CLEAR

SUSTAINABLE DYEING PRETREATMENT

OSM SHIELD, INC.

2023

OSM SHIELD™

WWW.OSMSHIELD.COM

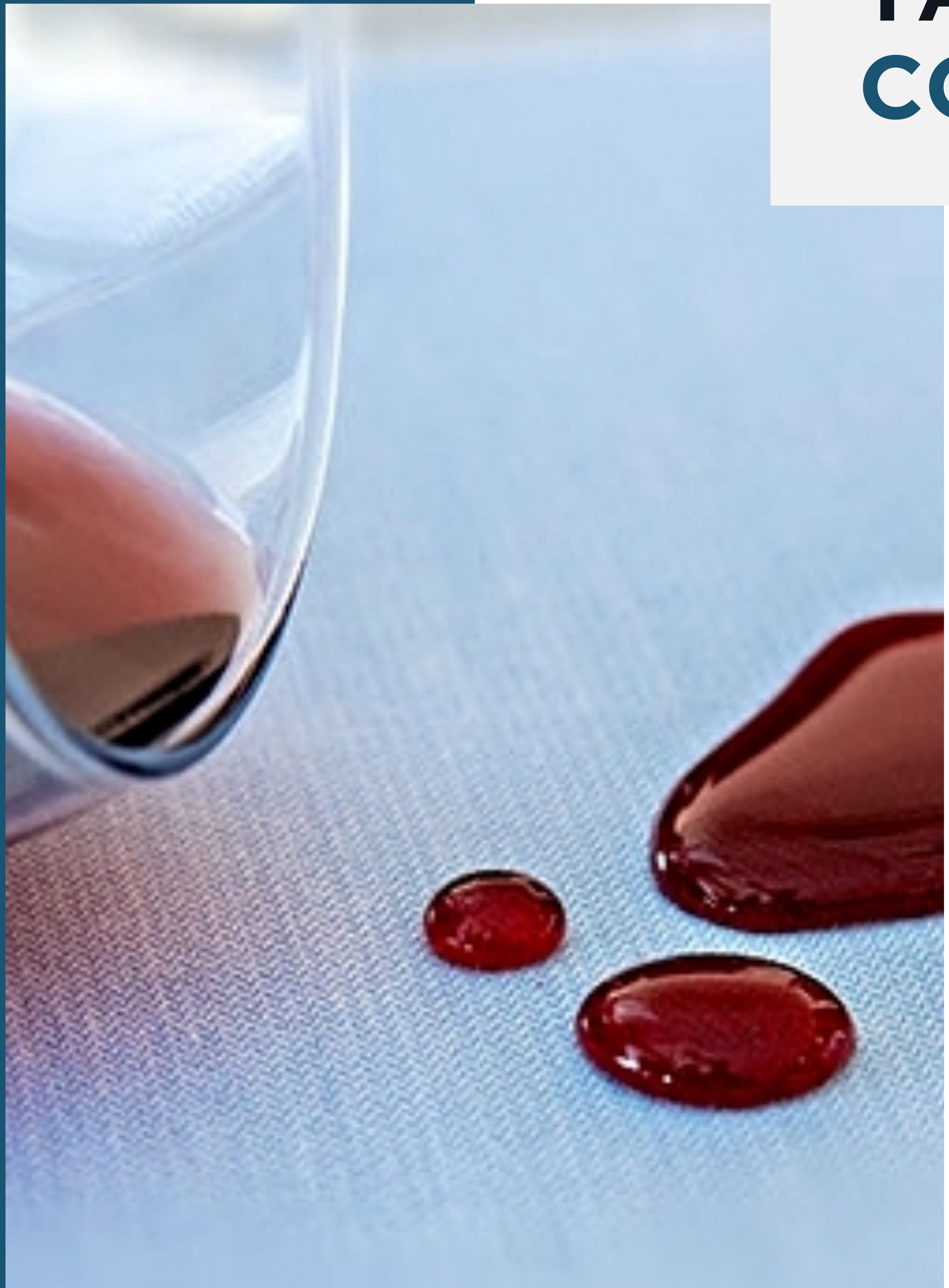


TABLE OF CONTENTS

CLEAR

CLEAR is a revolutionary cellulosic dye pre-treatment chemistry that allows for increased dye uptake, controlled strike rate, recyclability of the dye bath, 50% increased throughput, 82% water savings, 50% less dyestuffs, and 50% reduction in energy usage.

