Case Study - Reactive Dye Process Waste Water Treatment

One issue with the use of reactive dyes in a dying production process is the presence of residual dye in the waste water stream by the time it reaches local municipal WWTP. Color is a parameter that is used to determine the quality of waste water treatment and an excess of dye result in regulatory problems with the municipal WWTP.

Reactive Dyeing/Production Process:

The process begins with hot water ~150°F with the addition of soda ash and sodium chloride. These reactants are added to increase the efficacy of the reactive dying process.

The reactive dye is added to this solution.

The cloth is then added to the reactants and allowed to take up the reactive dye solution for 60 minutes.

This is followed by a number of cold and warm water rinses of the cloth to remove any residual dye.

These reactants and rinse water are then discharged into a waste water collection pit and storage tanks with a total capacity of 2,000 gallons.

Current Waste Water Process:

The waste water is treated with a combination of sodium hydroxide, sodium borohydride and sodium metabisulfite each in an aqueous solution and each metered in separately.

The material is allowed to react for ½ hour.

After reaction time the pH is shifted down with acetic acid. The waste water is tested color metrically prior to being released to the municipal WWTP.

Process Discussion:

This type of treatment being conducted is a way of masking the color of reactive dye by changing its physical chemistry by the addition of stabilizers and pH changes.

When this waste water reaches the larger flow of the municipal waste water the stabilizers and pH changes are diluted allowing the reactive dye to change back to its visible form. Because of the way the water is being treated it is important that we begin to review methods that actually oxidize the dye molecule to reduce or remove the color in the waste stream.

Oxidation is the process by which the reactive dye molecule is changed and broken chemically not allowing it go back into a visible dye. This can be done with extremes in pH through the addition of concentrated acids and bases or it can be done with other oxidants such as ozone and peroxides.

The issues with extreme pHs is that the use of concentrated acids can be dangerous, adds to worker safety, reoccurring expense and can result in more complex issues with waste water treatment.

The issues with the addition of peroxides are that the use of concentrated forms of hydrogen peroxide is similar to those of the concentrated acids.

In addition, both of the above mentioned treatments can increase BOD and COD of waste water discharge. Ozone is “Environmental Friendly” and the most powerful oxidizer commercially available in the market today with less worker safety issues. Ozone also improves the overall wastewater quality with no residues that make the treatment of the waste water more complex. The use of ozone oxidation systems have been used to control color in water for the past several decades.

Improvements to Current Process:

The addition of an equalization (EQ) tank will collect waste water in a larger volume allowing more retention time that will have a more stable less variable waste stream to treat. This EQ tank will also give the waste water an opportunity to cool down and provide greater contact time with any oxidation method (1/2 hour is not enough) while allowing for a more controlled and improved efficiency of the oxidation process.

The waste water needs to be cooler to treat. Oxidation reactions are usually exothermic (they give off heat) which increases the heat of the waste stream. Elevated temperatures can make oxidation reaction more difficult to maintain. Elevated temperatures of a solution with a great deal of oxidizers present can cause worker safety issues.

Conclusions:

The current treatment used could be altered to have the dye remain masked until it gets through the municipal treatment system. However, doing this is not the best option for regulators because it is not really altering the waste stream in a consistent and permanent fashion. This is not the best option for a business because the system limits the production expansion and production flexibility that could occur.

Adding an EQ tank will allow a cooler more stable waste stream to efficiently treat. Waste water should be cooled prior to being treated regardless of the treatment system. Most oxidation treatments work in a more efficient and controllable fashion below 70°F.

The waste water needs to go through an oxidation system that will allow for the chemical conversion of the reactive dye molecules instead of masking the dye. Having an ozone oxidation step should be the safest and most effective method available and the use of different oxidizers can be used in combination if required. Improve waste water delivered to the municipal WWTP as well as a more flexible and expandable system.

Sample picture represent ozone oxidation with no additional chemicals or filtration. The oxidation steps can be accompanied with a filtration step that would allow any residual oxidized dyes to be adsorbed.

Please contact us should you need additional information or have any questions.

Sincerely,

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