

Preparation of Aniline Blue Model Fabrics for Investigating the Light-fading Characteristics of the Historic Textile Dye

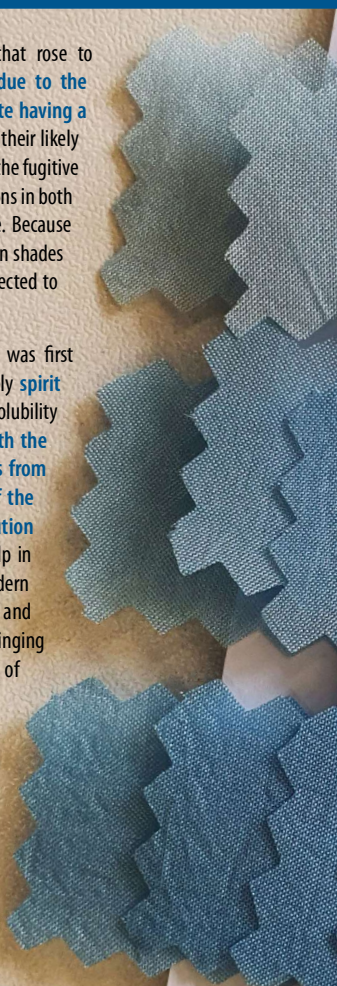
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- Aniline blue is among the early aniline dyes that rose to commercial prominence in the late 19th century due to the brilliance and range of colours that they offer despite having a reputation for low fastness. Their popularity suggests their likely presence in historic textiles from the period. Accounts of the fugitive nature of aniline blue towards light, including observations in both early and recent experiments, are recorded in literature. Because dyers tended to combine different dyes to achieve certain shades without much regard for chemical purity, it can be expected to find mixtures of synthetic and natural dye molecules.

- Dye manuals written shortly after 1860, when it was first synthesised, refer to three types of aniline blue, namely **spirit blues**, **soluble blues** and **alkali blues**, varying in solubility and method of application. **Cross-referencing this with the available information in colour chemistry textbooks from different time periods and the different editions of the Colour Index™, the generic names and constitution numbers of aniline blues were identified.** These help in understanding the dye's chemical constitution in modern chemistry terms, informing the selection of reagents and dyeing procedure for preparing model fabrics and bringing awareness of the limitation of the study in terms of representing historic textiles dyed with aniline blues.

- At present, aniline blues are sold more commonly as biological stains rather than textile dyes, typically consisting of Acid Blue 93 or Acid Blue 22, which are soluble blues. In an experimental study that uses model fabrics dyed with these stains, they would adequately represent a range of historic textiles dyed with aniline blue if they were applied using appropriate historic recipes.



Preparation of Model Fabrics

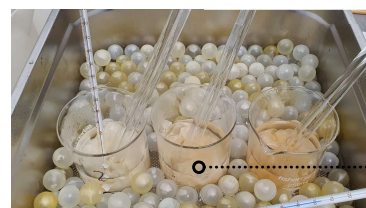
Model fabrics were prepared by dyeing scoured medium-weight plain woven silk habotai (Whaleys, Ltd.) using a procedure based on the recipes by Hummel in 1885 for dyeing silk. The aniline blue dye used in this study was purchased from Fisher Scientific. It was sold as Methyl Blue (Acid Blue 93, CI 42780, cat. no. H37721), a staining agent for examining biological samples. All additives used in dyeing were reagent grade.



- The aniline blue dye, which was initially in the form of lustrous brown solid crystals, was dissolved in deionised water, forming a brilliant blue stock solution.



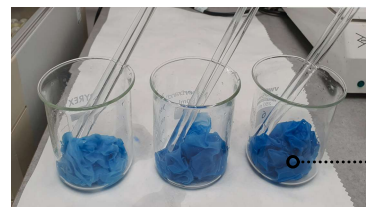
- The dye bath was prepared by adding an amount of dye stock solution to a 6% aqueous sodium carbonate solution. The solution became violet, and the colour became lighter as it was left to stand.



- Pieces of silk were dyed at different depths of shade in the alkaline dye bath at temperatures up to 100°C. As the temperature increased, the colour of the solution turned yellowish.



- At the end of the initial dye bath cycle, the pieces of silk only had a slight tinge of grey as they took up the dye in its colourless form.