The CLEAR chemistry eliminates the need for salt or alkali and can be applied either by exhaustion or pad-dry-cure.

CLEAR provides 99.9% dye exhaustion and results in virtually zero effluent.

Textile dyeing is one of the most polluting aspects of the global fashion industry, devastating the environment and posing health hazards to humans.

https://www.cnn.com/style/article/dyeing-pollution-fashion-intl-hnk-dst-sept/index.html

INTRODUCTION

Fashion is responsible for up to one-fifth of industrial water pollution, where wastewater is commonly dumped directly into rivers and streams. The discharge is often a cocktail of carcinogenic chemicals, dyes, salts and heavy metals.

The cheapest way for factories to get rid of unusable, chemical-laden wastewater is to dump it into nearby rivers and lakes.

The fashion industry uses around 93 billion cubic meters (21 trillion gallons) of water annually, enough to fill 37 million Olympic swimming pools, according to the Ellen MacArthur Foundation. Along with finishing, dyeing is the most polluting and energy-intensive processes involved in making our clothes.

Producing a single pair of jeans consumes around 7,500 liters (2,000 gallons) of water, from growing raw cotton to finished product, according to the United Nations.

The rivers and canals that run through Dhaka have turned a "pitch black color" due to the sludge and sewage produced by textile dyeing and processing factories. The water is "very thick ... like tar."

Not all of the chemicals and solvents used are hazardous, though the World Bank has identified 72 toxic ones that stem solely from textile dyeing. Once in waterways, they accumulate to the point where light is prevented from penetrating the surface, reducing plants' ability to photosynthesize. This lowers oxygen levels in the water, killing aquatic plants and animals.

https://www.cnn.com/style/article/dyeing-pollution-fashion-intl-hnk-dst-sept/index.html

INTRODUCTION

Once in the wastewater, dyeing chemicals are difficult to remove, said Sarah Obser, head of sustainability at PFI Hong Kong, a company that provides environmental and factory audits in Asia. "The substances don't degrade so they remain in the environment." Also among them are chemicals and heavy metals that can build up in the body, increasing the risk of various cancers, acute illnesses and skin problems. Others have been found to increase in toxicity as they work their way up the food chain.

But change is happening. In Bangladesh, there are signs textile producers are taking environmental responsibility more seriously, with brands committing to initiatives, such as the Partnership for Cleaner Textile (PaCT), that tackle water, energy and chemical use in the industry.

The fashion industry as a whole has undergone what Greenpeace East Asia's Toxics Campaign Manager Ada Kong describes as "a paradigm shift" in its awareness of how chemicals are impacting the environment.

Greenpeace's ongoing "Detox My Fashion" campaign that aims to eliminate hazardous chemicals from the fashion industry has, since 2011, seen big brands like H&M, Adidas and Levi's committing to identifying suppliers and implementing tougher environmental regulations and chemical management in their factories and supply chains.

There has also been a push for innovation in finding alternative chemicals and new technologies.

Yet, ridding the fashion industry of hazardous chemicals is likely to become even more challenging as our clothing addiction increases. Apparel consumption is set to rise by 63% to 102 million tons a year in 2030, according to a 2017 Pulse of the Fashion report.

https://www.cnn.com/style/article/dyeing-pollution-fashion-intl-hnk-dst-sept/index.html

CATIONIC COTTON DYE PRETREATMENTS

Today there are other cationic pretreatments available in the marketplace. The most recognizable is 3-chloro-2-hydroxypropyltrimethyl ammonium chloride (CHPTAC).

