Evolution of colours in football shirts through colorimetric measurements: Fiorentina's case.

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ABSTRACT

Football fans express their identification with their team especially with colours of football shirts. The respect of “tradition” is something so important that very small changes can provoke anger in fans, who express their opposition in news and social media. This could create problems for merchandising. Fiorentina (Florence’s football team) wears purple shirts, very uncommon in football world. In collaboration with Fiorentina Museum we have measured, with two different spectrophotometers, colours of shirts from the fifties to nowadays. We have evaluated the problems related to ageing and we have measured different points from the same shirts, different shirts from the same season and details different from the purple colour (e.g white used for numbers). Measurement show a clear change in colour during the considered years, strictly related with the introduction of colour television and new strategy of merchandising. Furthermore it is evident that every kit manufacturer prefer creating its own colour despite the existence of an “official” Fiorentina’s colour. Such measurements, made on shirts of proved authenticity, permit to improve the analysis about “historical shirts”, helping to discriminate between authentic or fake shirts: an important topic because an original shirt from Fiorentina first Italian league winner season could be sold for 5000 €. One example of very well done fake shirts is illustrated.

KEYWORDS colorimetry, purple, colour in textiles, colour in sports, aging of textiles

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1. Introduction

Colours of shirt for football teams are a very important part in the process of identification from fans. A football club can change every player, president, trainer and this is completely acceptable for every fan, while a change in colour could be considered as a betrayal of its history. This could create problems for merchandising (Derbaix and Decrop, 2011). Fiorentina (Florence's football team) is one of the few teams in the world wearing purple shirts (Salvi and Savorelli, 2009). Probably for this reason shirt's colour is a very sensitive topic for Fiorentina's fans.

In the recent years the introduction of high definition colour television and new strategy of merchandising have assigned an important role to shirt's colour. Checking and reproduction of official colours of a football team is nowadays very important.

2. Material and Methods

Thanks to the help of Museo Fiorentina (www.museofiorentina.it) we have received at our lab 50 original shirts belonging to different sport seasons. Every shirt is called using the year of the second part of the season; as an example, the shirt used during the season 1958-1959 will bel called 1959. We have measured every shirt using a Minolta spectrophotometer CM-2500c with 10 nm of resolution, 45°/0° geometry optics and 360-740 nm wavelength range. We have checked our measurements using, on three samples, a very accurate instrument: a Perkin Elmer spectrophotometer lambda 900 with an integrating sphere. The measurements of the two instruments agree within the experimental error (CM-2500c has a repeatability of ΔE^*_{ab}=0.04 and an inter-instrument agreement ΔE^*_{ab}=0.06): we decided to use CM-2500c that permits to see the exact point of measurement. This peculiarity is very useful, because it permits to measure also shirts where some colour are present in a very small area. In order to apply some colorimetric formulas we have used some algorithms from (Westland et al) and some others written by ourselves.

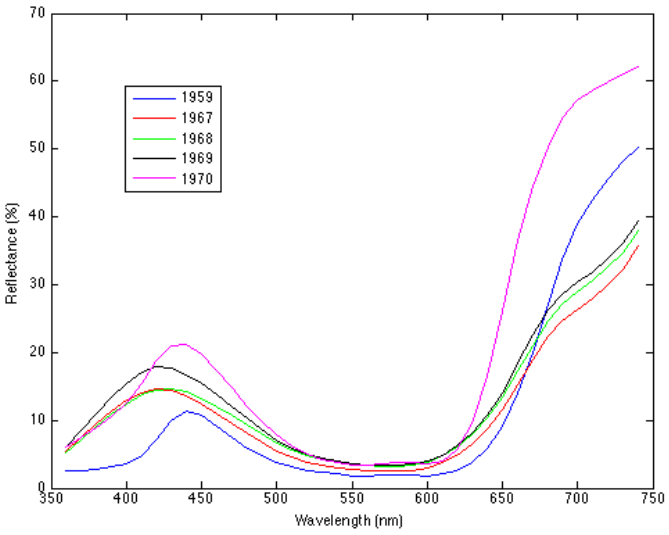

Fig. 1 – Reflectance spectra for 1959-1967-1968-1969-1970.

