Ultraviolet Absorbing Paints

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Abstract

We analyzed several samples of ultraviolet absorbing paints in order to avoid possible problems with false signals caused by reflected light on the walls of the fluorescence detector's bays, coming from low energy air showers or coming from the other parts of the air shower that it is being observed.

The Fluorescence group at Unicamp is in charge to realize a task that is to find enterprises in Brazil capable to produce paints with low reflectance coefficient in the Ultraviolet (UV) region of the electromagnetic spectrum. The reason why these paints must satisfy these requirement (low reflectance) is that it is necessary to avoid possible false signals, coming from the other parts of the air shower that it is being observed or from the low energies air showers. The fluorescence light generated by these air showers can be reflected on the walls of the bays where the fluorescence telescopes will be installed, causing these false signals, which it is undesirable.

First, we contacted three possible enterprises: PPG, Akzo Nobel and Renner Du Pont. However, only this last industry produces UV absorbing paints. They sent to us several samples with different colors of the same kind of paint, in order to realize reflectance tests. We expect that the better color for our goal will be the black color, of course, but it is interesting to analyze the behavior of some colors like white, green, grey and others with respect to the reflectance.

We did measurements of reflectance on small plates of metal with 8 different colors: standard ebony black, ebony black 20, ebony black 50, arena beige, mahler white, alamo green, alamo 2 green and haze grey. The three types of black colors indicates different concentrations of the product that absorbs the UV light, namely Tinuvim. We have a

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black color with a standard quantity of this product (standard ebony black). The colors ebony black 20 and ebony black 50 have 20% and 50% more Tinuvim than the standard ebony black, respectively. The other colors have the standard quantity of Tinuvim. We use a PERKIN-ELMER, Lambda 9-series 1645-UV/VIS/NIR Spectrometer, part of IFGW/UNICAMP facilities.

Raw data files containing our results for the reflectance coefficient in terms of the wavelength between 300nm-450nm, are available upon request. These data are summarized in the accompanying plots (1-2). We can observe that the lower reflectance coefficient is obtained by the three types of black colors, as we expected. It reflected only 6% of the UV light that reaches the material. This value represents a reasonable performance since we have a small probability that this reflected light reaches a photo-multiplier, considering the total area of bay walls for the fluorescence detector. It is important to note that the results are practically coincident for these black colors. It does not matter if we have more quantity of Tinuvim (20% and 50%). An extra quantity does not improve the performance of the black colors on the reflectance tests. All colors have a similar performance (7%) to wavelengths lower than 350nm, which means that from this point to large wavelengths the UV absorbing product stopped to suppress the reflectance light and the different colors have different performances (light colors reflect more UV light, as we expected).

Our conclusion about the UV absorbing paints is the following: the standard ebony black color is the better option for the bays of the fluorescence telescopes, considering performances and costs aspects. The Tinuvim product is very expensive and the performance of the other black colors with additional quantities of this product does not justify its choice.

We have two more points to consider: First, it is important to decide the material that will compose these walls in order to realize adherence tests. It will allow us to determine how much time this paint will resist on the walls. This is an important economic factor. Second, generally these paints contain lead chromate that is extremely pollutant and is must be avoid. As Renner Du Pont said, these points can be made without this product with more or less the same characteristics.

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Figure 1: Reflectance tests for samples with different colors of the paints.
Figure 2: Reflectance tests for samples with different quantities of UV absorbing substance (Tinuvim) to black paints. The quantity of the Tinuvim in the standard ebony black is the standard Ultraviolet black paint produced by the Renner Du Pont enterprise. The ebony black +XX have XX percents more Tinuvim then standard paint.