COATS

Bulletin Post
COATS SEWING SOLUTIONS

Denim Wash

Contents

Introduction

Ever since the inception of "blue jeans" in the 1870s as workwear for miners and cowboys, these iconic garments have evolved to become a popular item of casual wear throughout the world today. Coming in various fits to suit different tastes and fashions an important part of their appeal is the distressed look, visibly aged and worn, but still intact and functional. The process of washing improves the fastness properties of indigo-dyed denim jeanswear and in addition by altering the types of washes, various fashion looks are achieved.

In this technical bulletin we will explain how denim apparel is wet processed and highlight the parameters associated which need to be controlled in denim manufacturing and subsequent wash processes.

The "wash down" and other "post make" processes applied to denim garments are many and varied. Often the objective is to distress the garment so that it looks old and worn. This distressing gives the garments a "fashion" appeal and also softens an otherwise harsh fabric. These "post make" process can have a devastating effect on the sewing threads and therefore the seams, if care is not taken in their selection and application. After wash / post processing repair rates can be very high with harsh wash down treatments and 40% repair levels are not uncommon.

We highlight the Coats range of sewing threads that have been designed specifically to withstand the rigours of denim wet processing and which in addition can add a fashion element of their own through contrast colours and other decorative applications. For example, corespun threads such as Coats Epic and Dual Duty offer excellent all round sewing performance due to their construction and specially formulated lubrication. The high tenacity filament core provides the toughness for the majority of the most punishing applications. The cotton wrap of Dual Duty allows its colour to fade with the fabric whilst the polyester wrap of Epic retains more of its original colour.

Indigo Dyeing

Since indigo dyes are insoluble in nature, it is dyed under special dyeing conditions. The dyeing happens through a fermentation process by breaking the dye molecules into simpler substances. In this stage, it dissolves in the solution and the fabric yarn gets dyed. At a later stage, when it is taken to oxidisation by exposing it to air, the beautiful, deep and rich blue of indigo is achieved.

This tricky dyeing process is what makes denim wash so challenging and intricate.

Denim Wash - The Process

Washing processes impart the following effects on denim garments:

- Appearance / colour change
- Softening
- Dimensional stability
- Different handle

The degree of the above effects depend on processing conditions such as time, temperature, liquor ratio of washing batch and chemicals used.

Steps in the Denim Wash Process

Denim wash is a sequential process, which consists of many steps. Some of the major steps discussed here are:

1. Pre-treatment
2. Wash
3. Tinting and Dyeing
4. Softening

◀ Pre-treatment

This process is the first and most important part of denim washing, which includes:

1. Removing impurities
2. Desizing
3. Reducing the risk of creasing

1. Removing impurities

Impurities from the fabric or garment manufacturing stages can be oil-based or chemical-based. They can cause problems during the washing steps that follow, and hence are removed.

2. Desizing

During this stage, sizing material applied during weaving are removed to make it suitable for further processing.

3. Reducing the risk of creasing

Anti-crease agents are used to avoid creasing that can occur due to machine parameters like rotating speed, chemical reactions, production of the fabric and storage.

◀ Different Types of Denim Wash

After pre-treatment, denim garments may be subjected to different types of wash. Some of the commonly used wash types are:

1. Stone Wash
2. Acid Wash
3. Rinse Wash
4. Enzyme Wash
5. Bleach Wash

1. Stone Wash

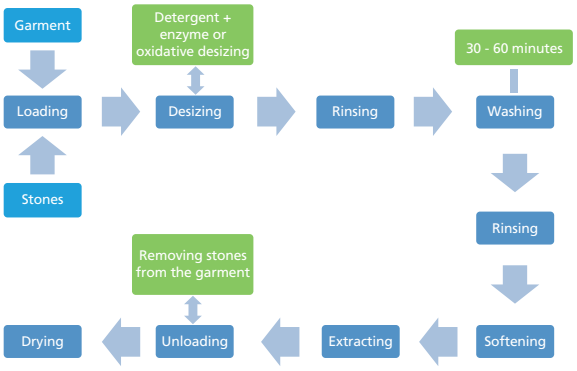
This is the most common and basic process for producing a washed-down look on denim garments. Towards the end of the seventies, pumice stones were discovered to accelerate the ageing process of indigo dyed denim garments.

Wash Components

The stones in widespread use today are pumice stones, which have numerous pores. These pores have very sharp edges, facilitating a very high degree of abrasion.

The Process

A typical stone wash process is as follows:



The degree of colour fading and change of garment feel depends very much on the ratio of weight of the stone to the fabric weight, which can vary from 0.5:1 to 3:1. During the treatment, the outer most layer of the indigo-dyed yarn is partially separated and the portion of the fibre inside, which is undyed, comes to the surface. The surface gets a softer handle through the mechanical process with pumice stones.

The degree of the wash-down effect depends upon several factors – the size of the stone, stone ratio, liquor ratio, duration of treatment, garment load, etc.

Size

The size of pumice stones available for stone washing vary from 1 cm to 7 cm in diameter. Pumice stones, around 2 to 3 cm in diameter, are used for finer denim qualities. The common size employed for normal denim qualities is 3 to 6 cm in diameter.