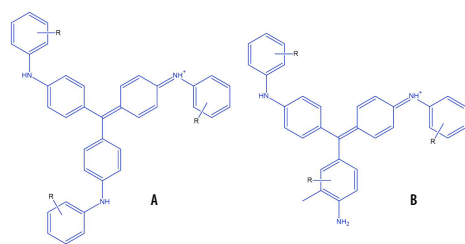


- After rinsing with water until it became neutral, the pieces of silk were transferred to a 6% aqueous sulphuric acid bath. The blue colour immediately developed upon immersion.

The fabrics were then rinsed until neutral, and air-dried.

Chemical Constitution and Application

The aniline blues are triarylmethane dyes, which are a class of some of the oldest synthetic dyes, characterised by their chromophoric system consisting of three aromatic rings bonded to a central carbon atom. They are also referred to as phenylated rosanilines as they were derived from rosaniline and pararosaniline, which are chemical constituents of the dye magenta.



	CIGN*	CI CN*	Core**	R
Solvent Blue 23	42760		A	3 H
Solvent Blue 3	42775		B	3 H
Acid Blue 119	42765	A	1 SO ₃ ⁻ , 2 H	
Acid Blue 110	42750	B	1 SO ₃ ⁻ , 2 H	
Acid Blue 48	42770	A	2 SO ₃ ⁻ , 1 H	
Acid Blue 93	42780	A	3 SO ₃ ⁻	
Acid Blue 22	42755	B	3 SO ₃ ⁻	

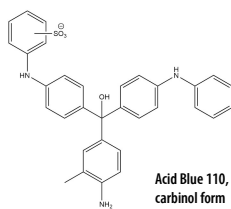
* Colour Index™ generic name and constitution number

** Pararoslaniline core (A) or rosaniline core (B)

- Spirit blues, which were the first aniline blues to be synthesised, are composed mainly of diphenyl and triphenyl derivatives of rosaniline and pararosaniline. The additional phenyl groups make the structure bulky and nonpolar, so preparing a stock solution of spirit blues required using an organic solvent, such as alcohol, instead of water.

- Soluble blues, which are water-soluble aniline blues classified in the Colour Index™ as acid dyes, were later synthesised by converting spirit blue molecules to sulphonic acids, similar to how indigo is treated to from the water-soluble indigo carmine. The monosulphonic acid derivative is called Nicholson's blue or alkali blue because it was applied to textiles in an alkaline bath.

- While dyes under the same Colour Index™ chemical classification tend to have similar application methods, this is not always the case as some dyes, like aniline blues, can be applied in several ways. Acid Blue 110 and Acid Blue 119, for example, are referred to as alkali blues because of their distinctive method of application. The fabric is dyed in an alkaline bath where the fibres absorb the dye in its colourless carbinol form. It is then transferred to an acidic bath, in which the conjugated system of the dye molecules is recovered, and the blue colour is developed.



Selected References

- American Association of Textile Chemists and Colorists and Society of Dyers and Colourists. Colour Index. 3rd ed. Vol. 1. Bradford, Yorkshire, England: Society of Dyers and Colourists, 1971.
- Barnett, Jennifer C. "Synthetic Organic Dyes, 1856–1901: An Introductory Literature Review of Their Use and Related Issues in Textile Conservation." *Studies in Conservation* 52, no. sup1 (June 2007): 67–77. <https://doi.org/10.1179/sic.2007.52.Supplement-1.67>
- Forster, Sam Vettese, and Robert M Christie. "The Significance of the Introduction of Synthetic Dyes in the Mid 19th Century on the Democratization of Western Fashion." *Journal of the International Colour Association* 11 (2013): 1–17.
- Hummel, J.J. *The Dyeing of Textile Fabrics. Manuals of Technology*. London: Cassell & Company, Ltd., 1885. <https://www.worldcat.org/title/4297916>
- Travis, Anthony S. *The Rainbow Makers: The Origins of the Synthetic Dye Industry in Western Europe*. Book, Whole. London;Bethlehem, Pa; Lehigh University Press, 1993.
- V&A Collections. "Day Dress," March 28, 2006. <https://collections.vam.ac.uk/item/O122391/day-dress-unknown/>
- Venkataraman, K. *The Chemistry of Synthetic Dyes*. Vol. 2. 8 vols. New York: Academic Press, 1952. <https://go.exlibris.link/1nIVjp7P>



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