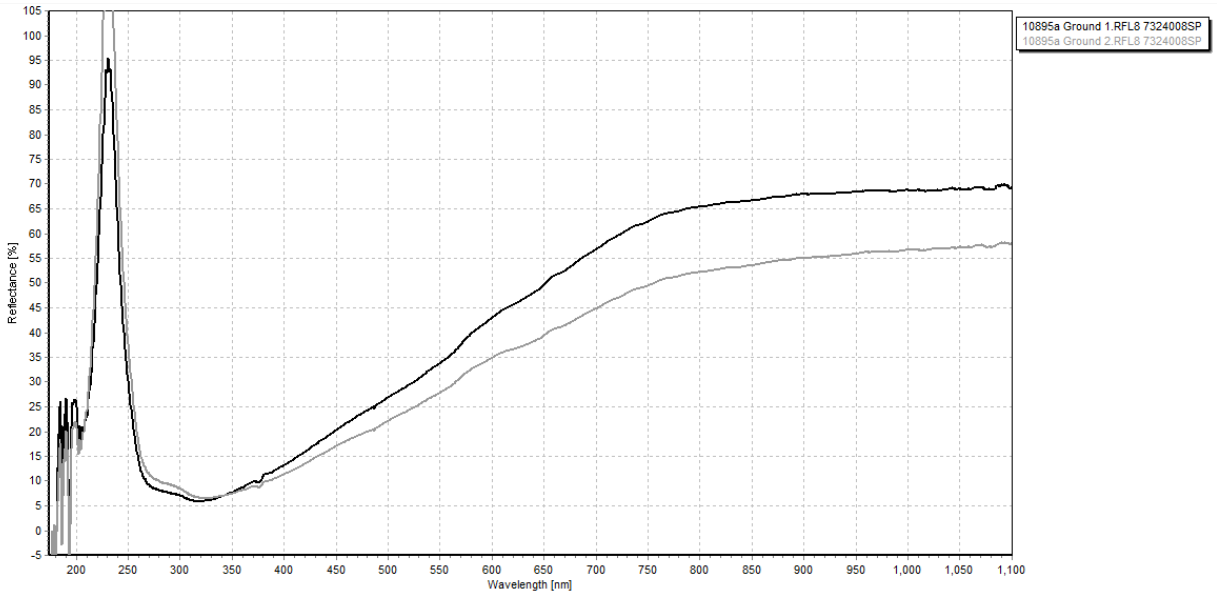

10886 Yellow 1.RFL8 7324008SP
10886 Yellow 2.RFL8 7324008SP
10886 Yellow 3.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

