DEVEN SUPERCRITICALS PVT.LTD. *Presents*

For The First Time In The World:

Waterless Dyeing of ALL Textiles with Conventional Dyes

SUPRA UNO®

ONE TECH TO COLOR ALL

(USA Patent no. US 11015289 B2, Indian Patent no. 298213)

Pioneering in Supercritical Fuild Technology Development since 1998...

FASHION INDUSTRY'S ENVIRONMENTAL IMPACT REDUCTION CHALLENGE

The textile industry, especially its dyeing & finishing operations, are one of the largest consumers of water in the world. Further, it also involves the use of a huge quantity of hazardous auxiliary chemicals which end up in wastewater, polluting the soil, water resources, making an irreversible damage to both the environment and human health.

With the increasing demand for compliances in the fashion industry, there is an urgent need for replacing the conventional water-based dyeing & finishing techniques by a sustainable solution that truly minimises the environmental impact. This solution must reduce the use of hazardous chemicals along with minimizing the water & energy usage while being versatile, efficient and cost-effective.

INNOVATIVE, VERSATILE AND VIABLE SUSTAINABLE SOLUTION

SUPRAUNO®

ONE TECH TO COLOR ALL

SUPRAUNO® developed by Deven Supercriticals is an internationally patented, unique dyeing and finishing technology using Supercritical CO_2 , which for the first time in the world, allows the waterless use of conventional dyes and their traditional tri-chrome recipes for the sustainable dyeing of various man-made and natural textile types, truly revolutionizing the textile dyeing and finishing operations.

SUPRAUNO® in comparison with Conventional Dyeing for Polyester-Cotton Blends

90%	76%	70%	67%
Auxilary Chemicals Saved	Water Saved	Time Saved	Energy Saved

ADVANTAGES

NO WATER USED &

~90% LESSER AUXILIARY CHEMICALS

SUPRAUNO® uses Supercritical CO_2 as the medium for dyeing instead of water used in conventional dyeing processes. SUPRAUNO® achieves better dye utilization, uses substantially lesser hazardous chemicals, thus, minimizing their release into the water resources preserving the environment & health, achieving sustainability in textile manufacturing.

VERSATILE

Our innovative, patented SUPRAUNO® technology has for the first time in the world, enabled the use of Supercritical CO_2 for waterless dyeing of not only Polyester but also for various other man-made & natural textiles such as Nylon, Acrylic, Viscose, Cotton, Linen, Wool etc. & their blends. Thus, SUPRAUNO® has made sustainable textile dyeing truly versatile, viable, simple.

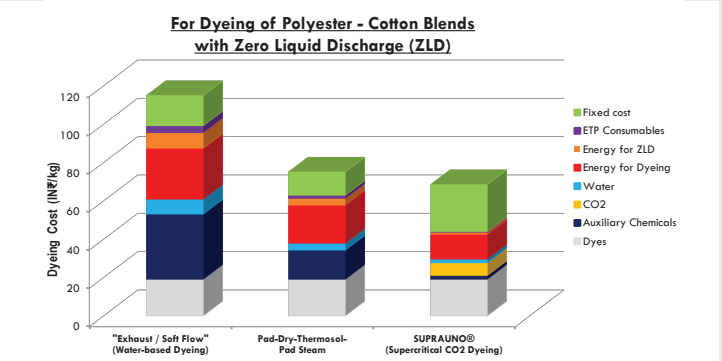
NO SPECIAL DYES

SUPRAUNO® allows the waterless use of conventional dyes & their tri-chrome recipes for the sustainable dyeing process. This improves the viability as no special dyes are required as in prior-art processes. Also, the expertise of the Dye Masters remain useful. Our innovation achieves efficient & uniform penetration & fixing of conventional dyes.

COMPARISON OF SUPRAUNO® WITH OTHER SUPERCRITICAL CO_2 PROCESSES

	Features	Deven Supercriticals Patented (SUPRAUNO®) SC CO_2 Technology	Conventional SC CO_2 Processes
A	Which types of Textiles can be Dyed?		
	Polyester	✓	✓
	Cotton, Linen. Flax etc.	✓	✗
	Viscose and Modified Cellulose	✓	✗
	Polyester - Cotton or Viscose Blends	✓	✗
	Nylon, Acrylic, Wool etc.	✓	✗
B	Suitability of Conventional / Traditional Dyes	✓	✗
C	Dyes suitable for the process		
	Disperse Dye	✓	✓
	Reactive Dye	✓	✗
	Direct Dye	✓	✗
	Acid Dye	✓	✗
	Basic (Cationic) Dye	✓	✗
D	Achieving Desired Shade by using in-house Trichrome Recipe?	✓	✗
E	Solubility of Dyes in SC CO_2	HIGH	LOW
F	Dye Utilization / Dyeing Efficiency	HIGH	MODERATE
G	Finishing possible along with Dyeing step?	✓	✗
H	Batch Time (T)	ABOUT HALF (T/2)	LONG (T)
I	Commercial Level Scale-up	EASY	DIFFICULT
J	Final Shade Buildup	BASED ON RECIPE	CHANGES WITH BATCH TIME
K	Batch to Batch Consistency	EASY	DIFFICULT

ECONOMIC VIABILITY



SUPRAUNO®, is an economically viable solution for the textile industry with overall dyeing costs remaining comparable to conventional water-based dyeing. SUPRAUNO® avoids two-step dyeing for Polyester-Cotton blends, uses no salt and no reduction clearing along with much lesser quantity of auxiliary chemicals, which otherwise would have ended up in the wastewater. This further reduces the Zero Liquid Discharge (ZLD) equipment size and its energy requirement. Hence, SUPRAUNO® significantly reduces overall Pollution, Water and Energy load.