Variants

Different wash names like sand wash, golf ball wash, micro wash and micro-sand wash – which are types of stone wash – refer to the use of very small size pumice stones.

Equipment

Drum washing machines are used for stone washing. The capacity of drum washing machines can be up to 200 kg. Some of these machines are equipped with tilting facility to empty the washed garments.

Stone Wash Effects

- Under normal circumstance (fabric-stone ratio at 1:2), colour fading is irrespective of the fabricstone ratio.
- Smaller stones give slightly better fading effect, but this would reduce the colour contrast due to more uniform abrasion.
- Fading effect increases with the stone wash time. However, increase of the effect becomes insignificant when the washing time exceeds 90 minutes.

2. Acid Wash (Moon Wash)

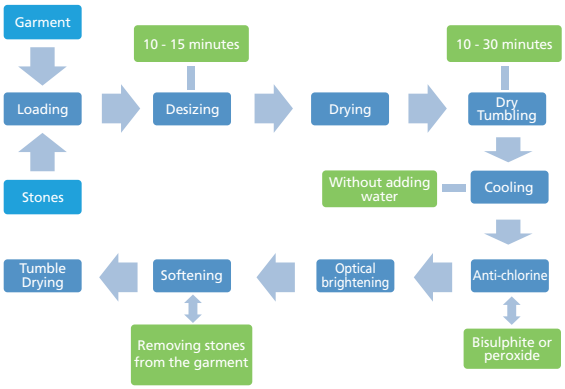
Acid washing or ice washing is usually done by dry tumbling the garments with pumice stones presoaked in an acid solution, such that localised bleaching is effected in a non-uniform sharp blue / white contrast in the garment.

Wash Components

Pumice stones pre-soaked in sodium hypochlorite (5 to 10%) or potassium permanganate (3 to 6%).

The Process

A typical acid wash process is as follows:



The process involves soaking of pumice stones in a net or mesh fabric in solutions of potassium permanganate for at least one or two hours and then draining off the excess liquor. This treatment results in a very strong bleaching effect at the raised parts whereas the lower parts remain dark. The selection of sodium hypochlorite or potassium permanganate depends upon the dyestuff and the required effect.

Drawbacks

Acid washing or moon washing is a tedious and dirty bleaching process, since the manganese dioxide formed out of the potassium permanganate must be removed from the trousers after the process. The hypochlorite bleaching process is fast, efficient and cheap, but it also suffers from a number of disadvantages. The process is relatively difficult to control because it is difficult to obtain the same level of bleaching in repeated runs.

Furthermore, hypochlorite is a harsh chemical that can damage cellulose, resulting in severe strength loss, breakages and pinholes at the seams and pockets. Since hypochlorite is a hazardous chemical, precautions should be considered while using it in the production floor.

3. Rinse Wash or Mill Wash

The objective of rinse washing is to keep the fabric appearance as dark as possible. The denim is desized width wise in open-width washing machine and the dye is not washed out.

Variants

One variety of the rinse wash is desizing ready to wear trousers in drum washing machines. The disadvantage in this process is very poor rub fastness.

4. Enzyme Wash

As denim is made of cotton, it too consists of cellulose. Cellulases can be used to give denim a worn look. Enzymes have opened up new possibilities in denim finishing by increasing the variety of finishes available. For example, it is now possible to fade denim to a greater degree without running the risk of damaging the garment. Cellulases are the enzymes commonly used in enzyme wash. As the name suggests, it degrades cellulose.

Wash Compenents

Enzymes are molecular proteins which accelerate biochemical reactions within a short span of time. The most commonly used enzymes in the textile industry include alpha amylases, proteases, catalases and cellulases.

Multi-component enzymes are cellulases introduced by leading manufacturers which contain a range of different cellulases which affect different parts of the cellulase.

Mono component enzymes have only one component, and are precise in their action. The Denimax range of products belongs to this category.

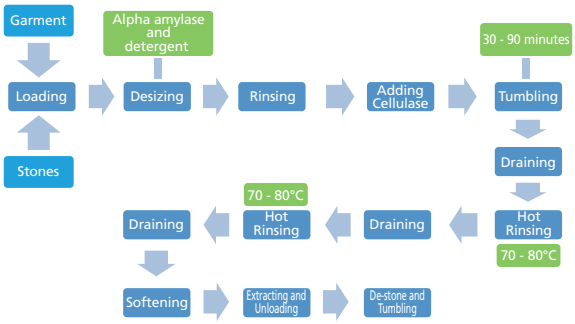
Advantages of Cellulase (Enzyme Wash) over Pumice (Stone Wash)

The most widely used application of cellulases (neutral and acid cellulases) is the replacement of pumice stones in the 'stone washing' process to produce the aged appearance of denim garments. Some of the advantages of enzyme wash are:

- The use of cellulases instead of pumice stones prevents damage by abrasion to washing machines and the garments, eliminates the need for disposal of the used stones, and improves the quality of the waste water.
- The load of garments may also be increased by as much as 50% since stones are no longer added. Depending on the finishing effect required, a mixture of cellulases and pumice may be used, which causes the surface fibres to weaken and later be removed when subjected to either fabric to fabric abrasion or fabric to stone abrasion during the washing. The temperature and the pH used must be specific to the type of cellulase employed. For enzymatic stone washing, acid cellulase and neutral cellulase are available.
- While pumice stones are effective on the fibre surface, cellulases react inside the fibre as well.

