STANTEX project

WP2: Statistical analysis for the identification of the best correlation between Pt-Co scale and ZDHC guidelines

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PREPARATORY ACTIONS

According to the STANTEX project activities, this work package aims to identify the chromophore groups and a representative correlation between different dyestuffs and ETP effluents in terms of Pt-Co or APHA (American Public Health Association Color Scale) scale and the ZDHC guidelines. The Pt-Co scale was originally developed in the 1890s as a visual indicator of the purity of waste water, where a slightly yellow colour is due to the leachates of naturally occurring organic materials such as leaves, bark, roots, humus and peat. Today, Pt-Co scale is used as a metric for purity in the textile, chemical, oil, plastics, and pharmaceutical industries. This scale serves to quantify the appearance of yellowness, a visual indicator of product degradation due to exposure to light and/or heat, the presence of impurities, and negative effects of processing. This visual yellowness colour scale is based on a chemical reagent solution, best defined in ASTM D1209 Standard Test Method for Colour of Clear Liquids (Platinum Cobalt Scale). The instrumental APHA/Pt-Co/Hazen method designed to correlate the ASTM D1209 visual APHA/Pt-Co/Hazen colour scale is best defined in ASTM D5386 Standard Test Method for Colour of Liquids Using Tristimulus Colorimetry. The APHA/Pt-Co/Hazen scale is a single number (measured at 455 nm), low chroma yellowness metric based on the dilution of a reagent Pt-Co (potassium chloroplatinate) stock solution. Each APHA unit is based on a dilution by volume of 500 parts of Pt-Co stock solution per million parts of distilled water. Distilled water ('water-white') is rated as APHA/Pt-Co 0. The reagent APHA/Pt-Co/Hazen stock solution carries a rating of 500 APHA/Pt-Co/Hazen units. Recently, ZDHC has defined the wastewater guidelines where is highlighted that the colour must be tested in accordance with the standard method ISO 7887-B. In this regards, the colour is now identified, by the absorbance, through three different wavelengths (436 nm, 525 nm, 620 nm) and then converted in m^{-1} depending on the optical pathlength used.

In order to cope with the new guidelines and considering that till now the Pt-Co sensor is more available in the market and using three different probes, one for each wavelength, can be expensive, this study aims to find a robust statistical correlation between the Pt-Co values and the three absorbance required. To carry out the activity, different dyestuffs and ETP effluents were used and tested. A final tool was defined to get the colour measure in m^{-1}, at different wavelength, starting from the Pt-Co scale.

STATISTICAL METHODS

To carry out the experimental activity were used 5 industrial reactive dyestuffs, 4 industrial disperse dyestuffs and 8 textile ETP water effluents. Table 1a shows the types of dyestuff used while table 1b shows the type of ETP effluent used.