Fig. 2 – Fiorentina's shirt for season 1958-1959.

Ageing is a real problem in this kind of measurements. Nowadays every shirt is used only one time but during the 70's and before every shirt could be used and washed many times during a season, producing a degradation in colours. Furthermore, old shirts could be inhomogeneous in colours: in order to check this hypothesis, we have measured the same shirt (1959, the oldest available where the ageing problem should be greater) in ten different points apparently of the "same purple". The results expressed in the CIELAB system with 2° observer and D65 illuminant are are L^*=25.1±0.7, a^*=27.9±0.7, b^*=-42.4±0.9.

3. Experimental Results

For every shirt we can examine the reflectance spectrum and the colour coordinates. Here we present only some data in order to present the variability trough years: a complete report will be published in the future together with some psychophysical measurements that want to investigate if every Fiorentina shirt could be called "purple" nowadays. In Fig.1 the reflectance spectra of 1959 (the oldest shirt available at Museo Fiorentina when we made the measurements) 1967, 1968, 1969, 1970 are shown. The first 4 shirts are very dark (shirt of 1959 is presented in Fig.2). This is a typical feature of the shirts in the "golden age" of Fiorentina (Fiorentina won the championship in 1955-1956 and 1968-1969): a radio show devoted to Fiorentina is called "Viola Scuro" (Dark Purple in Italian) in order to create a link with these famous years. The 1970 shirt is redder and less dark.

1982 (Fig.3) is a very famous shirt for the history of Fiorentina because in that year many football team decided to renovate their shirt and their logo. Probably we can define 1982 as the first year of the "modern football". The year before Fiorentina's logo was completely renewed with an overlap between the traditional red fleur-de-lis and a capital "F", for Fiorentina. Supporters disliked it when it was introduced, but the logo remained until 1990. In the same year for the first time in Italy a sponsor name was allowed on the shirt.

1982 is the brightest shirt in Fiorentina history. Its difference is evident looking at Lightness, but also looking at reflectance spectra (Fig.4).

Fig. 3 - Fiorentina's shirt for season 1981-1982.

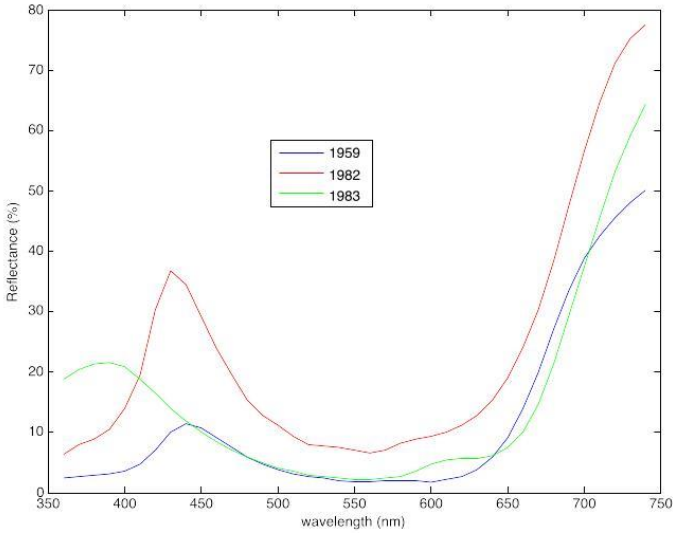

Fig. 4 – Reflectance spectra for 1959-1982-1983. 1982 is brighter compared with 1959 (that we can consider the golden standard) but also with 1983.

Another important year was 1978 because for the first time on Fiorentina's shirt appeared the logo of the "technical sponsor": Adidas. The "technical sponsor" is the factory producing shirt, socks, shorts and other part of the kit and should not be confused with the main sponsor previously cited that could be completely unrelated with football's world. In 1979 Adidas produce the first synthetic shirt (until that year the shirts were made using wool). Despite these great changes reflectance spectra are quite similar (Fig.5) because probably Adidas made a big effort to maintain the same colour.