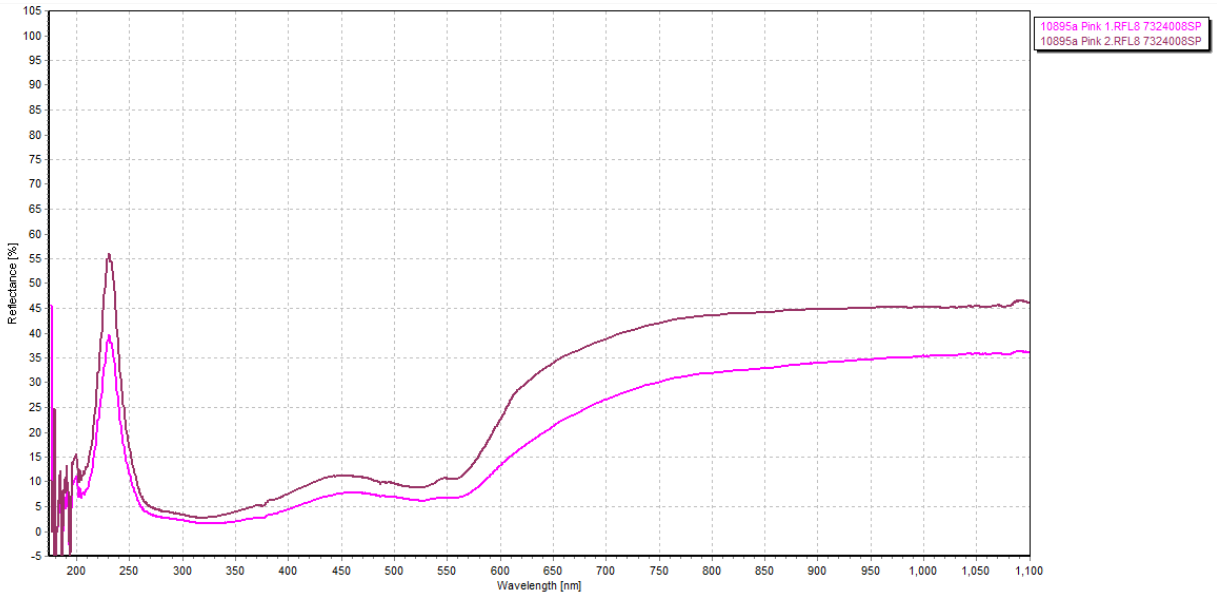

10886 Young Ground 1.RFL8 7324008SP
10886 Young Ground 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

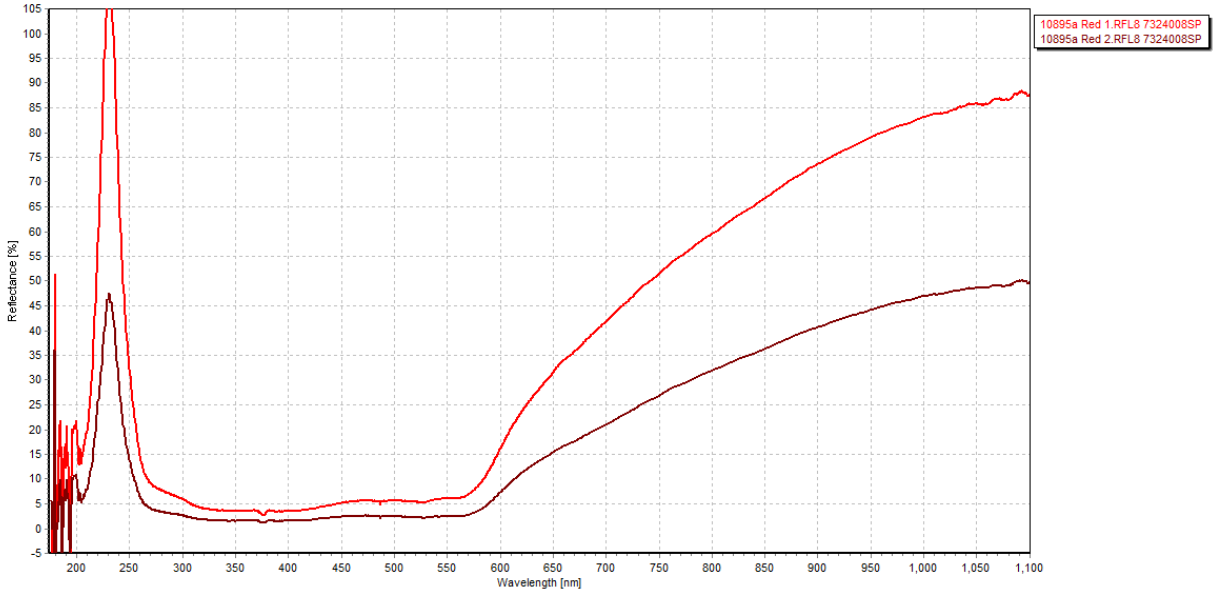
10895a

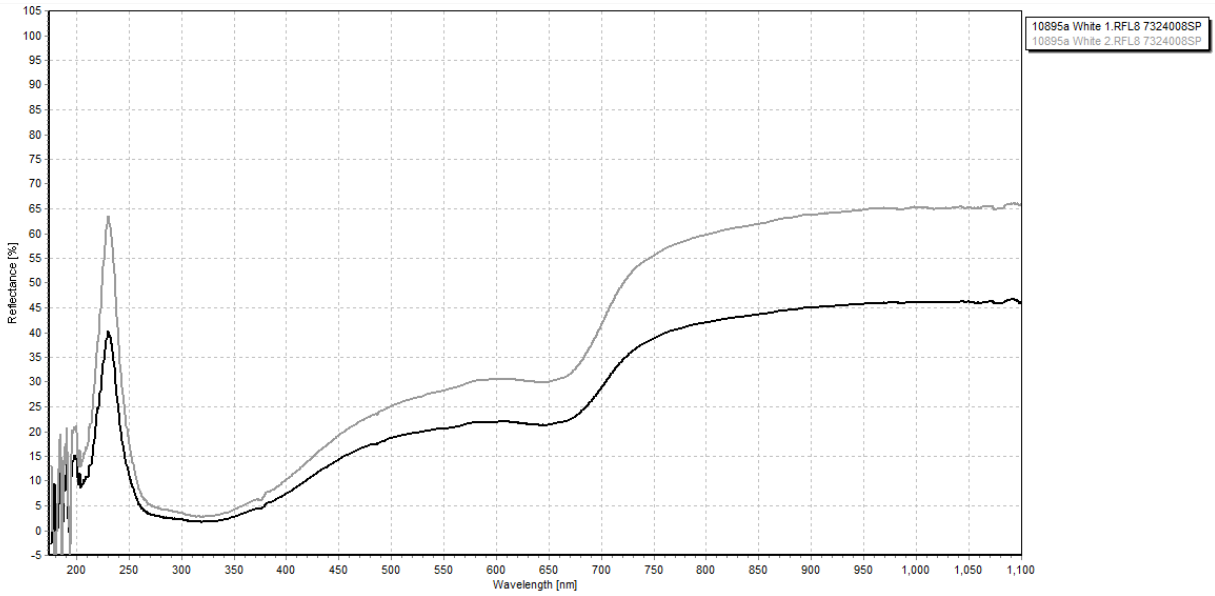

10895a Blue 1.RFL8 7324008SP
10895a Blue 2.RFL8 7324008SP
10895a Blue 3.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

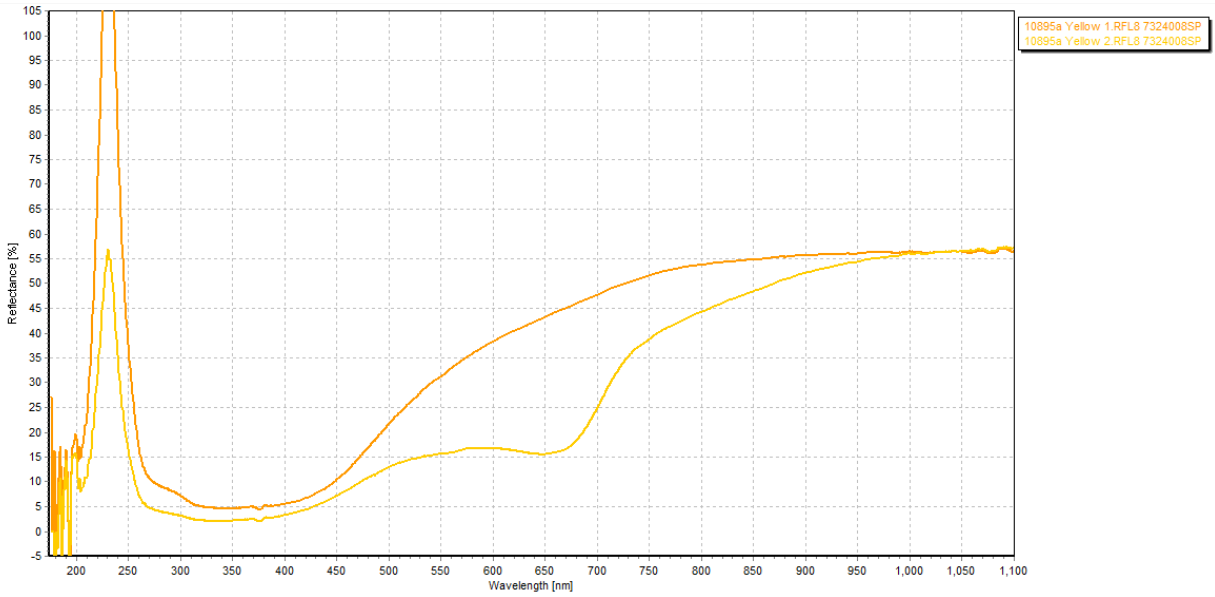

10895a Green 1.RFL8 7324008SP
10895a Green 2.RFL8 7324008SP
10895a Green 3.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]


10895a Ground 1.RFL8 7324008SP
10895a Ground 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

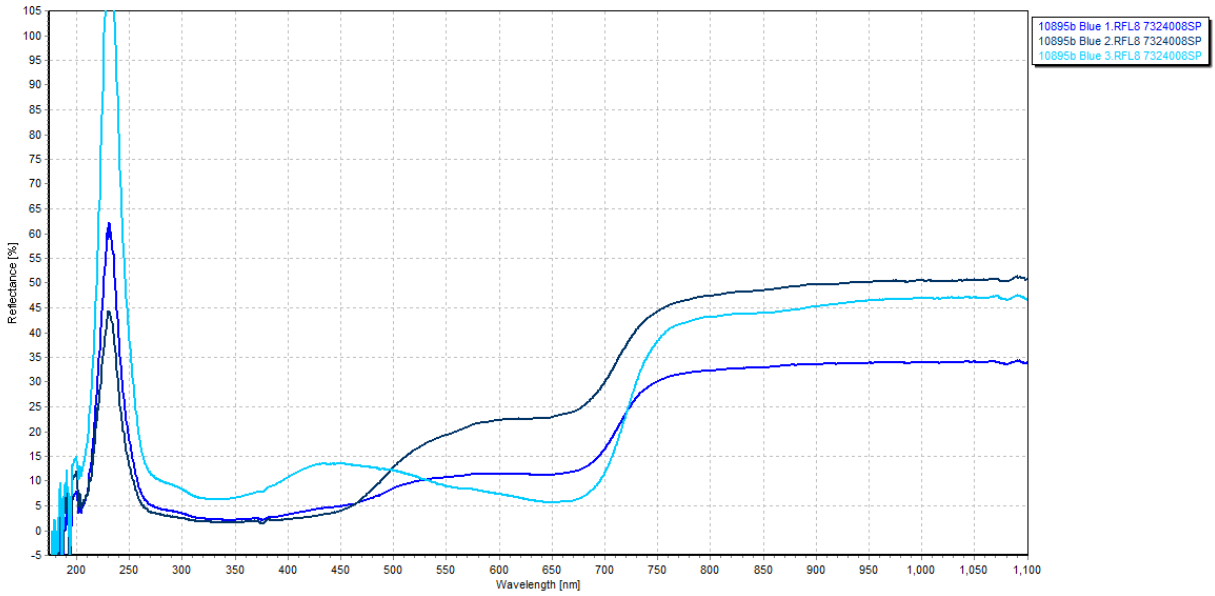

10895a Pink 1.RFL8 7324008SP
10895a Pink 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

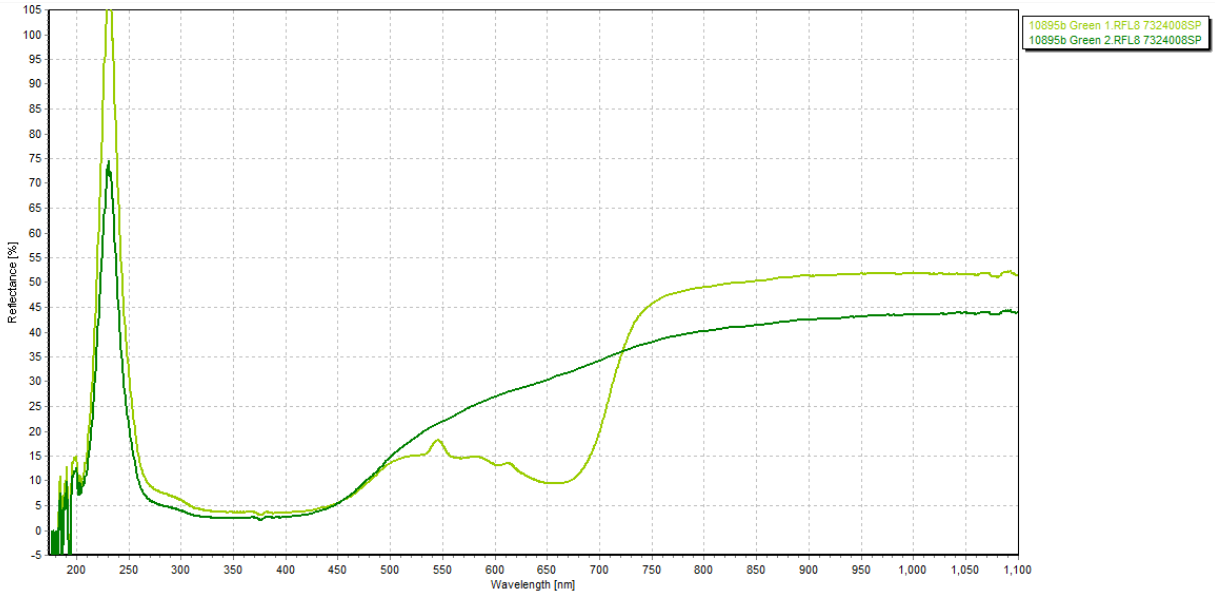

10895a Red 1.RFL8 7324008SP
10895a Red 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

