

+ What are reactive dyes?

Reactive dyes are a class of dyes that consists of highly colored, bright shades. They attach themselves permanently to the substrate – e.g., cotton, wool, nylon or silk – by a chemical reaction that forms a strong bond between the dye molecule and the fiber, thus resulting in textiles with good wash fastness properties.

Reactive dyes are the most important method for the coloration of cellulosic fibers because they result in high quality textiles in a wide variety of shades. The dyes can be applied using conventional dyeing systems and the textile can be dyed in the yarn, fabric or garment state. In addition, both woven textiles and knitted textiles can be dyed very effectively with reactive dyes.

+ What is the application of reactive dyes?

Reactive dyes are used to dye cellulosic materials such as cotton, rayon, linen, flax and lyocell. They can also be used to dye protein fibers such as wool and silk as well as nylon, but the reaction conditions are different than for cellulosic materials.

Reactive dyes are very soluble in water but during the dyeing process, they require high temperatures and salt to facilitate the movement of the dye towards the textile. Soda ash or some other alkali is used to fix the dye onto the textile. After dyeing, the fabric must be washed and rinsed several times to remove any unreacted dye and to ensure that the resulting fabric meets brand quality standards.

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

One of the biggest limitations with reactive dye as an input for the circular economy is the use of a large amount of toxic auxiliaries such as salts, soda ash and detergents during the dyeing process. Although salt and soda ash are not necessarily hazardous chemicals on their own, the sheer volume of these chemicals can change the salinity and pH of freshwater ecosystems.

Many reactive dyes are also sourced from non-renewable sources and thus contribute to wasteful use of petroleum derived chemicals. Some reactive dyes for cellulose may also contain relatively scarce metals such as copper.

Finally, some reactive dyes have low fixation rates, which means that not all of the dye is fixed onto the textile. Any dye that is not fixed ends up in the wastewater and ultimately the environment unless it is treated by wastewater treatment facilities, limiting the reuse or biodegradation of the dye.

+ Why were **reactive dyes** chosen for the Call to Innovation?

Reactive dyes for cotton were chosen for the Call to Innovation because they are commonly used to dye cellulosic materials. Many cause environmental pollution by, for example, releasing unreacted dyestuff and other auxiliary chemicals, which may result in high levels of salinity. All of these residual chemicals can affect local ecosystems. To find and certify reactive dyes that have high degrees of fixation and use less water, energy, salt and soda ash during the dye cycle is a huge environmental benefit given the volume of reactive dyes that are used and the positive impact they could have as a result.

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

Fashion Positive PLUS members have identified nine specific reactive dyes from Dystar Group with potential as inputs for the circular economy. These dyes, from the Remazol® or Levafix® product ranges, have been specifically chosen based on their potential for *Cradle to Cradle Certified GOLD* level certification.

The dyes were chosen because they have already been awarded a GOLD level material health certificate from *Cradle to Cradle Certified*. Many shades can be made from a library of nine dyes, so certifying these dyes will result in a versatile palette.

The Fashion Positive PLUS members engaged DyStar in May 2017 to begin the full certification process for both the Remazol® and Levafix® dyes. Once these dyes have been certified, they will be added to the Fashion Positive Materials Collection.

The nine dyes have the following sustainability attributes that make them good candidates for full *Cradle to Cradle Certified GOLD* level certification.

- + Do not contain azo structures
- + Do not contain metals
- + Compared to conventional reactive dyes, less water, salt and soda ash are required during dyeing
- + These dyes have higher fixation rates than other reactive dyes.

+ What's exciting about priming **reactive dyes** as an input for the circular economy?

Reactive dyes are a popular class of dyes, the majority of which, pollute the environment and require a high chemical load. Optimizing a subset of reactive dyes in the textile dye market that can instead be inputs for the circular economy would drive much needed change and generate greater awareness.