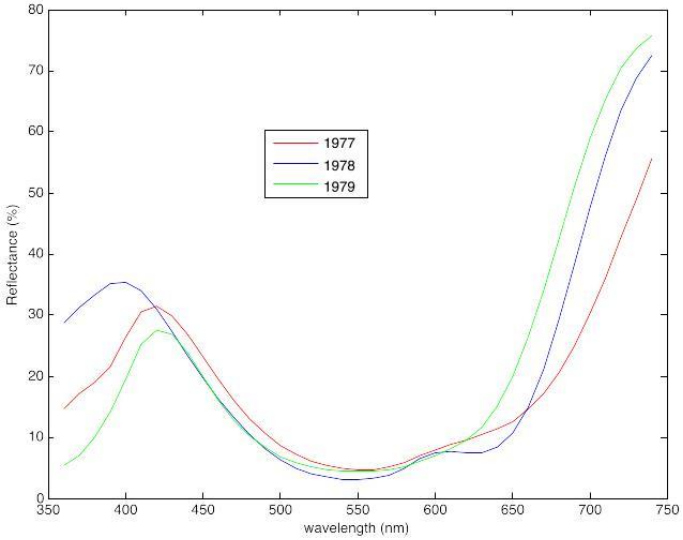

Fig.5– Reflectance spectra for 1977-1978-1979.

Transforming the CIELab coordinates into CIELCh coordinates (Wyszecki and Stiles) it is possible to study the evolution of the hue. We have calculated ΔH^*_{ab} (variation in the hue) using as reference point 1959 shirt. Using this approach, it is very evident the change in hue happened in 1970 (Fig.6).

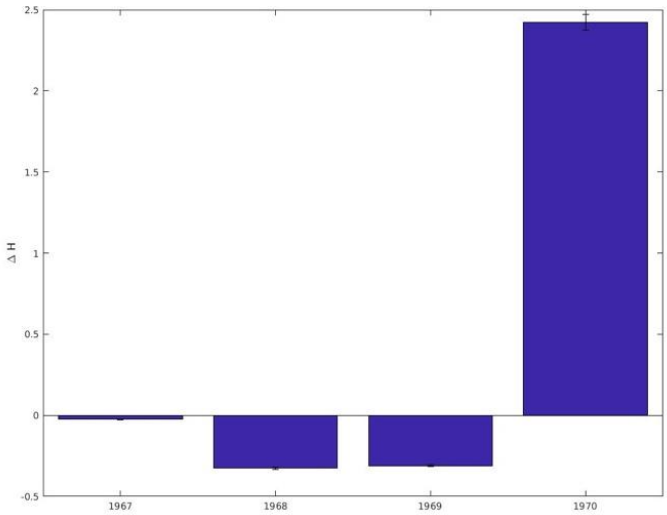

Fig.6– ΔH from 1959 evaluated for 1967, 1968, 1969. In 1970 there is a big change in hue.

But particularly interesting is the relationship between technical sponsor and hue. Every technical sponsor tends to use a "proprietary" purple, realising its own colour. Looking at Fig.7 we can note that there is a good correspondence between technical sponsor and hue.

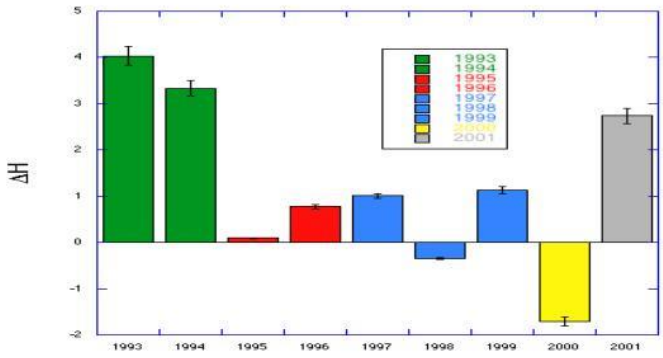

Fig.7– ΔH from 1959 evaluated for seasons from 1992-1993 to 2000-2001. At the same colour correspond the same technical sponsor

This behaviour is also evident looking at season from 2002-2003 to 2012-2013 (Fig.8).