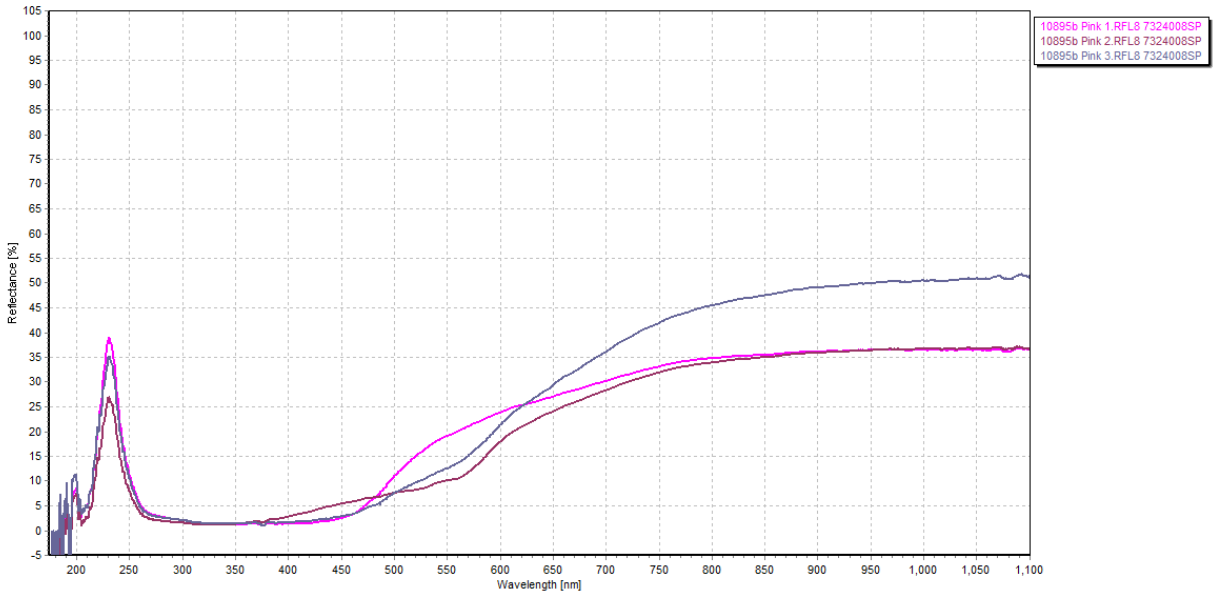

10895a White 1.RFL8 7324008SP
10895a White 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

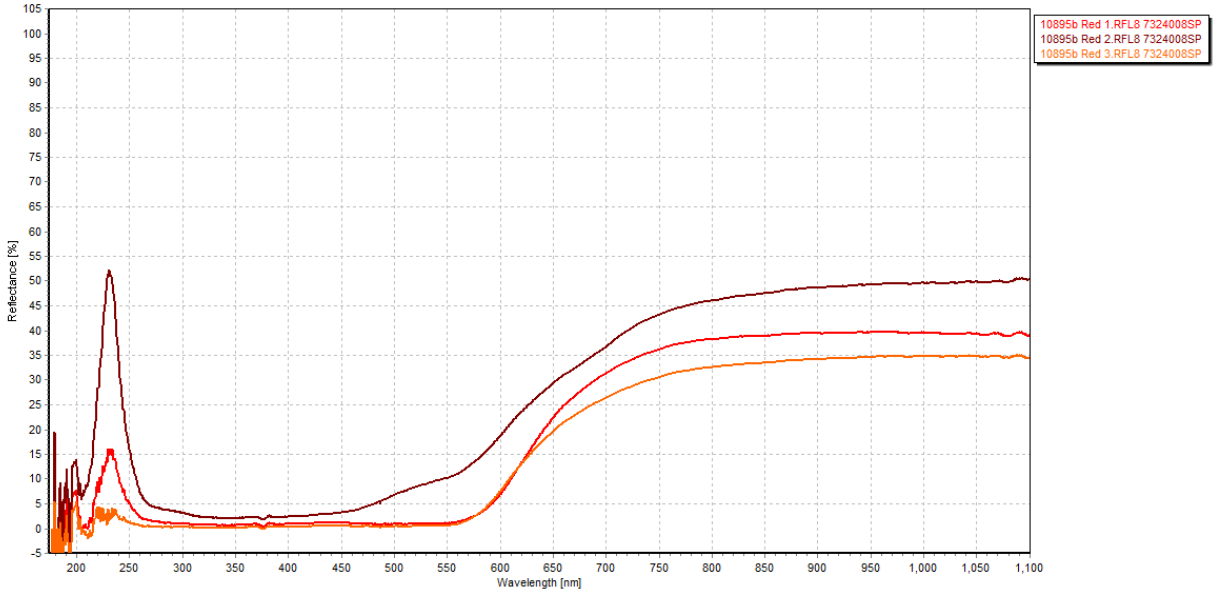

10895a Yellow 1.RFL8 7324008SP
10895a Yellow 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