CLEAR is a superior alternative to CHPTAC:

- CHPTAC requires a cold-pad-batch pretreatment process which takes 16 hours to complete, followed by several washings and neutralizations with citric acid. CLEAR utilizes a dip-pad-dry-cure process that takes less than 3 minutes followed by a simple rinse prior to dyeing.
- CHPTAC has a high strike rate and requires process changes to compensate whereas CLEAR has a controllable strike rate
- A 40% loss of CHPTAC can occur during the dye process due to hydrolysis, which ends up in the effluent.
- CHPTAC's molecular structure contains epoxy, which poses potential for occupational hazards
- CHPTAC needs to react with alkali to form EPTAC - the active form in the traditional cationic cotton process. EPTAC is a category 2 carcinogen and irritating to skin, eyes, and membranes. CLEAR doesn't depend on any epoxy type reactions to fixate to the cellulose.
- CHPTAC has a strong fish smell while CLEAR does not.
- CLEAR results in a clear and recyclable dye bath at the end of the dyeing cycle. CHPTAC does not.

For more info see Exhibit B

CLEAR FEATURES & BENEFITS

- Significantly improved color yield
- Epoxy free and hence non-combustible
- No hydrolysis
- Controllable strike rate
- Effective with acid dyes, direct dyes, and reactive dyes
- Environmentally safe for people and the planet
- Requires only a single rinse cycle after dyeing
- No salt or alkali required
- Greater than 99.9% dye exhaustion
- Clear dye bath after dyeing allows for recyclable dye bath
- 50% energy savings
- 50% less dyestuffs
- 82% less water consumption
- 50% increased throughput
- 50% increased Return on Asset (ROA)
- Virtually zero effluent
- Cost effective
- Can be applied as a liquid emulsion on conventional tenter frame equipment using a dip-pad-dry-cure application method.

TEXTILE PROCESSING STEPS - KNITS

Dye Process for Cotton Knit Fabric - Standard Process

- Prepare yarns for knitting
- Knit fabric
- Scour
- Bleach
- Rinse
- Dye
  - Direct or Reactive dye using salt, alkali (soda ash)
- Rinse Cycle - 2x for light shades
- Rinse Cycle - 4x for medium shades
- Rinse Cycle - 6x for dark shades
- Slit
- Finish
- Cut & sew

Dye Process for Cotton Knit Fabric - CHPTAC

- Prepare yarns for knitting
- Knit fabric
- Scour
- Bleach
- Rinse
- Slit
- CHPTAC pretreatment
- Batch for 16 hours
- Heavy wash and neutralize
- Dye
  - Direct or Reactive dye without salt, alkali
- Single Rinse Cycle
- Finish
- Cut & sew

Dye Process for Cotton Knit Fabric - CLEAR

- Prepare yarns for knitting
- Knit fabric
- Scour
- Bleach
- Rinse
- Slit
- Pretreatment with CLEAR chemistry
- Light rinse
- Dye
  - Direct or Reactive dye without salt, alkali
- Single Rinse Cycle
- Finish
- Cut & sew

TEXTILE PROCESSING STEPS - WOVENS

CLEAR

Dye Process for Cotton Woven Fabrics - Standard Process

- Size warp yarns
- Weave fabric
- Desize
- Scour
- Bleach
- Rinse
- Dye
  - Direct or Reactive dye = salt, alkali (soda ash)
- Rinse Cycle - 2x for light shades
- Rinse Cycle - 4x for medium shades
- Rinse Cycle - 6x for dark shades
- Finish
- Cut & sew

Dye Process for Cotton Woven Fabrics - CHPTAC

- Size warp yarns
- Weave fabric
- Desize
- Scour
- Bleach
- Rinse
- CHPTAC treatment
- Batch for 16 hours
- Rinse and neutralization
- Dye
  - Direct or Reactive dye without salt, alkali
- Single Rinse Cycle
- Finish
- Cut & sew

Dye Process for Cotton Woven Fabrics - CLEAR

- Size warp yarns
- Weave fabric
- Desize
- Scour
- Bleach
- Rinse
- Pretreatment with CLEAR chemistry
- Light rinse
- Dye
  - Direct or Reactive dye without salt, alkali
- Single Rinse Cycle
- Finish
- Cut & sew

PERFORMANCE

CLEAR significantly improves color yield when dyeing cellulosic fabrics, with performance gains of up to 78% color yield improvement.

