Biochrome

Any Pigment Produced by a Living Organism

What is Biochrome?

The environmental toxicity, mutagenic and teratogenic nature *(Chauhan,& Pathak, 2013)* of synthetic origin pigments have lead to escalating interest towards natural pigments *(Chauhan, Dalsaniya,& Pathak, 2015)* that are biodegradable and environmentally-friendly *(Venil, Zakaria,& Ahmad, 2013)*. The application of biochromes in textile dyeing is free from disposal problems and does not cause pollution *(News and Insights, 2020)*. In addition many natural dyes have inherently antimicrobial properties *(Kasiri,& Safapour, 2013)*. Furthermore, some natural dyes, such as carmine found in lipsticks, will not cause harm or health problems when ingested *(News and Insights, 2020)*. Natural colour can come from both organic, namely plants (flowers, stems, leaves, bark, wood and algae), animals (insects and mollusks) and organisms (bacteria and myco), and inorganic, minerals (earth, rocks, salts and metals), sources *(Raspanti, 2019)*. Colour application on different materials can be segregated into dyes (a liquid bath that is soluble in water and can also be absorbed into materials), inks (a dense liquid that is soluble in water and can be absorbed into material) and pigment (a powder that is insoluble in water and can only be applied onto materials) *(Raspanti, 2019)*.

The Process of Making Biochrome

Natural Dyes
A huge component of looking at natural dyes is studying animal fibers and vegetable fibres. Animal fibres (wool, silk, angora, mohair, alpaca and camel) are protein-based and have scales that open with heat, allowing the dyes (binded to the mordants which attaches to the cortexes of the fibre) to fully penetrate the material while vegetable fibers (cotton, linen, ramie, hemp, sisal, jute and viscose) are cellulose-based and have a much harder time absorbing and bonding with the mordants (needing to be combined with tannins or soaked beforehand in sodium carbonate to expand the fibers enough for the mordants to penetrate and for the dyes to bond with the mordants). The process includes weighing of dry fibres, washing and scouring said fibers, adding mordants (alum, iron or copper) to the fibers, preparing a dye bath that is enough to submerge the fibers completely based on the weight of dry fibers, measuring the pH of the dye, rinsing with lukewarm water and choosing between changing the colour by mordanting or by modifying the pH of the liquid (acidic, alkaline, copper, iron modifiers) used for rinsing *(Raspanti, 2019)*.

Bacteria Dyes
A dye is a coloured substance that chemically bonds to the substrate to which it is being applied. The bacteria dyeing process includes placing the textiles in an autoclave bag at 121 degrees, mixing the growing medium, sterilising the textiles, petri dishes and growing medium in a pressure cooker, sterilising the work area with ethanol and camping gas, tagging the petri dishes, pouring the growing medium and placing of sterilised textiles in the petri dishes and inoculating the petri dishes with bacteria *(Raspanti, 2019)*.

Natural Inks
Ink compositions require a vehicle (the liquid in which the pigment is suspended such as water, ethanol, oil and gel), a binder (the substance that acts like a glue between the dye stuff and the liquid such as arabic gum) and an additive (the substance that helps with stabilising, intensifying, modifying, preserving or thickening the ink such as guar gum). The process
includes combining dye stuff and vehicle (water is used for regular inks and ethanol 96% is used for marker inks), boiling and stirring (reducing the dry dye stuff into a thick liquid is essential for regular inks while stirring and extracting colour by mixing the dye stuff with more ethanol multiple times is nec essary for marker inks) and preserving, thickening and modifying (salt is a great addition to stabilise and preserve
water-based inks, acids and alkalis can be used to change the appearance of colours, arabic gum helps to thicken and stabilise regular inks; marker inks do not require salt or guar gum to be added) *(Raspanti, 2019)*.

Pigments
Pigments are colours that stay colourful and are used to preserve and recyle dyes. The process includes precipitating, filtering and drying and grinding and mixing. To precipitate, simmer down the leftover dye bath, pour the leftover dye bath into a narrow container, add a dissolved alum (20g) solution and then a dissolved sodium carbonate (5g) solution to the dye bath and stir till the effervescence seizes. To filter and dry, let the pigment fully separate from the leftover water by allowing the mixture to rest. Once settled, pour the water into a paper coffee filter. After which, place the filter with pigment to dry. To grind and mix, scrape the pigment off the paper coffee filter, grind the collected pigment with a mortar and pestle, mix different pigments together to create clear shades and colours or mix pigment with arabic gum, soy milk or linseed oil to create paints and watercolours *(Raspanti, 2019)*.

How Environmentally-Friendly is Biochrome?

+ Safe, Non-toxic and Hypoallergenic Highly Sustainable Biodegradable Renewable Resource

+ Mild Dyeing Conditions (Tao, 2021)

+ Higher Ultraviolet Absorption in Fabrics They Are Used on (Campbell, 2019)

+ Zero Waste Water
Lack of chemicals and toxic products means that all the waste water can filtrate out to neighbouring farms to be re-purposed *(Luna & Rose, 2021)*.

– May Not be Entirely Natural
Some mordants (heavy metals such as lead, chrome, copper and mercury) are toxic and can poison the environment if handled improperly. Chemicals can also be added during the growing and harvesting of plants, making the dye inorganic *(Fabric of the World, 2020)*.

– Inconsistencies in Quality
Due to differences in soil pH levels and unpredictable weather patterns, the quality of dye extracted from plants can not be inconsistent. To achieve consistency, the plants need to be grown in a controlled environment. This is impractical, given the high amount of dye required for the mass production of textiles. Natural dyes also fade under light exposure and are washed off easily *(Fabric of the World, 2020)*.

– Naturally Substances May be Poisonous
Hematin and hematoxlyn, found in logwood, a naturally occurring dye, are very poisonous and should not be inhaled or absorbed through the skin *(Fabric of the World, 2020)*. Bloodroot, another natural dye source, can cause irritation and inflammation *(News and Insights, 2020)*.

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