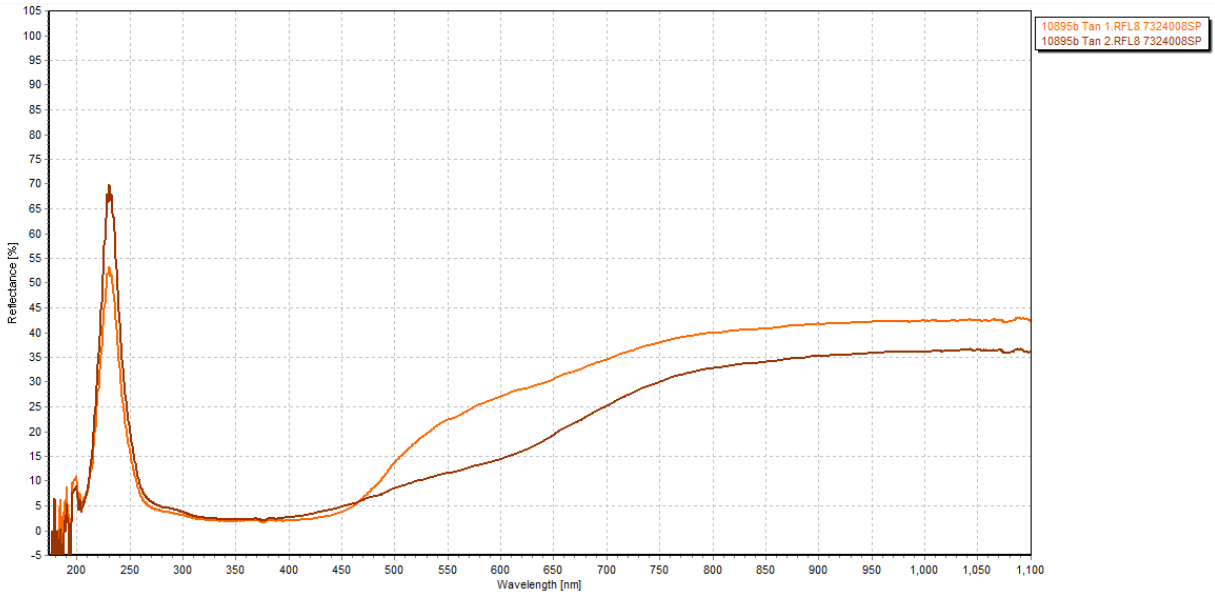
10895b

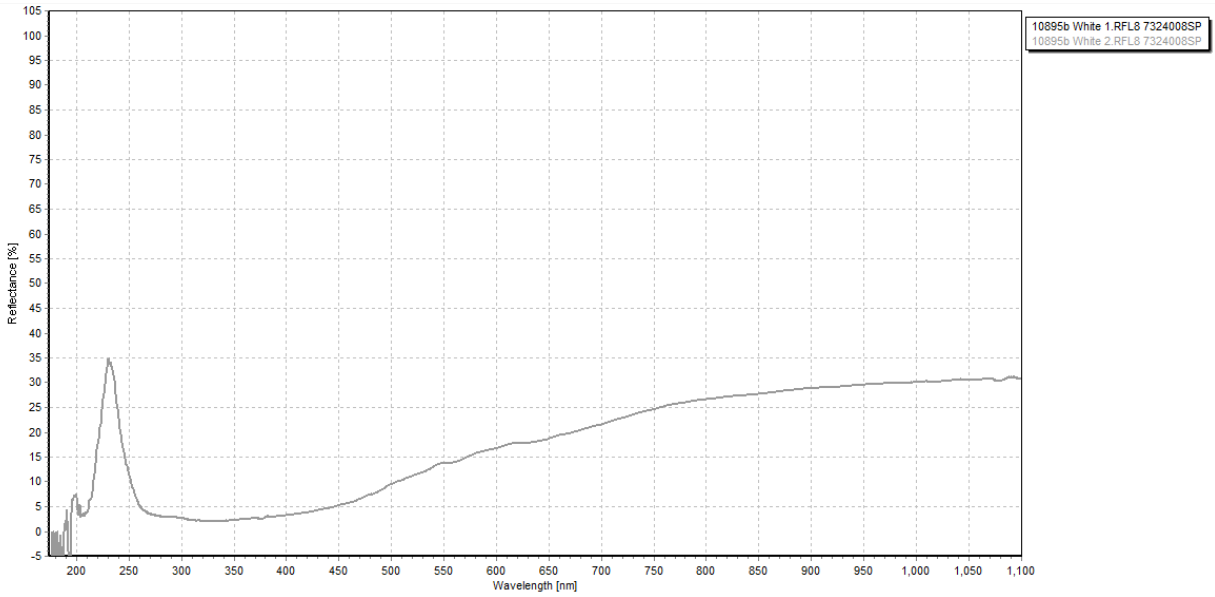

10895b Blue 1.RFL8 7324008SP
10895b Blue 2.RFL8 7324008SP
10895b Blue 3.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

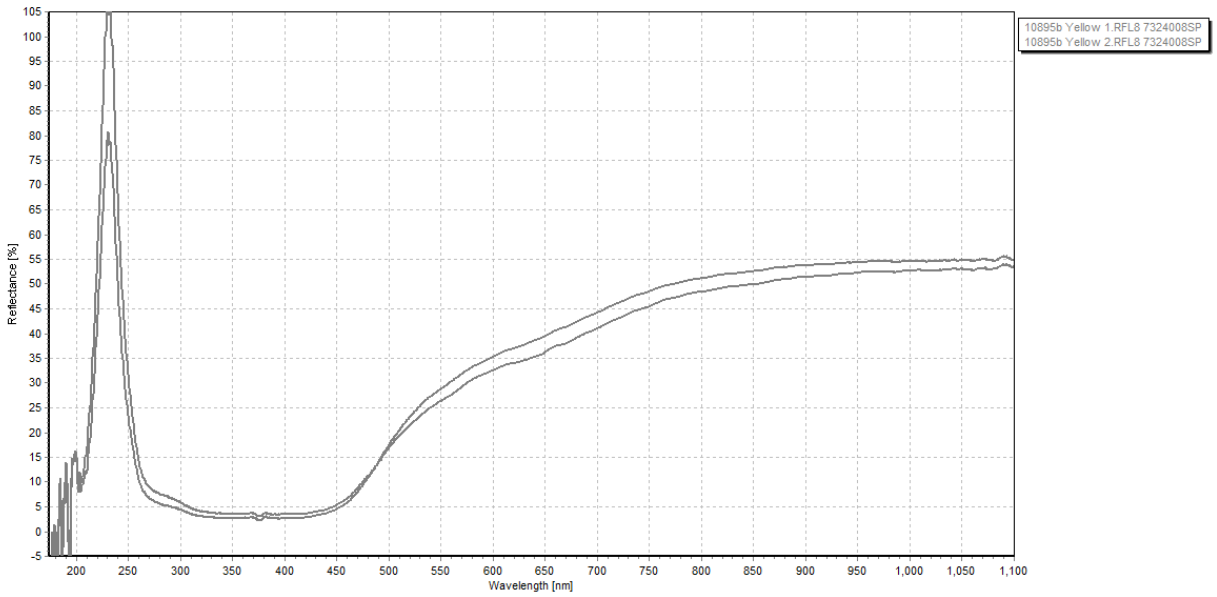

10895b Green 1.RFL8 7324008SP
10895b Green 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]


10895b Pink 1.RFL8 7324008SP
10895b Pink 2.RFL8 7324008SP
10895b Pink 3.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

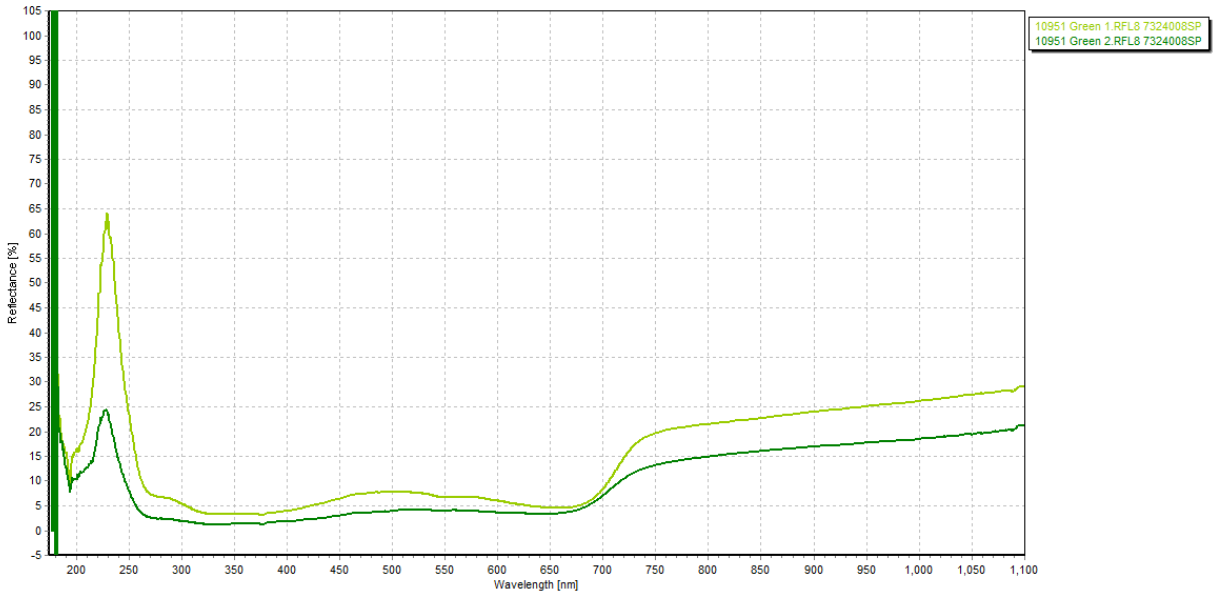

10895b Red 1.RFL8 7324008SP
10895b Red 2.RFL8 7324008SP
10895b Red 3.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

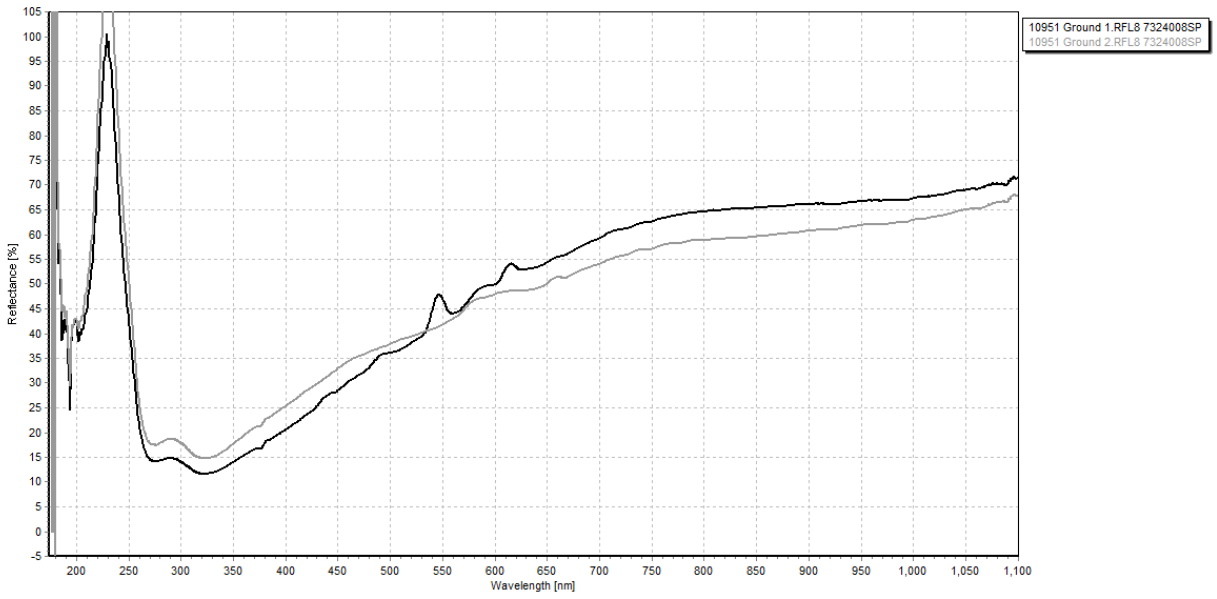

10895b Tan 1.RFL8 7324008SP
10895b Tan 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