CLEAR pretreated fabrics are comparable to untreated fabrics in:

- Colorfastness to dry crocking
- Colorfastness to wet crocking
- Colorfastness to laundering
- Colorfastness to light – 20 and 40 hours

CLEAR has a controllable strike rate which helps ensure levelness of dyeing.

For more information see OSM's "Performance, Cost Savings, and Environmental Accountability" presentation.

COST SAVINGS

CLEAR reduces dyeing costs specific to: labor, water, energy, dyestuff, salt, alkali, and increases return on assets (ROA) and operating leverage:

- Up to 23% reduction in variable/direct costs*
- 50% increased throughput
- 82% decrease in water consumption
- 50% energy savings
- 50% reduction in dye costs
- No salt or alkali required
- 50% greater return on assets (ROA)
- 50% increase in operating leverage
- Single rinse cycle after dyeing
- Virtually eliminates effluent disposal and associated costs

For more information see OSM's "Performance, Cost Savings, and Environmental Accountability" presentation.

* In one costing case study performed by OSM, using the CLEAR chemistry results in an increased margin contribution of 23%.

ENVIRONMENTAL ACCOUNTABILITY

CLEAR results in 82% less water usage through increased dyeing efficiency, a 99.5% reduction in effluent disposal, and 50% energy savings.

For more information see OSM's "Performance, Cost Savings, and Environmental Accountability" presentation.

MARKET OPPORTUNITY

- The Global Reactive Dyes Market is projected to be worth USD $8.20 Billion by 2030 registering a CAGR of 9.3% during the forecast period 2021–2030.
- 27 million tons of cellulosic fabric is produced annually.
- Reactive dyes are the fastest growing dye segment.
- CHPTAC is a cationic etherification pretreatment agent for cellulosic fabrics to improve the bonding of dyes to the fibers during the dyeing process.
- Current cellulosic dyeing processes require massive amounts of water, salt, and alkali, are damaging to our environment, and are inefficient and wasteful.
- **Replace traditional cellulosic dyeing processes and CHPTAC with CLEAR, a new sustainable dye pretreatment chemistry application - positioned as a much more cost effective, production efficient, sustainable, safe, and environmentally friendly alternative.**

EXHIBITS

CLEAR DYE BATH VIDEO

Beaker on the left:

-Standard reactive dyeing procedure using salt and alkali
-Resulted in only 70% to 80% dye exhaustion leaving behind salt, alkali, and unexhausted dye in effluent
-Bath must be dumped after dyeing
-Deep shades require up to 6 rinse cycles
-Effluent disposal problems

Beaker on the right:

-Fabric pretreated with CLEAR
-50% less dyestuff
-Dye cycle takes 50% less time
-No salt or alkali
-Single rinse cycle
-99.9% dye exhaustion
-Clear bath at the end of the dye cycle – NO EFFLUENT!
-Dye bath can be recycled 5X or more times

EXHIBIT A

THE FACTS

Some Facts on Dyeing Cellulosic Fabrics

1. Cellulosic fabrics require aggressive treatment steps prior to and during dyeing, First, the fabric must be desized, scoured, and bleached.
2. When a cellulosic fabric is placed in an aqueous solution, the fabric surface acquires a negative charge, which repels the negatively charged dye molecules in direct and reactive dyes. To offset the negative charge on the fabric surface, large quantities of salt are required to enhance the dye uptake when working with reactive and direct dyes. Alkali is also added to the dye bath to improve dye fixation when using reactive dyes. This generates an effluent containing a significant amount of chemical waste that has an adverse impact on the environment, aquatic life, and humans. Furthermore, this conventional dyeing process requires significant volumes of water, which generates a consequential amount of wastewater at the end of the dyeing process.
3. To eliminate the need for large amounts of salt and alkali, significantly save water and energy, enhance the affinity of cellulosic fabrics to direct and reactive dyes, and increase dye exhaustion, the ionic nature of the fabric must be changed. The fabric must be positively charged so that it can work as a magnet and attract and ionically bond to the dye molecules that are negatively charged.
4. Sometimes pretreatments are used to alter the ionicity of the fabric. The most common fabric pretreatment used to generate positive charges in cellulosic fabrics is CHPTAC. However, CHPTAC presents serious occupational hazards because it generates an epoxy compound in the pretreatment bath. Furthermore, 40% of CHPTAC is lost during fabric pretreatment process due to hydrolysis, it is classified as a category 2 carcinogen, and it generates a terrible stench in the workplace.

