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A New Era Begins – breakthrough in bulk production of **INDIGO** spray dyeing on warp yarn

The fruitful cooperation between DyStar and company RotaSpray introduced during ITMA Milano in 2015 has led to the successful development of INDIGO Spray Dyeing (rotary atomizer technology RotoDyerTWIN®) on warp yarn into bulk production in Türkiye, India and Pakistan. Both companies announce a salt-free dyeing solution for the denim industry (Cadira® DENIM) with highest flexibility in regard to batch length and special effects.

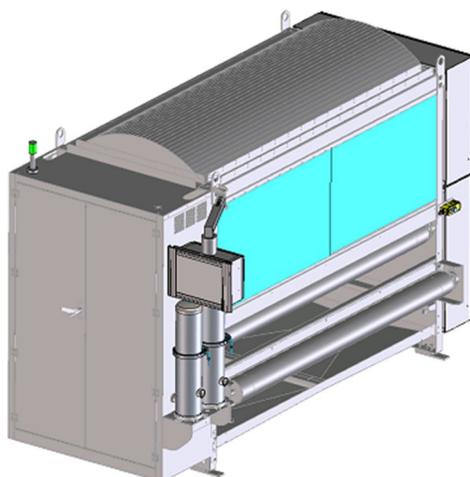
Cadira® DENIM

Spray dyeing on warp yarn combines DyStar Indigo Vat 40% Solution with the ecological friendly reducing agent: Sera Con C-RDA. Marketed as the “cleanest indigo on the market,” DyStar Indigo Vat 40% reduces sodium hydrosulphite usage by 99% in spray dyeing and results in cleaner waste water and less water usage. This combination allows denim manufacturers to achieve salt-free dyeing with a significant effluent load reduction. DyStar reports that Cadira® DENIM reduces the amount of sulphates by up to 95 percent and decreases Chemical Oxygen Demand by up to 80 percent, compared to dyeing with indigo powder and the conventional reducing agent Hydrosulphite. Total solids can be reduced up to 90 percent. Additionally, the process reduces waste discharge from effluent treatment plants because no additional salt is created and this also will reduce the apparel and textile industries' water, energy consumption.

RotoDyerTWIN® Spray Application Technology

Rotary atomizers have been established in the textile industry for several decades. However, this existing spray technology is mainly for rewetting textiles with moisture. Effective optimization of the spraying parameters in the RotoDyer® and RotoCoater® spraying technology, as well as many years of experience of the development partner in Brazil, have resulted in a breakthrough in DENIM finishing and dyeing of textile fabrics as well as warp yarn. The unavoidable limitations and technological compromises of existing sheet (slasher) and rope dyeing technologies and the enormous cost pressure and increased global pressure for sustainability and resource conservation were the motivation for a technological leap forward in spray application technology.

The INDIGO spray liquors are fed to the rapidly rotating spray discs. To achieve the ideal impact velocity of the single droplet and for a uniform drop size spectrum, the target droplet diameter, spray disk diameter and the angular velocity of the droplet are of crucial importance.



RotoDyerTWIN®



Indigo 40% solution and Sera Con C-RDA

Rotary atomizers are based on the principle of Coriolis force, which occurs in addition to the centrifugal force. The pre-reduced INDIGO spray solution, the volume flow in ml/min per nozzle, is fed through the injector precision throttle with a relatively low pressure to the rotary atomizer (spray disc) in the centre. The distance from the surface of the spray disk to the precision throttle is exactly defined. The spray disk rotates at the angular velocity. As a result of the centrifugal acceleration, the INDIGO solution flows to the spray disk edge and reconfigures into the same size drops (aerosols) after the trailing edge of the disk. This defined aerosol is then thrown into the capillary system of the warp yarn. The Coriolis force describes the behaviour of the INDIGO solution on the surface of the rapidly rotating spray disk.

Based on control algorithms these parameters will lead to the following pick-ups on warp yarn or DENIM fabrics to deliver the highest flexibility

- Minimal Application (MA) 12% - 35% → e.g. Spray Coating in DENIM Fabric Finishing
- Add-on 36% - 200% → e.g. [INDIGO Warp Yarn Dyeing](#)

With process and layout modifications INDIGO-COAT, Reactive, Sulphur, Direct and Pigment dyes can be applied by spray dyeing as well. Also the spray application of fixing agents and oxidation chemicals etc. can be integrated in sheet dyeing (slasher) as well as rope dyeing machines.

For consideration of the total operating costs and the life cycle cost calculation as meaningful cost management tools we summarise the following as core arguments:

- High flexibility on small lot sizes
- No entry of dirt, lint, fat, waxes, residual surfactants or alkali into the spray liquor
- Forced application of INDIGO dye molecule into the yarn by rotating atomizers (disks)
- The yarn is not exposed to any mechanical stress caused by squeezing
 - no change in the capillary structure of the yarn
- Residual liquor quantities during recipe change in wastewater are drastically reduced.
 - RotoDyer = 48 l only)
- No complex tank farm management needed for recycling and replenishment of baths
- Simple recipe change with 12 m yarn loss only per colour change
- Supporting Zero Discharge Sustainability Solutions
- Elimination of dyebath overflows, no tailing and no side/centre variation
- Eco-friendly
- Awarded with most important ECO-certificates