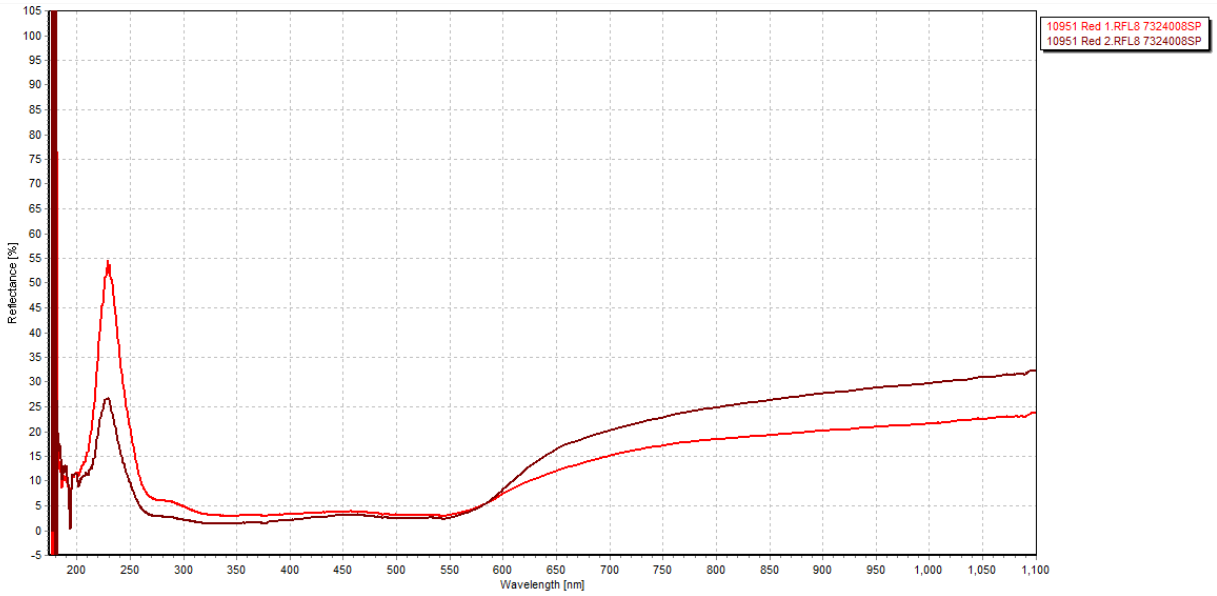

10895b White 1.RFL8 7324008SP
10895b White 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

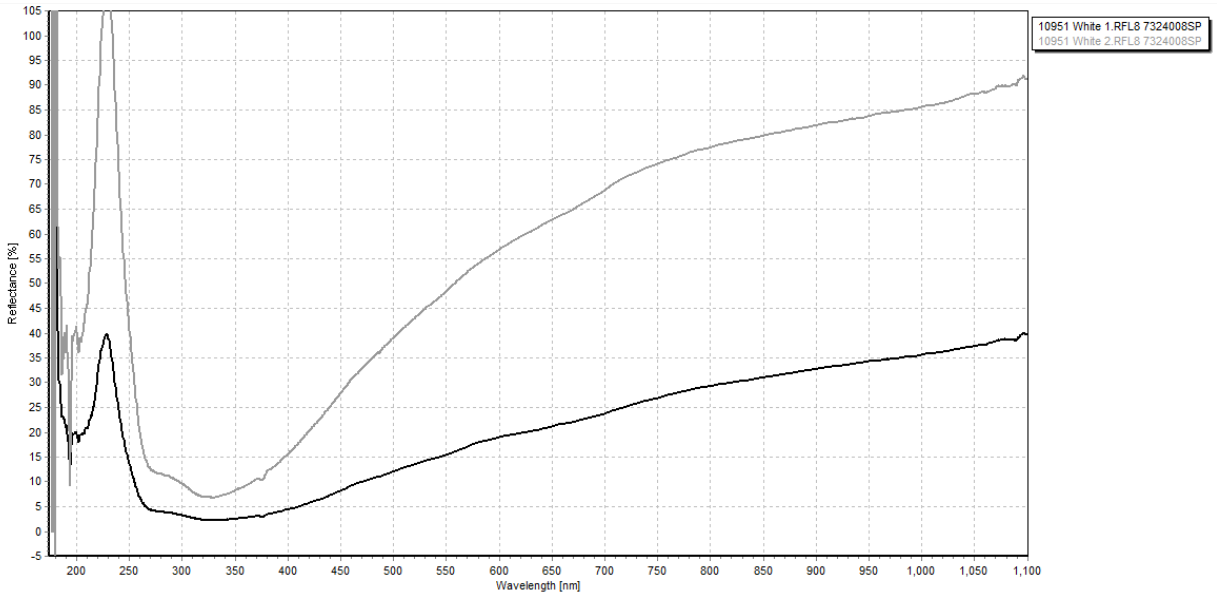

10895b Yellow 1.RFL8 7324008SP
10895b Yellow 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