THE FACTS

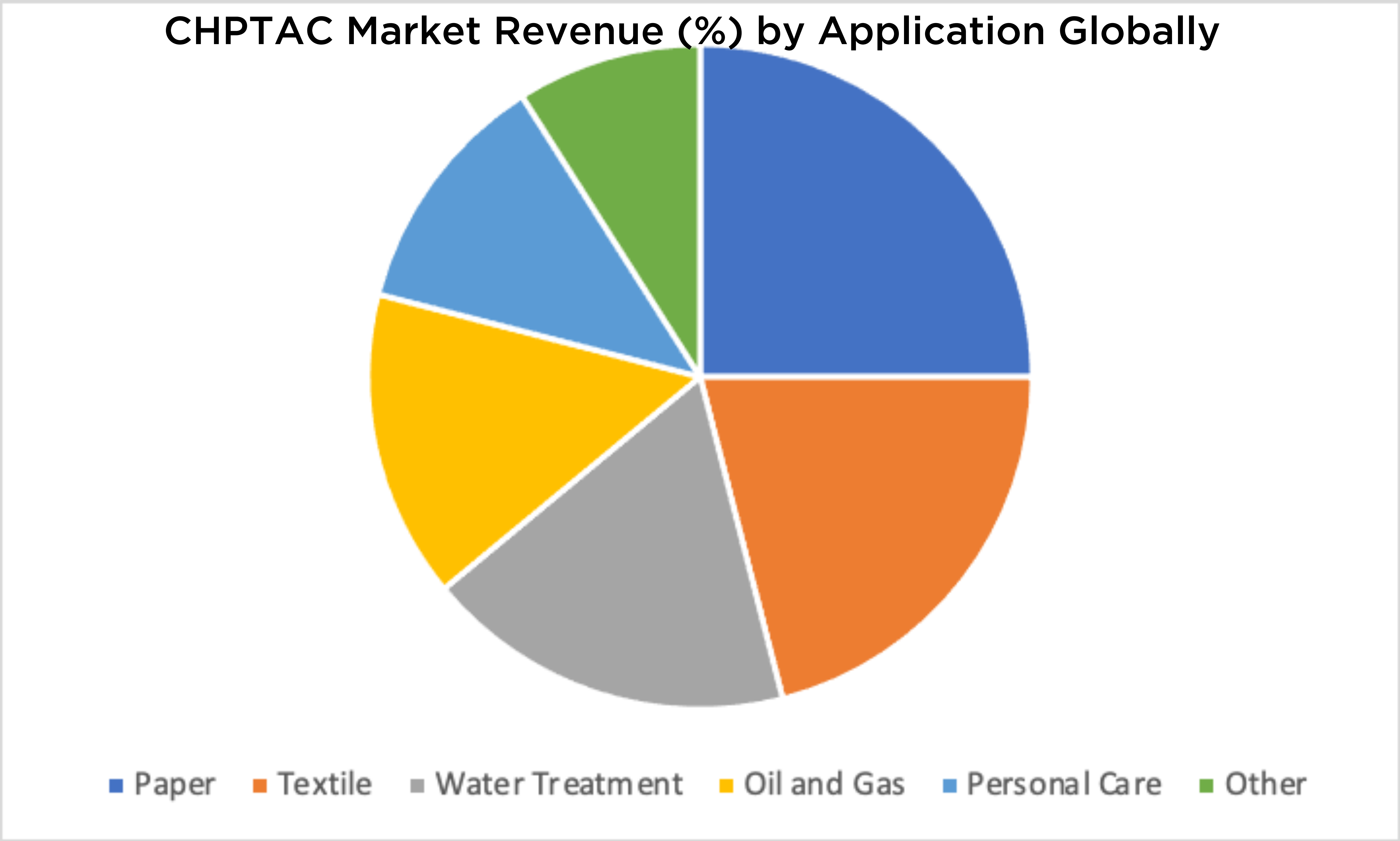
5. The percent dye exhaustion efficiency in the case of direct or reactive dyes is in the range of 70-80%. The remainder of the dye residue is left in the bath resulting in an effluent with significant amounts being released into the environment.

