Sustainable Innovation
Waterless Dyeing with SCF Technology

Dr. Pankaj Desai
Overview

- Shri Jayantibhai Jariwala, Chairman, founded Colourtex in 1970

- Commenced dyestuff manufacturing in the industrial suburb of Surat in 1976

- Today, with over 750 dyestuffs & chemicals from an installed capacity of 91,000 ton in five manufacturing sites at Surat, Colourtex is the largest dyestuff producer in the country

- Strong backward integration with 84,000 ton of dye intermediates and additives

- 2014-15 sales stood at Rs. 3080 Cr. / USD 495 million
System Compliance

ISO 14001:2004 & OHSAS 18001:2007 certified

ISO 9001:2008 certified

ETAD member

bluesign® System Partner

BLC member

LWG Member

EQHSMS, ETAD code of ethics, bluesign® and Responsible Care compliance reflect commitment for sustainable growth
The Colourtex Setup

Headquarter, production and application service labs located in Surat, Gujarat province, India.

Regional sales offices and service labs all over India.

Subsidiaries in
- USA
- Peru
- South Korea
- Honduras

Subsidiaries with Technical Service Laboratory

Agents in
- Philippines
- Indonesia
- Bangladesh
- Sri Lanka
- Thailand
- Taiwan

- Portugal
- Syria
- Iran
- Pakistan
- Spain
WORLD FIBER CONSUMPTION

GLOBAL FIBER MARKET 2010

- Cotton: 33%
- Synthetic Fibers: 58%
- Wool: 2%
- MMC Fibers: 6%
- Cellulose Gap: 1%

73.8 million tons

GLOBAL FIBER MARKET 2013

- Cotton: 30%
- Synthetic Fibers: 62%
- Wool: 1%
- MMC Fibers: 7%

85.4 million tons
MAJOR CONCERN FOR TEXTILE INDUSTRIES

• Higher Water Consumption
• Higher Energy Consumption
• Higher CO$_2$ Emission
• Higher Effluent Generation
• Longer Dyeing Cycle
• Poor Reproducibility
• Intensive Labor
MAJOR CONCERN FOR TEXTILE INDUSTRIES

Increasing Water Scarcity and Environmental Awareness Force to Adopt more Sustainable Technology.
So What if…

You could dye fabrics with:

- No Water
- No Waste Water
- Low CO₂ Emissions
- Low Energy Consumption
- No Chemicals & Additives
- Complete Automation
WATERLESS DYEING TECHNIQUES

- Dyeing with Supercritical CO2
- Digital Printing
- Plasma Dyeing
- Transfer Printing
- Foam Dyeing
WATERLESS DYEING TECHNIQUES

✓ Dyeing with Supercritical CO2
✓ Digital Printing
✓ Plasma Dyeing
✓ Transfer Printing
✓ Foam Dyeing
CARBON DIOXIDE IS:

- # NONTOXIC & NONFLAMMABLE

- # SUSTAINABLE & RECYCLABLE

- # INEXPENSIVE & ABUNDANTLY AVAILABLE

- # THE SAME QUALITY ANYWHERE IN THE WORLD

- # THE BEST OF BOTH WORLDS IN SUPERCRITICALPHASE (PERMEABILITY, DENSITY, CARRIER)
SCF DYEING TECHNOLOGY PREVENTS:

- Use of TOXIC components
- Use of FRESH WATER
- LARGE WASTE streams
- HIGHER ENERGY Consumption
- Intensive LABOR
When carbon dioxide is heated to above 31°C and pressurized to 74 bar, it becomes supercritical, a state of matter that can be seen as an Expanded Liquid, or a heavily compressed gas.

One Characteristic of a Supercritical fluid is high (liquid like) density that enables dissolution of compounds.
DYEING WITH SUPERCritical FLUID (SCF)

- The supercritical fluid CO2 causes the polymer fiber to swell allowing the disperse dye to easily diffuse within the polymer.

- This deep penetration provides effective coloration of hydrophobic polymers.

- Dyeing and removing excess dye are processes that are done in the same vessel.