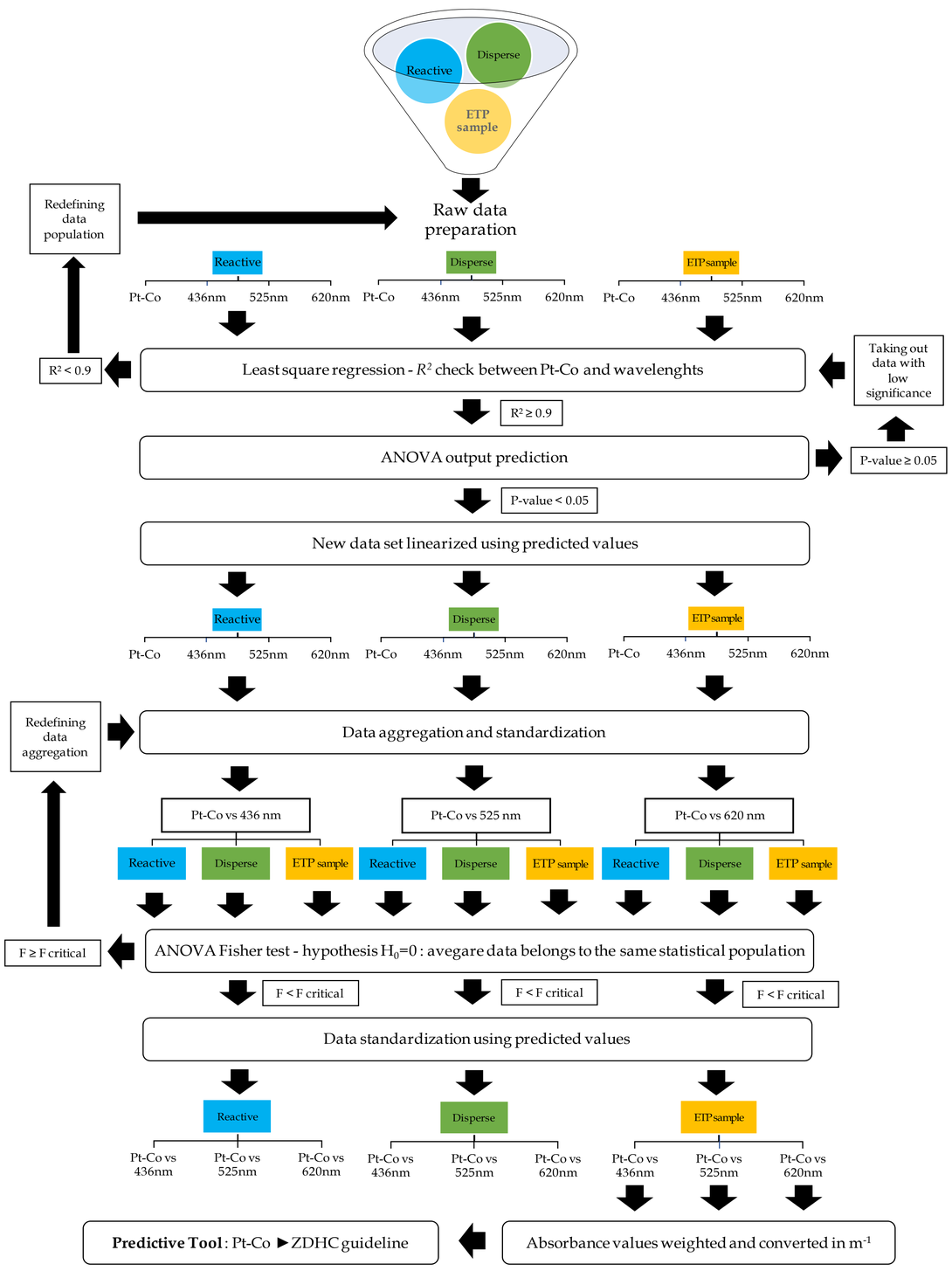
Dyestuff	Type
BLUE LBN	Reactive
YELLOW TE-R	Reactive
BLACK TE-V	Reactive
RED TE-3B	Reactive
MIXED	Reactive
BLUE RA 150	Disperse
YELLOW 6G-LS	Disperse
RED 2BL	Disperse
MIXED	Disperse

Table 1a: Industrial dyestuffs

ETP effluent	Type
Sample "A"	Home dyeing
Sample "B"	Home&Towel dyeing
Sample "C"	Denim washing + Home dyeing
Sample "D"	Denim washing + Knit dyeing
Sample "E"	Denim washing
Sample "F"	Knit dyeing
Sample "G"	Knit dyeing
Sample "H"	Denim dyeing

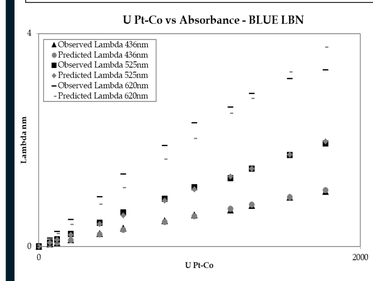
Table 1b: Industrial ETP effluent

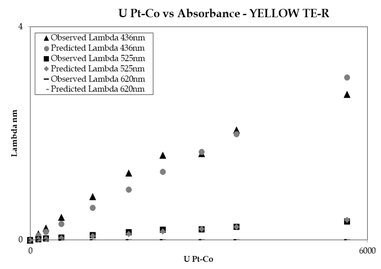
Absorbance at different wavelengths and Pt-Co values were measured using the spectrophotometer (DR1900, Hach Lange). The dyestuffs solutions were prepared using tap water considering that for the analysis, temperature and salinity don't interfere is the measurements.