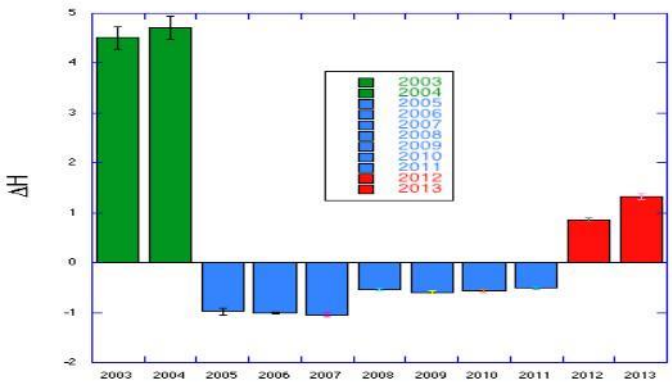

Fig.8– ΔH from 1959 evaluated for seasons from 2002-2003 to 2012-2013. At the same colour correspond the same technical sponsor

3.1. *Comparison between authentic and fake shirts*

Colorimetric analysis could be very useful also to distinguish authentic historical shirt from fake shirt. An authentic Fiorentina's shirt for example from 90's can be evaluated 300 €, but a shirt from 60's can be sold at 5000 € and this evaluation provokes a big market for fake reproduction. Recently we have examined a shirt pretending to be an original shirt from season 1969-1970. Comparing this shirt with two original shirts from Museo Fiorentina (Museo Fiorentina receives some shirts directly from players admitted to the Hall of Fame) we have noticed that the red of the fleur-de-lis in the tested shirt is completely different (ΔE_{ab}=9.3) from the red of the two original shirts. Instead the red of the two original shirts is the same (ΔE_{ab}=0.7). Obviously this is not a decisive proof, because in those years, before the introduction of official technical sponsor, some differences could be due to different suppliers. But it is a hint that, together with the analysis of textiles and weave, can help an expert in his/her evaluation.

4. Conclusions

Through the years purple in Fiorentina's shirts is changed in many different ways. While the first shirts are dark, nowadays we can see very bright shirts that result pleasant on the TV screen. A definitive Fiorentina's purple do not exist: every technical sponsor creates its own purple. A colorimetric analysis could be useful in order to discriminate between authentic and fake shirts.

We have inserted in this paper data regarding some interesting periods for Fiorentina's shirts. People interested to the whole archive of data can contact the authors.

5. Conflict of interest declaration

The authors state that no actual or potential conflicts of interest exist including financial, personal or other relationships with other people or organizations within three years of beginning the submitted work that could inappropriately influence, or be perceived to influence, their work.

6. Funding source declaration

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8. Short biography of the author(s)

Alessandro Farini - is a physicist with PhD in Optics. He is the head researcher of the VisionLab at the CNR-National Institute of Optics in Florence, lab devoted to Applied Psychophysics. Farini's research work is addressed to lighting, ophthalmic optics and colorimetry. He is teaching Geometrical Optics and Physical Optics at the University of Florence, degree in Optics and Optometry. Farini is involved in science outreach.

Elisabetta Baldanzi - Degree in Physics at Pisa University with a thesis entitled "collisional Coupling between the Stark components in the rotational spectrum of CH3F", Scholarship in Science Communication at the National Institute of Physics of Matter in Genoa, Targetti Foundation Lighting Academy Coordinator. Currently at the National Institute of Optics of the National Research Council based in Florence in the Laboratory of Ergonomics of View, research on issues related to psychophysics of vision, lighting and ophthalmic optics.

Marco Raffaelli - achieved in 2013 his bachelor degree in Optics and Optometry at the University of Florence, with a thesis entitled: "Photometric and psychophysical characterization of some mobile phone displays". Since November 2013 he has been working at the CNR-INO of Florence as diagnostic technician for the non-invasive study of artworks and as collaborator with the laboratory of psychophysics of vision.

Francesco Russo - was born in Florence and studied as an electrical expert at the Meucci Institute in Florence. He took a degree certificate in optics and optometry at the university of Florence in 2014 and, in the same year, the optical diploma at Vinci. He has been employed of

Gestione Silo (Florence) since 2015. This paper concerns his degree thesis.

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