- Residue dye is minimal and extracted, can be recycled.
BASICS OF SCF DYEING TECHNOLOGY

1. CO₂ Storage
   - CO₂ > 95% recycled

2. CO₂

3. Dyeing Process
   - (250 bar/ 120°C)
   - CO₂ + < 0.02% of Dye

4. Separator Pressure Drop

5. Dyed Fabric
WATERLESS DYEING SCIENCE
ADVANTAGE

- Significant Lower Operational Costs
- Shorter Batch Time (up to 50%)
- Reduction in Energy Cost (40%)
- Zero Water Consumption
- Zero Waste Water
- Zero Processing Chemicals
- Zero Drying Cost for Dyed Fabrics
- 98% Colour Consistency
- Significant Less Re-dyeing
- EASY Colour Correction
- Above 95% CO$_2$ is Recycled
Quality

SCF Dyeing Results are equal or better v/s Conventional Dyeing (Leveling, Colour-fastness, washing, staining)
Quality

Washing Fastness: (AATCC 2A) at 49°C/45 mins.  
AATCC Soap 0.15%  
Liquor 150 ml  
Steel Balls 50 Nos.

YELLOW  
Treated Shade  
Staining on multifibre fabric

SCF Dyeing  
Conventional Dyeing  
(After Heat setting at 110°C/30 Sec

RED  
SCF Dyeing  
Conventional Dyeing  
(After Heat setting at 110°C/30 Sec

Conventional Dyeing  
(After Heat setting at 180°C/30 Sec
Quality

Washing Fastness: (AATCC 2A) at 49°C/45 mins.  
AATCC Soap 0.15%  
Liquor 150 ml  
Steel Balls 50 Nos.

BLUE
Treated Shade

Staining on multifibre fabric

SCF Dyeing

Conventional Dyeing  
(After Heat setting at 110°C/30 Sec)

Conventional Dyeing  
(After Heat setting at 180°C/30 Sec)

BLACK

SCF Dyeing

Conventional Dyeing  
(After Heat setting at 110°C/30 Sec)

Conventional Dyeing  
(After Heat setting at 180°C/30 Sec)

SECONDARY CELLULOSE ACETATE (Diacel)  
BLEACHED UNMERCERIZED COTTON  
NYLON (S, S)  
POLYESTER (TERYLENE)  
ACRYLIC (COURTELLE)  
WOOL WORSTED
Quality

Corangar Yellow PE-3279 : 0.25%
Corangar R. Blue PE-3688 : 0.245%
Quality

Coil Test for Migration Study

Conventional Dyeing V/S SCF Dyeing

OUT IN OUT IN

YELLOW

OUT IN OUT IN

RED

OUT IN OUT IN

BLUE

Much Better Migration Observed in SCF Dyeing Compare to Conventional Dyeing
Safety

Control and Safety Loop

1. Control PLC
2. Safety PLC
3. Safety valves all over the machine
4. Operators, Emergency stop
5. CO₂ detection system
6. Fully comply with ASME design-code
7. CERTIFIED by BUREAU VERITAS & LLOYD’S
CORANGAR PE:
Specially designed Disperse Dyes range from Colourtex is approved by DyeCoo for SCF Technology
DYES FOR SCF DYEING TECHNOLOGY

CORANGAR PE DYSES PROVIDING COMPLETE RANGE TO ACHIEVE FULL COLOUR SPACE
DYES FOR SCF DYEING TECHNOLOGY

[Color chart with 100 color samples]

COLOURTEX INDUSTRIES PRIVATE LIMITED
SCF DYEING TECHNOLOGY- STATUS

Synthetics
- currently
  - 100% PES
  - Woven / Knit / Micro
- 2015-2016
  - YARN
  - Polyamide
  - Spandex

Cotton / Blends
- >2016

Niche markets
- On Demand
  - Leather
  - Acrylics
  - Silk
CURRENT INSTALLATION
STEP-1
STEP-2
DYE HOUSE OF THE FUTURE
“We are aspiring to become the most eco-friendly textile group providing DryDye fabrics and garments”

Mr. David Yeh,
Managing Director ,
Tong Siang Co. Ltd.

“We see this as an important step towards revolutionizing the textile dyeing industry. This product line proves that our technology is economical viable and suitable to scale, while hugely decreasing environmental impact”.

Mr. Mats Blacker
CEO,
DyeCoo
“While the ultimate environmental impact of this innovation cannot be quantified at this stage, the use in textile processing of SCF – super critical fluids – has set the industry on a greener, more environmentally sustainable path,”

DR. PANKAJ DESAI