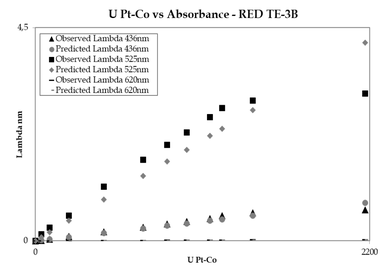


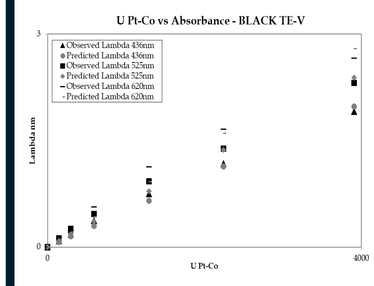
STATISTICAL RESULTS

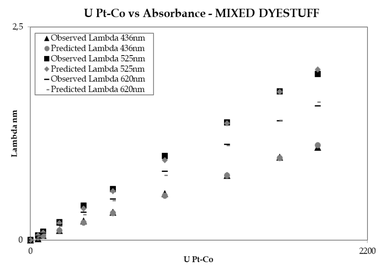
Reactive dyestuffs

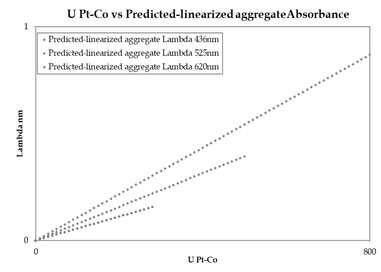




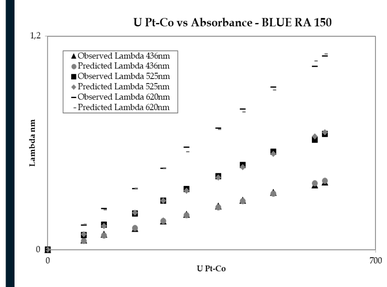


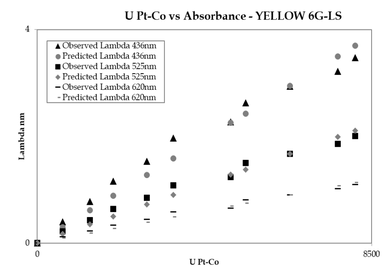


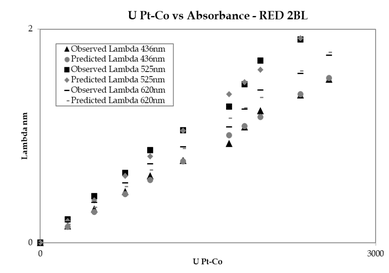


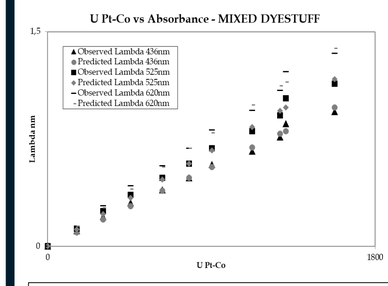


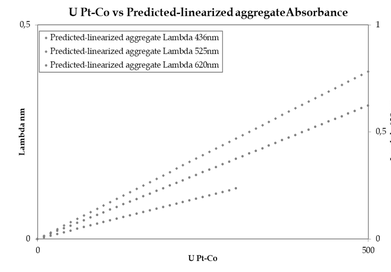
Disperse dyestuffs



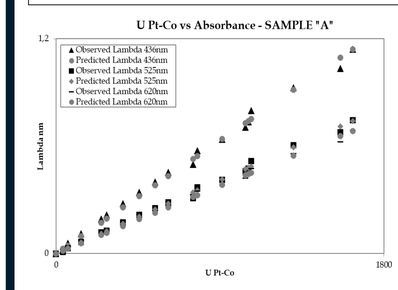


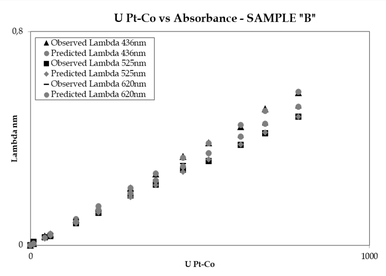


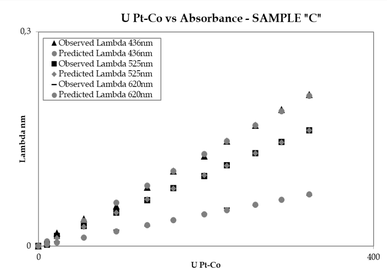


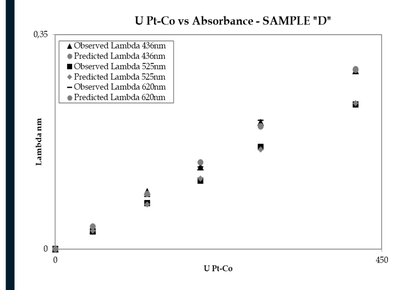


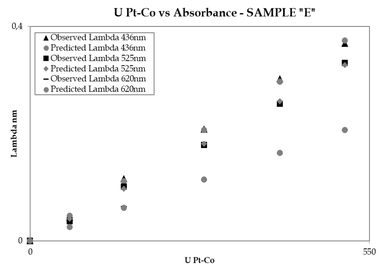
ETP sample

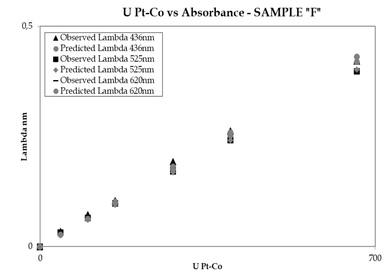


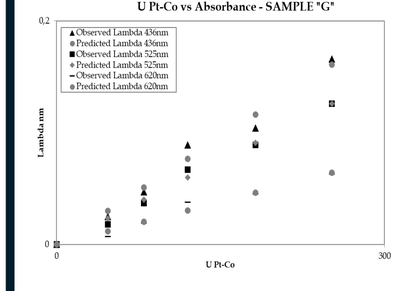


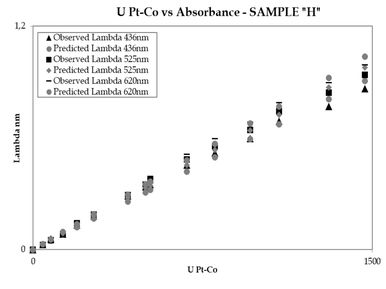


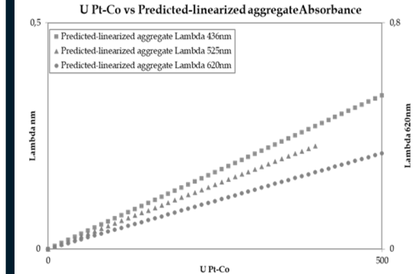


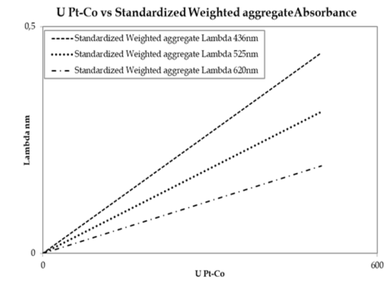


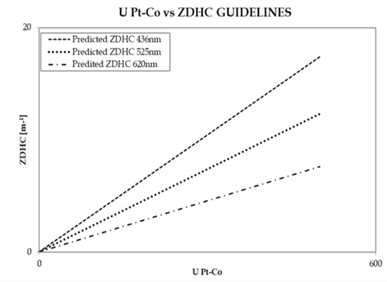












DISCUSSION

The raw data was prepared and, for each dyestuff and ETP sample, the correlation between Pt-Co and the absorbance at different wavelengths was identified. The predicted absorbances through the ANOVA analyses were calculated and a new linearized data set was prepared for the aggregation procedure. The linear equations Pt-Co vs. absorbance, at different wavelength and for each dyestuff and ETP sample, were aggregated using the Fisher test in order to check if the average values are reliable and can statistically describe the data population. The aggregate data was redefined to ensure that F was lower than F critical. The assumption H_0=0 was tested and proved. The final standardized data population, was identified and validated. For the ETP sample, the standard data population, each Pt-Co vs. absorbance set was weighted and converted in m^{-1} in order to develop the predictive tool Pt-Co → ZDHC guideline.

Some discrepancies were found between predicted-linearized aggregate absorbance and standardized-weighted absorbance. Further investigation on the field is required for a better calibration of the predictive model.