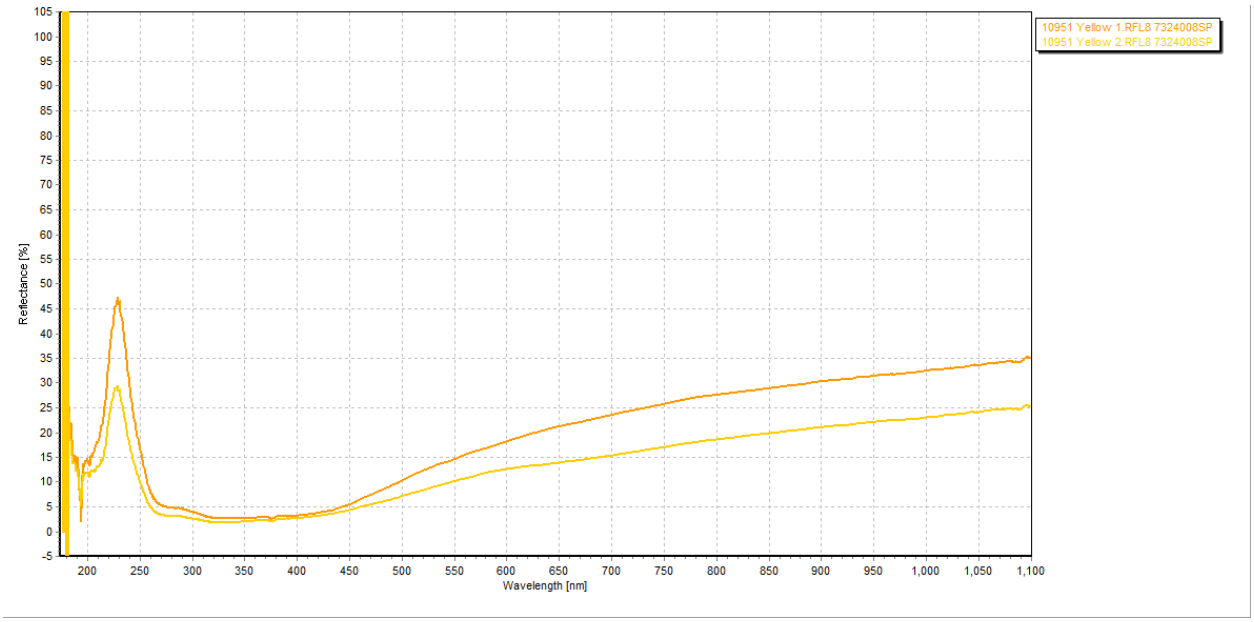
10951


10951 Green 1.RFL8 7324008SP
10951 Green 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

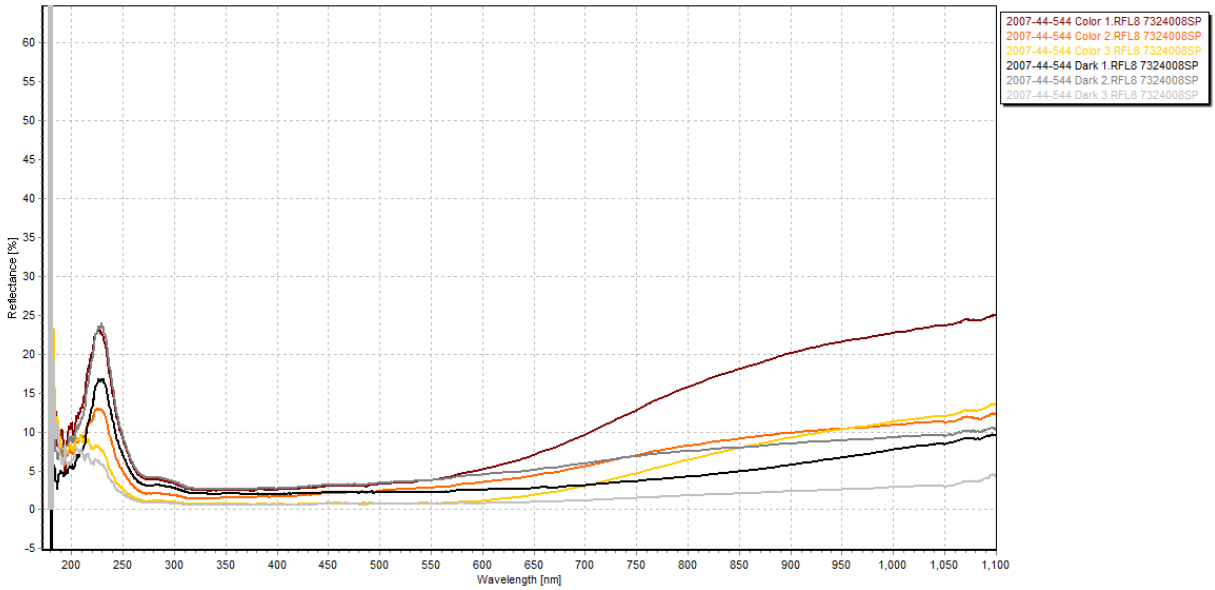

10951 Ground 1.RFL8 7324008SP
10951 Ground 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

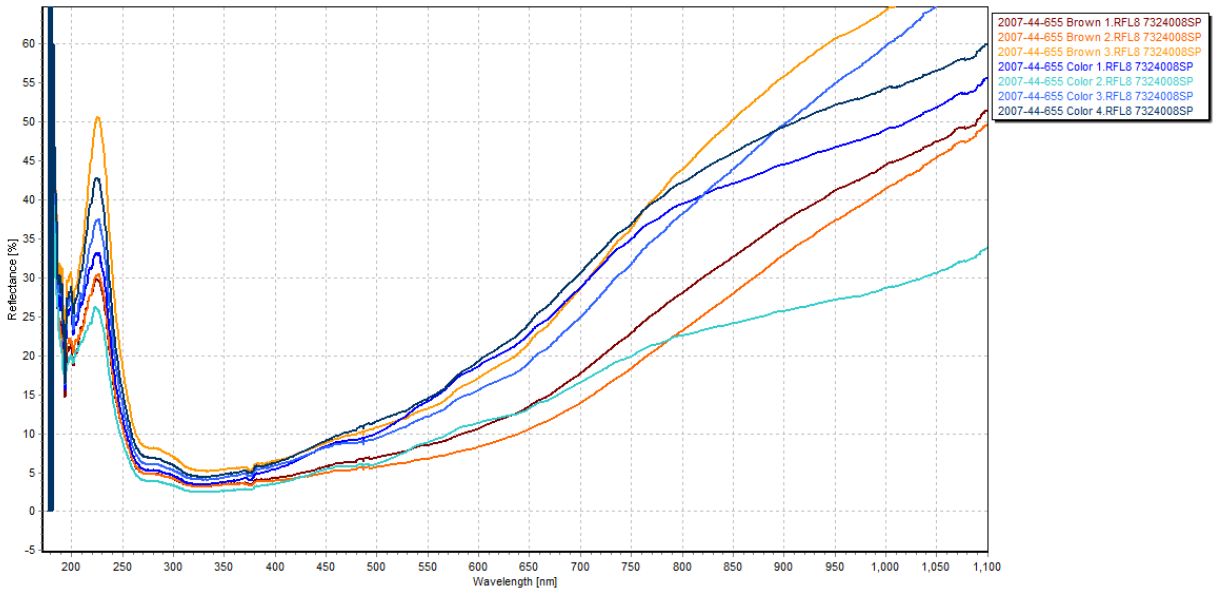

10951 Red 1.RFL8 7324008SP
10951 Red 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

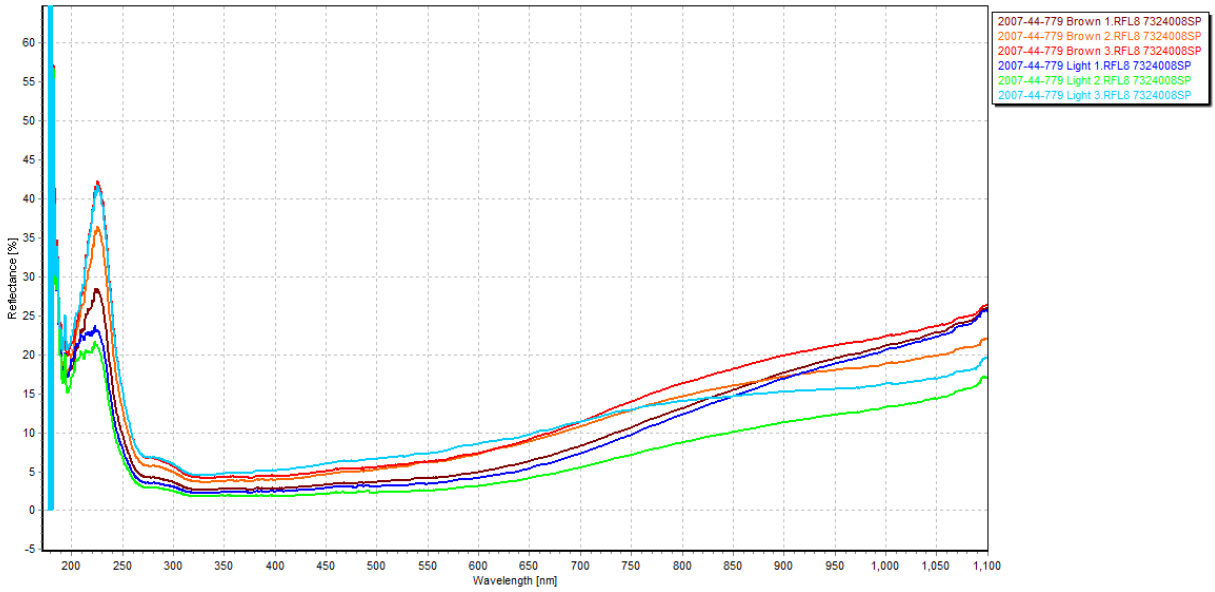

10951 White 1.RFL8 7324008SP
10951 White 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

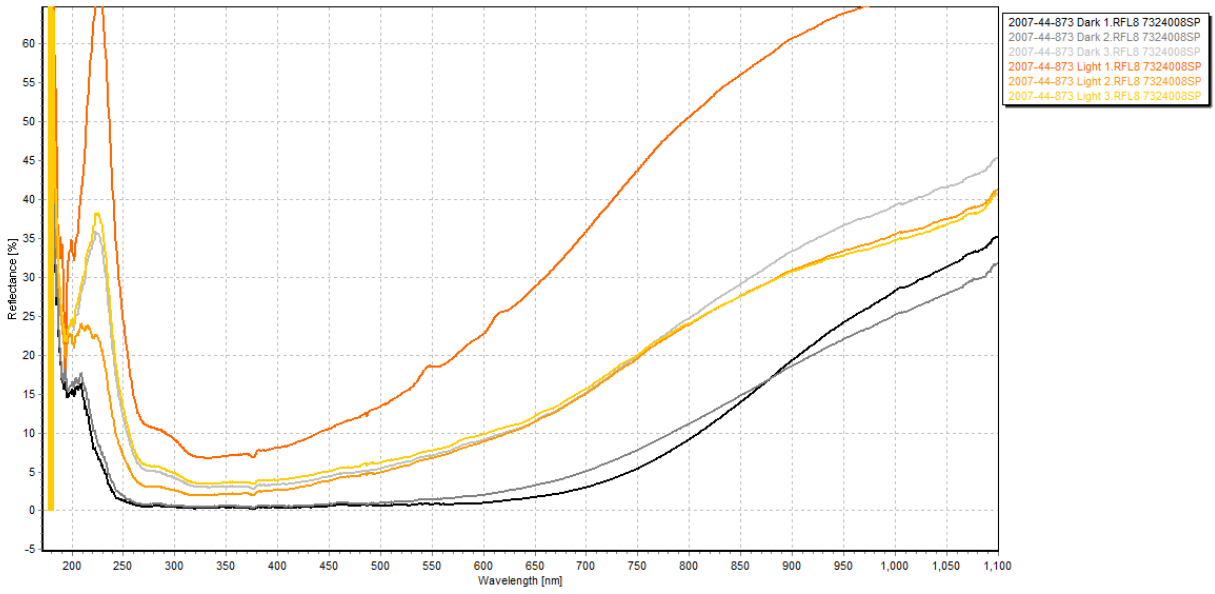

10951 Yellow 1.RFL8 7324008SP
10951 Yellow 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]
105
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
-5
200
250
300
350
400
450
500
550
600
650
700
750
800
850
900
950
1,000
1,050
1,100