6. “Textile dyeing is one of the most polluting aspects of the global fashion industry, devastating the environment and posing health concerns to humans.
https://www.cnn.com/style/article/dyeing-pollution-fashion-intl-hnk-dst-sept/index.html

EXHIBIT B

THE FACTS

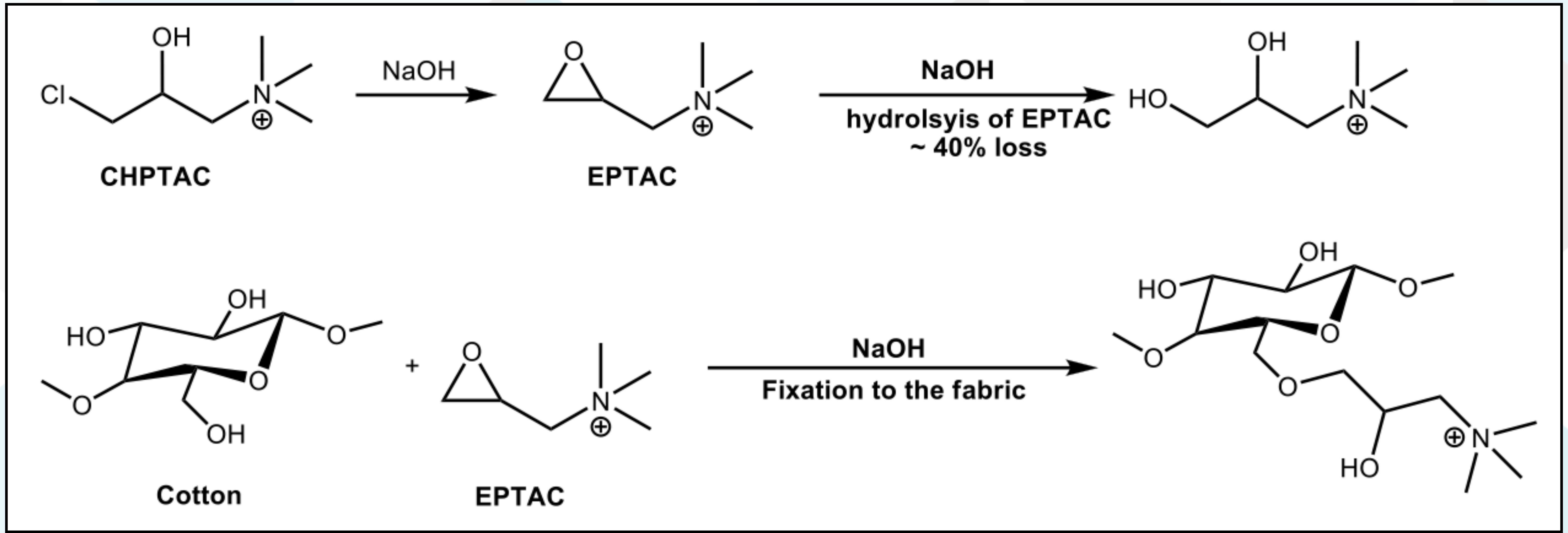
The CHPTAC market is forecasted to reach $228.1 million by 2025 at a CAGR of 4.5% during 2020-2025. The efficacy of CHPTAC to act as a liquid cationic etherification agent has significantly driven its demand in the textile industry. In the textile industry, CHPTAC is used on cellulosic fibers to improve the bonding of dyes to the fibers during the reactive dyeing process. The textile industry accounts for 21% of the CHPTAC revenue mix.



THE FACTS

Cationiziation of Cotton with CHPTAC

Reaction scheme for Cotton Cationization



Issues:

- Epoxy generation poses serious occupational hazards
- TMA has stinky fish smell
- 40% EPTAC hydrolyzes to inactive diol
- EPTAC is a category 2 carcinogen and irritating to skin, eyes, and membranes
- Requires several washings and neutralizations with citric acid