

## Denim - The wonder fabric

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DENIM was first introduced to the world by a city called Nimes in France in the early 19th Century.

Classic denim is a heavy fabric made of 100% cotton which is woven from coarse Indigo dyed warp yarn while the weft is left as undyed greige. Initially denim was popular as workwear during the industrial revolution and later on it was transformed into fashion fabrics as a number of innovative finishes were carried out on it. The Hollywood movies of the 1950's and the hippy movement of the 1960's fueled the demand for denim as the rebellious youth converted to 'Jeans' from traditional clothing. Denim became a universal symbol and expression of individualism

Earlier denim fabrics were dyed with natural Indigo extracted from Indigofera plant during the eighteenth century. In the year 1885 the global production of natural Indigo was around 5000 metric tons. In 1883 Adolf Von Baeyer discovered the chemical structure of Indigo. Thereafter synthetic Indigo was first produced by BASF in Germany in the year 1897. BASF was also the first to produce Hydrosulfite in 1906, a powerful reducing agent that is required to convert synthetic Indigo into Leuco (dyeable) form. The 'Blue' denim was now available in large quantities to satisfy the growing global demand.

These days denim has moved from being dyed in the traditional blue color (using Indigo dye) to being dyed in a variety of colors using Sulphur dyes, Vat dyes, Reactive dyes, Direct dyes and Napthols

Today there are over 500 textile mills around the globe that produce in excess of 7 billion meters of denim per annum. This means the world produces roughly 1 meter per year for every living person on the planet. The production of denim is slated to increase to 9 billion by the year 2020. The production of denim which was predominantly in the western countries in the 1950's has increasingly moved to Asia over the years. Currently 70% of the global denim production is done in Asia with roughly 45% of the global denim production done in China alone. The other leading denim producers in Asia are India, Pakistan, Thailand and Bangladesh.

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### Denimprocessing

Continuous dyeing with Indigo is done by either of the two methods given below :

- Rope dyeing
- Slasher or Sheet dyeing

The primary difference between Rope dyeing and Sheet dyeing is the number of steps involved in production. In sheet dyeing there are two steps viz. sheet dyeing and direct/beam warping. In Rope dyeing there are four steps viz. Ball warping, Rope dyeing, Re-beaming and Sizing

### Process sequence in Indigo Slasher/ Sheet dyeing : The numbers given in brackets are number of baths.

Pretreatment --- Washing --- Dye Bath + Oxidation --- Washing --- Drying --- Sizing --- Drying  
(1-2) (8) (2-4)

### Process sequence in Indigo Rope dyeing :

Pre-Scouring --- Hot wash --- Cold wash --- Dye baths + Airation --- hot wash --- Cold wash --- Softener  
(Boiling-off) (8) (for rope opening)

Both processes have their own advantages and disadvantages. Some of them are listed below:

| Indigo Dyeing Ranges         |   |   |
|------------------------------|---|---|
| Comparison of Dyeing Methods |   |   |
|                              | Rope Dyeing   | Slasher Dyeing / Loop Dyeing  |
| Advantages                   | <ul style="list-style-type: none"> <li>• High production rate - 24 or 36 ropes</li> <li>• No stop changing to the next dyelot</li> <li>• Listing due to the dyeing process is impossible</li> <li>• No waste of yarn</li> </ul> | <ul style="list-style-type: none"> <li>• Compact ranges</li> <li>• Suitable for fine yarn counts</li> <li>• One production step from warp beam to sized yarn</li> <li>• High flexibility</li> <li>• More suitable for colour denim</li> </ul> |
| Disadvantages                | <ul style="list-style-type: none"> <li>• Labour-intensive rebeaming</li> <li>• Limited flexibility due to big dyebath volume</li> <li>• Additional costs for softener</li> </ul>  | <ul style="list-style-type: none"> <li>• Listing is impossible</li> <li>• Yarn wastage caused by stoppages</li> <li>• Limitation in fastness in case of extremely short dipping time and deep shades</li> </ul>                               |

### Pretreatment

1. Pre-wetting : ( for Slashers ) -This is a very important step. The wetting has to be rapid with de-aeration property so

that the yarn is uniformly wetted. This process is done to avoid streakiness. Many wetting agents fail in providing uniform and rapid wetting. Leomine Organics Pvt Ltd. has two excellent products viz. Leomine Deaerator RWD which is phosphonate based and Leomine Wet RDM which is not based on phosphonate. Leomine wet RDM wetting time is around 2 seconds while Leomine Deaerator RWD is around 5 seconds. Both have excellent de-aeration property. Pre-wetting is done at room temperature. Immersion time is minimum 6 seconds. This process ends with a cold rinse. Some Deaerator RWD or Wet RDM could be carried forward to the next process which is good since it helps in foam control and wetting

2. Boiling off :(for rope form dyeing)- here 10 ml/l of NaOH ( 50% ) is recommended along with RWD or RDM. Both products are stable in Caustic and do not foam at higher temperature. Addition of Leomine Chelant CSA is recommended which is stable to alkali, acids and salts at high temperature. It chelates Calcium, Magnesium, Iron and other heavy metals which if present in free form will affect dyeing. Temperature is maintained at 90°C. Immersion time minimum 10 seconds
3. Causticizing : This process increases the affinity between cotton and the reduced Indigo (leuco). The short immersion time ensures that only the outer layers of the yarn are causticized. This controls penetration of the dye and good ring dye effect is achieved. Here we recommend Leomine Merceriser MCS and Leomine Chelant CSA . The treatment is done at room temperature. Immersion time maximum 15 seconds.
4. Causticizing without subsequent neutralization : Here the process is causticizing followed by two hot rinses at 60°C followed by number of cold rinses as required; preferably two
5. Causticizing with neutralization : Causticize followed by

two hot rinses at 60°C. Neutralize using Leomine Buffer PAB. Two cold rinses are done next. It is essential to ensure that there is no acid carry forward because if so then there will be insoluble Indigo that will be formed.

In pretreatment, it is recommended to use a detergent Leomine Wash DFB which has excellent emulsification and extractive properties to remove cotton impurities and improve uniformity in subsequent dyeing

## Dyeing

### *Indigo dyeing process :*

The chemicals used are Indigo dye, Hydrosulfite, Caustic Soda and dispersing agent

Leomine Disperse XPD (Powder ) or Leomine Disperse XPL (Liquid) are high performing dispersing agents to ensure proper dispersion of the reduced Indigo. XPD / XPL avoid agglomeration of dyestuff and results in uniform dyeing

## After-treatment

**Leomine Fast Fix FFF** is a formaldehyde free branched dye fixing agent to improve wet fastness and results in darker shade after wash down.

**Leomine Softener LYK or Leomine Softener AOD** along with 1 g/l of Leomine Buffer PAB is recommended. These softeners improve re-beaming efficiency and tear strength

## Sizing

**Leomine Size SSC or Leomine Size FCO** are versatile sizing agents for sizing denim yarns. Size SSC is based on starch and Size FCO is based on acrylates with excellent de-sizing properties and stability to alkali.

**Leomine Wax ASE or Leomine Wax AWA** can be used for lubrication

**Leomine Organics Pvt Ltd.** understands the emerging requirements of the denim industry and is constantly innovating to make its customers more successful in their field of operation. ■