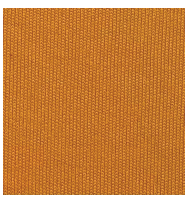
SUPRAUNO® is truly sustainable, versatile & efficient, yet very simple to implement, hence, it can accomplish environmentally friendly, green objectives of the textile industry around the world for replacing conventional processes with a sustainable process.

STEPS INVOLVED IN SUPRAUNO®

1. Mixing Dyes as per Trichrome Recipe along with Finishing/Additives in Aqueous Dye Solution — Dye-solution
2. Pre-coating — Pre-Application of a Thin layer of dye solution on Textile + Drying, to increase the surface area and interaction of the dye with Supercritical CO2
3. Placing the Pre-Coated Textile in Supercritical Dyeing Vessel and adding Supercritical CO2 at controlled pressure and temperature — Pressurization
4. Dyeing — Resulting in improved interaction of dyes & additives with the Supercritical CO2 deep inside the pores, capillaries and the matrix of the textile material
5. Depressurizing the Supercritical CO2 Dyeing Vessel completing the Uniform, Single Step Dyeing and Finishing process — De-pressurization
6. Washing — Washing of the Dyed Fabric Using a Washing Range to Remove any Unfixed Dyes & Additives

TEXTILES DYED USING SUPRAUNO®

Types of Polyester Textiles Dyed with SUPRAUNO®


Micro Denier Polyester


SORONA® Polyester

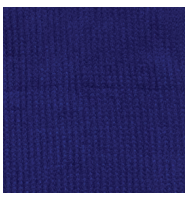

Recycled Polyester

Other Textiles Dyed


Nylon


Polyester-Cotton Blend

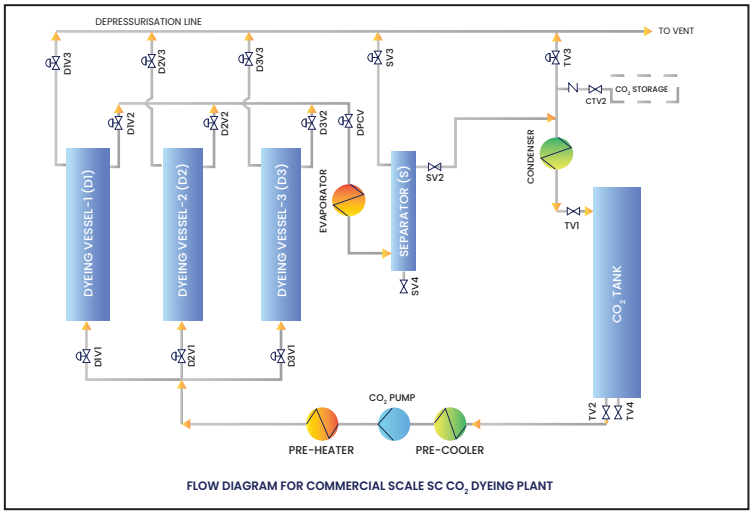

Cotton


Acrylic


Zipper Tape


PET Yarn

SUPRAUNO® SC CO_2 PROCESS



FLOW DIAGRAM FOR COMMERCIAL SCALE SC CO_2 DYEING PLANT

Supercritical (SC) Carbon Dioxide (CO_2) based dyeing and finishing plant would have dyeing vessels, separator, CO_2 hold-up tank, heat exchangers etc., state of the art Programmable Logic Controller (PLC) and Human Machine Interface (HMI) terminal with a safety interlock logic software for safe operation and reproducible results.

The dyeing process works in a closed loop with constant circulation of CO_2 in the system. It is a semi-batch operation with a typical batch time of ~ 1.5 to 2 hours.

The dye pre-coated textile material to be dyed is held in the dyeing vessel with the help of perforated textile holder for easy handling and uniform contact between Supercritical CO_2 and the textile material. The Dyeing vessel is equipped with specially designed quick acting closure for easy and fast opening of the pressure vessel. The CO_2 leaving the separator is fed back to the CO_2 hold-up tank for recirculation.

PATENTS GRANTED

- **"Process for Dyeing of Textile Materials using Supercritical Fluid"** (Indian Patent no. 298213, USA Patent no. US 11015289 B2)
- **"A Control Valve having a Hollow Piston for Controlling Flow of Fluid"** (USA Patent no. US 10883612 B2, Europeon Patent no. EP 3440387 B1, Indian Patent no. 425453)
- **"System for Continuous Feeding and Discharging of Solid Material to & from a Vessel Operating under High Pressure"** (USA Patent no. US 10328406 B2, European Patent no. EP 3242741 B1)


Dr. A.P.J Abdul Kalam (former President of India) giving Award to Dr. Swapneshu Baser for contributions in development of SCF Technology

AWARDS AND RECOGNITIONS

- Selected for South Asia INNOVATION PROGRAMME of 'Fashion for Good': a global platform for innovation, based in Amsterdam to make all Fashion 'Good', April 2021
- 'Young Engineer Award' from the Indian National Academy of Engineering (INAE), for year 2000
- Economic Times (ET) MSME Excellence Icons Award, under 'Most Innovative MSME of 2020' by Times of India (TOI) group and DCCIA
- 'Excellence in Entrepreneurship in Research and Innovation' Award from Entrepreneurs' International, 2021
- 'Dr. P.K. Patwardhan Award' for Technology Development & Transfer for year 2001
- 'NOCIL award' from IIChe for the year 1997
- 'Technology Developer Award' at Industry Green Chemistry World, IGCW'19, for waterless textile dyeing using supercritical CO_2

CONTACT US

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