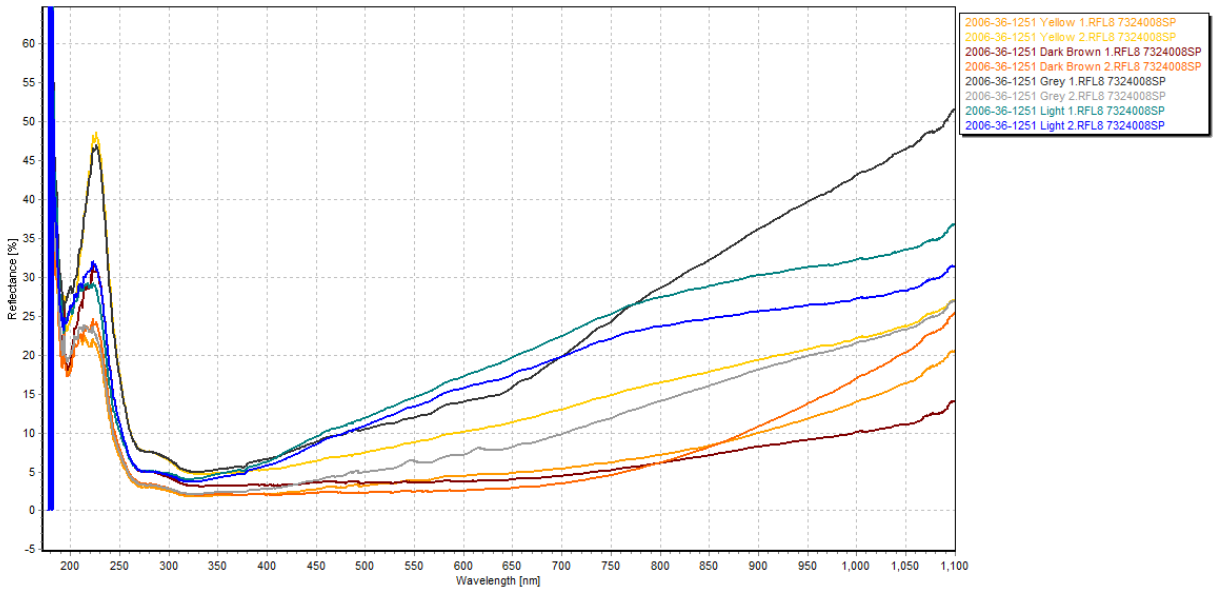
Appendix C: Archaeological Spectra

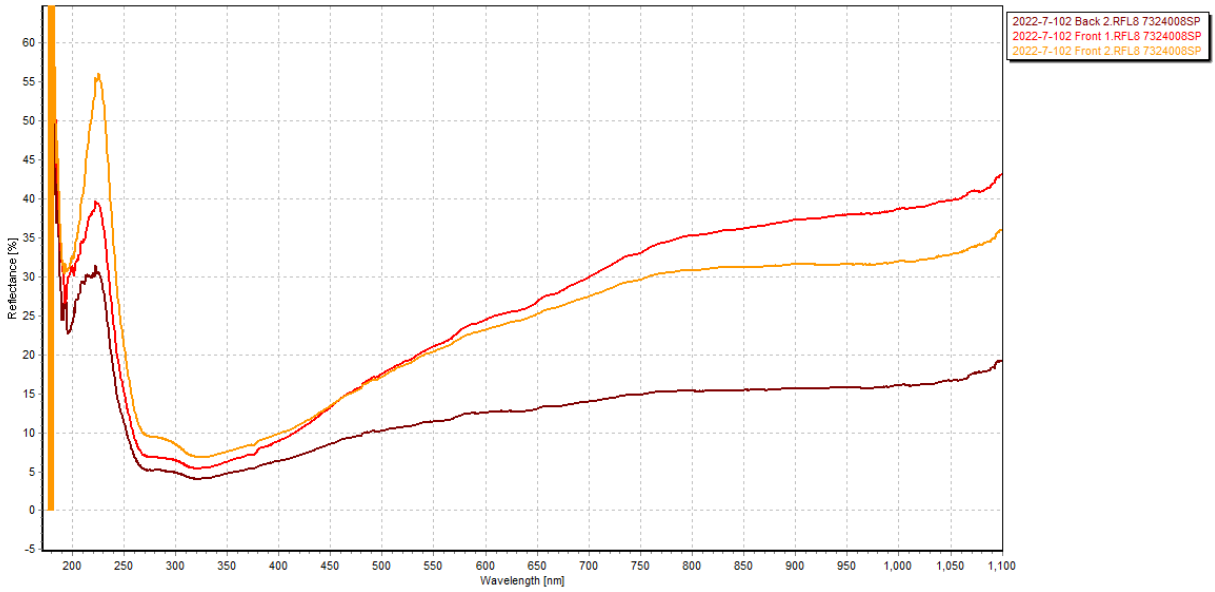


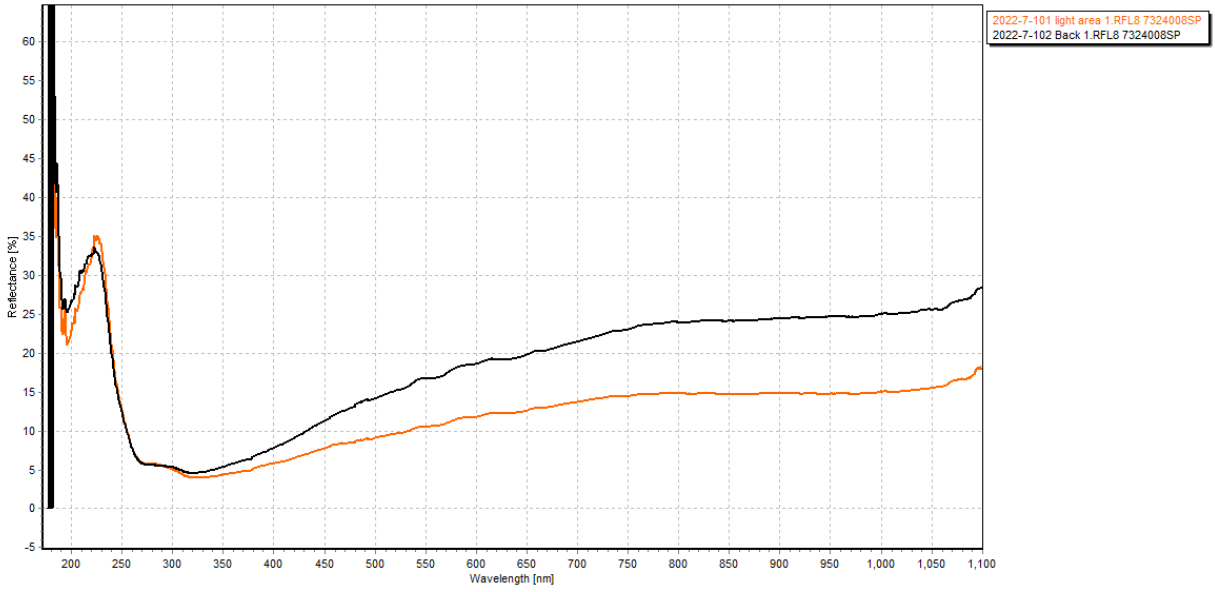


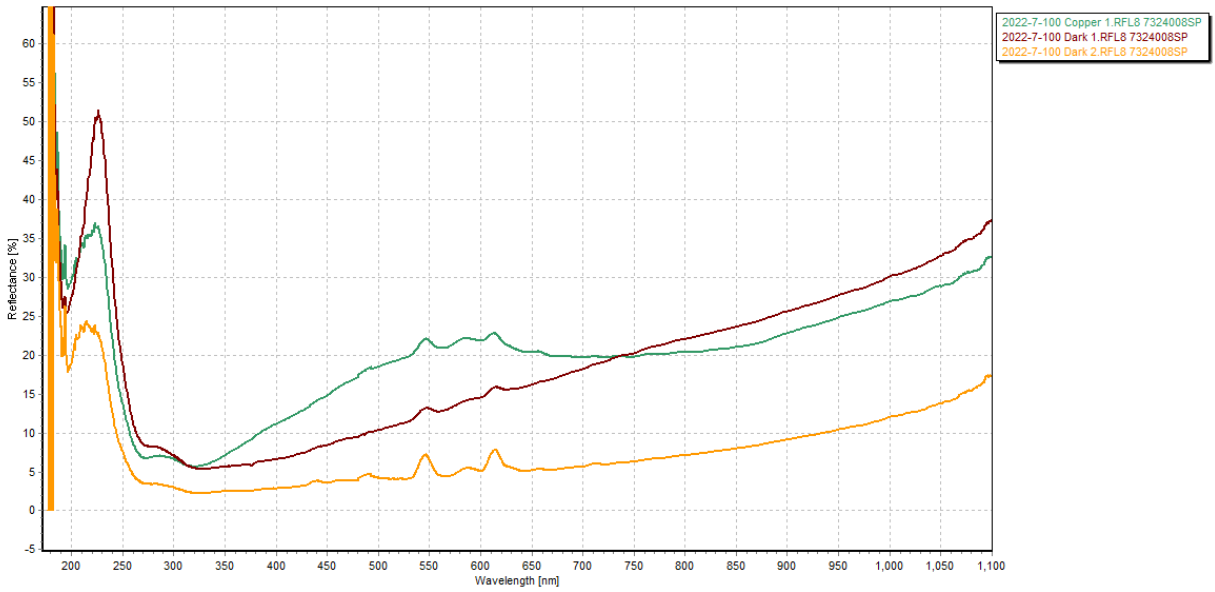


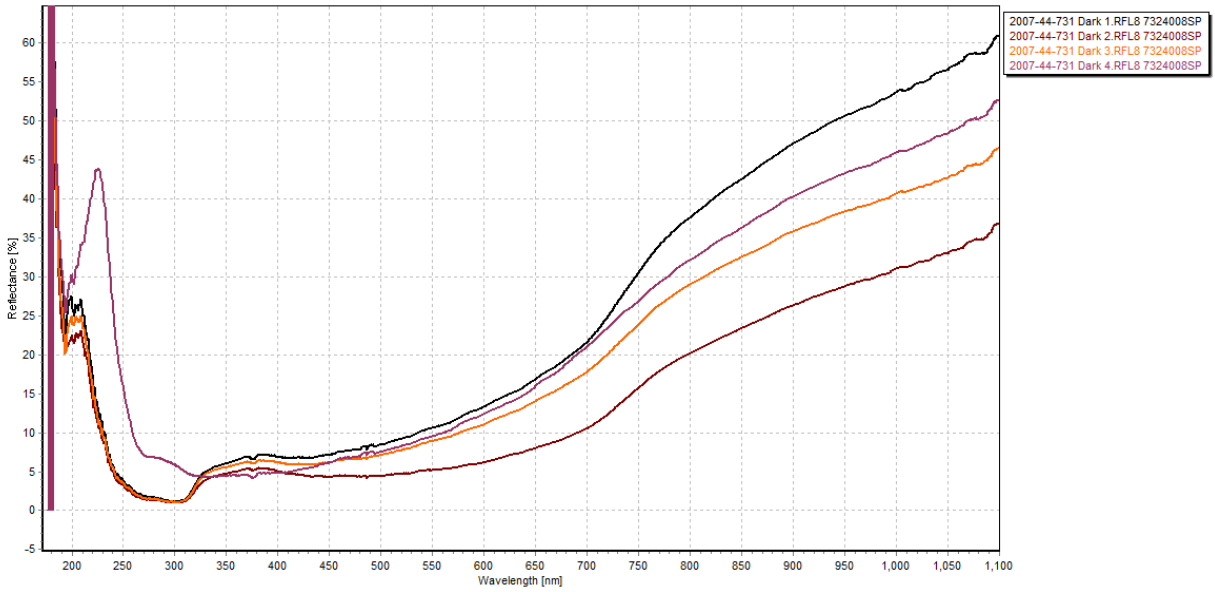

2007-44-873 Dark 1.RFL8 7324008SP
2007-44-873 Dark 2.RFL8 7324008SP
2007-44-873 Dark 3.RFL8 7324008SP
2007-44-873 Light 1.RFL8 7324008SP
2007-44-873 Light 2.RFL8 7324008SP
2007-44-873 Light 3.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]

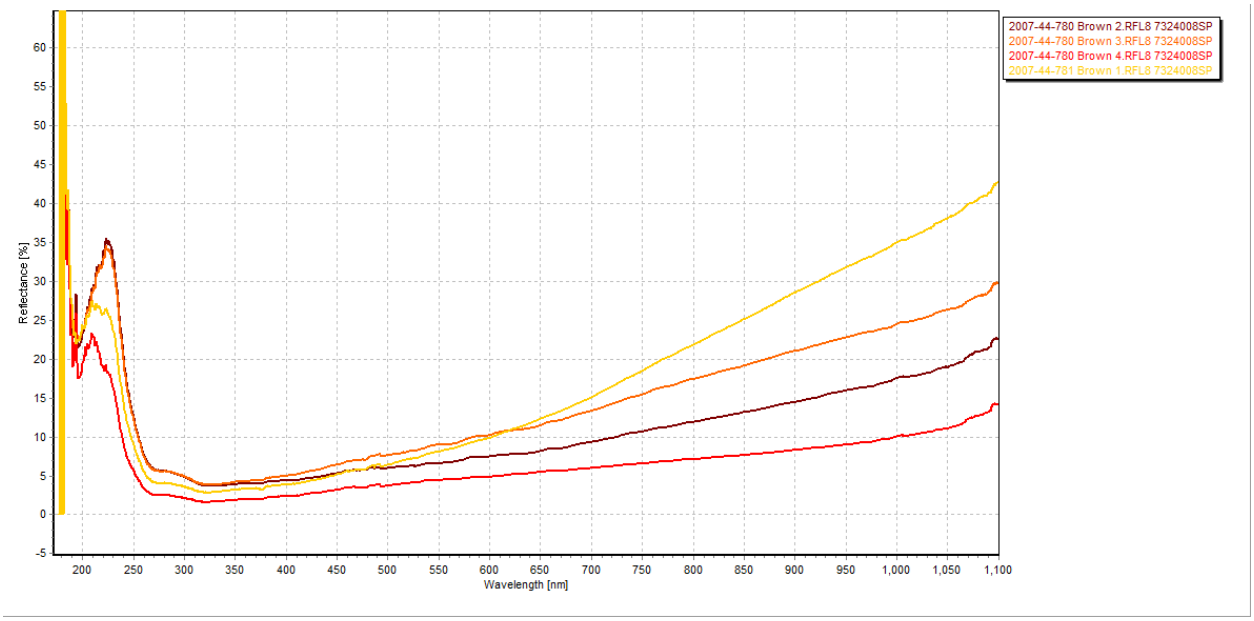

2006-36-1251 Yellow 1.RFL8 7324008SP
2006-36-1251 Yellow 2.RFL8 7324008SP
2006-36-1251 Dark Brown 1.RFL8 7324008SP
2006-36-1251 Dark Brown 2.RFL8 7324008SP
2006-36-1251 Grey 1.RFL8 7324008SP
2006-36-1251 Grey 2.RFL8 7324008SP
2006-36-1251 Light 1.RFL8 7324008SP
2006-36-1251 Light 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]


2022-7-102 Back 2.RFL8 7324008SP
2022-7-102 Front 1.RFL8 7324008SP
2022-7-102 Front 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]


2022-7-101 light area 1.RFL8 7324008SP
2022-7-102 Back 1.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]


2022-7-100 Copper 1.RFL8 7324008SP
2022-7-100 Dark 1.RFL8 7324008SP
2022-7-100 Dark 2.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]


2007-44-731 Dark 1.RFL8 7324008SP
2007-44-731 Dark 2.RFL8 7324008SP
2007-44-731 Dark 3.RFL8 7324008SP
2007-44-731 Dark 4.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]


2007-44-780 Brown 2.RFL8 7324008SP
2007-44-780 Brown 3.RFL8 7324008SP
2007-44-780 Brown 4.RFL8 7324008SP
2007-44-781 Brown 1.RFL8 7324008SP
Reflectance [%]
Wavelength [nm]
60
55
50
45
40
35
30
25
20
15
10
5
0
-5
200
250
300
350
400
450
500
550
600
650
700
750
800
850
900
950
1,000
1,050
1,100