SULFUR DYES

+ What are sulfur dyes?

Sulfur dyes are a class of dyes used to dye cotton. They are fairly cheap and have good wash and lightfastness. They can be applied using conventional dyeing systems such as continuous woven, denim warp and knitted goods in jet machines.

Sulfur dyes have a limited range of hues and are mostly black, brown and dark blue.

They are insoluble in water, tend to be very large molecules with high molecular weights and always contain at least one sulfur atom. In many cases, the actual dye structure is unknown and reaction mechanisms are not fully understood.

+ What is the application of sulfur dyes?

Sulfur dyes are used to dye cotton, either in the yarn or fabric form. Because they do not dissolve in water, a strong reducing agent such as sodium sulfide or sodium hydrosulfide is required to make the dye water-soluble. This reaction requires a high temperature and the presence of an alkali to raise the pH.

Once the dye is water-soluble, it can be absorbed easily by the yarn or fabric. After the yarn or fabric is removed from the dye solution, the substrate is left in the open air so that the dye can oxidise and become water-insoluble again, thus providing color with good fastness properties.

+ What currently limits sulfur dyes as an input for the circular economy?

One of the biggest limitations for sulfur dyes as an input for the circular economy is the use of wasteful and highly toxic dye auxiliaries required for the dying process. One of these auxiliaries, sodium sulfide, is eventually released into the effluent and is not biodegradable.

+ Why were sulfur dyes chosen for the Call to Innovation?

Sulfur dyes were chosen for the Call to Innovation because they are commonly used to dye denim and provide a range of colors to accompany standard indigo-dyed jeans. In addition, they can be used with indigo dye to provide different hues such as red-cast indigo or green-cast indigo. They can be bleached and washed to give a variety of shades and different visual aesthetics, just like indigo.

+ What is the action plan for sulfur dyes through the Call to Innovation?

Fashion Positive PLUS members have identified a new range of sulfur dyes from Archroma, called Diresul® RDT, with high potential as an input to the circular economy.

Diresul® RDT dyes can be further split into EarthColors, derived from biomass, and Advanced Denim, designed to mimic and potentially replace indigo. Diresul® RDT dyes were chosen because they were designed with sustainability in mind and play a vital role in the denim industry by providing additional shades and hues.

The Fashion Positive PLUS members engaged Archroma in May 2017 to begin the certification process for both EarthColors and Advanced Denim. Once these dyes have been optimized and certified, they will be added to the Fashion Positive Materials Collection.

Diresul® RDT and EarthColors have the following sustainability attributes that make them good candidates for *Cradle to Cradle Certified* GOLD level certification.

+ Do not contain azo structures
+ Do not contain metals
+ Use biodegradable reducing agents such as dextrose and glucose
+ Compared to conventional sulfur dyes, less water is required during the synthesis of EarthColors
+ EarthColors are reduced with non-sulfide reducing agents such as dextrose, which results in less polluted dyebath effluent.

+ What's exciting about priming EarthColors and Advanced Denim as an input for the circular economy?

EarthColors and Advanced Denim embrace a holistic sustainability approach from concept to manufacture, which fits into the Cradle to Cradle framework.

EarthColors are biosynthetic sulfur dyes because they are derived from natural waste products such as almond shells and rosemary leaves, thereby diverting waste from the landfill. EarthColors also provides supply chain transparency.

Advanced Denim can replace indigo. Its main sustainability attributes are the water and energy savings that result during the dyeing stage when compared to conventional indigo dyeing.