The Process

A typical enzyme wash process is as follows:



Acid Cellulase: These enzymes are applied at an acid pH value of 4.5 to 5.5 at 50 - 60°C. At the beginning of enzymatic treatments negative effects on the tensile strength could be observed. The application of acid cellulases reinforced the 'backstaining' problem. Backstaining is the result of soiling of the weft thread and the pocket lining by the detached indigo dyestuff.

Neutral Cellulase: neutral cellulase is used in denim washes. It is applied at pH value of 6 to 7 at 50 to 60°C. Compared to acid cellulases, neutral cellulases have a less negative effect on the tensile strength. For improved surface abrasion, higher quantities are required in the case of neutral cellulase.

An enzyme dose of 2 to 4 grams per litre is normally sufficient. In general, the colour of the enzyme washed goods are more uniform, particularly when stone is not used. Since cellulases are only reactive on cellulose, any sizes or other impurities must be removed before the cellulase treatment.

Neutral cellulase is still more widely used in denim wash than acid cellulase. The reason is that the tendency of indigo dye to redeposit on the surface of the fibre is much higher in acid medium than that in neutral medium.

Enzyme Wash Process Parameters

- For neutral enzyme, the best performance is obtained at pH 6 - 7.
- A satisfactory result can be obtained when enzyme dosage is in the range of 0.5 - 2.0 g/l cellulase.

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5. Bleach Wash

In bleach wash, a strong oxidative bleaching agent is added during the washing, with or without pumice stones. The purpose of the bleaching is to decolourise the dark blue shade by destroying the indigo dye molecules with oxidative bleaching chemicals.

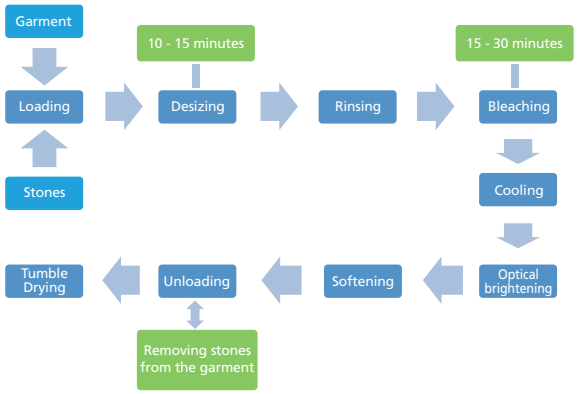
Wash Components

Sodium hypochlorite is generally used as an agent. As on date, 'Chlorine Bleach' is the most effective bleach agent for indigo since all shades can be obtained from it.

Drawback

The problem with this bleaching method is the fact that the fibre is damaged and there is emission of polluted waste water.

A typical bleach wash process is as follows:



Variations

Ecologically less harmful methods such as laccases, potasium permanganate, potasium persulfate, sodium caustic, peroxide have been tried. However, they cannot be compared with chlorine bleach as far as the effect and looks are concerned. The 'White Bleach' method is a variation of the normal bleach in which, chlorine bleach is carried out two to three times one after the other in different treatment baths.

Bleaching with hypochlorite

- **Optimum Dosage:** 40 g/l when using a hypochlorite with 12% available chlorine. Increase in hypochlorite dosage effectively increases the colour fading to a certain limit.
- **pH:** At 7 or lower, the rate of bleaching is rather fast which may present difficulty in controlling the shade. It is suggested that the bleaching bath should be slightly alkali by adding soda ash to pH 9-10 such that bleaching effect could be effectively monitored by the bleaching time.
- **Chlorine Bleach:** 15 ml (150 g/l active chlorine)
- **Temperature:** 50 - 60°C. A higher temperature increases the bleaching action and hence the colour fading. But for the temperatures above 70°C, the effect would be similar.
- **Time:** 15 minutes
- **Rinse:** cold

Dechlorination

After every chlorine bleach, the remaining chlorine must be removed by dechlorinating with sodium bisulphite. Dechlorination can also be carried out with hydrogen peroxide instead of sodium bisulphite.

- **Sodium Bisulphite:** 3 g/l
- **Temperature:** 40 - 50°C
- **Liquor Ratio:** 1:5
- **Time:** 10 minutes
- **Rinse:** warm or cold

Common Process Parameters

Desizing

Denim garments that are made from indigo or sulphur slashed-dye will have sizes that are water-soluble and insoluble in nature.

Starch-based sizes are most commonly used. Methods employed to desize them are washing with alkaline agents, acidic agents, oxidative chemicals and with enzymatic amylase.

The most effective and preferred method is enzymatic desizing using amylase. The typical parameters are as follows:

- **Amylase:** 1 - 2 g/l
- **pH:** 6 - 7
- **Temperature:** 60 - 70°C
- **Time:** 15 mins
- **Liquor Ratio:** 1:6 to 1:8
- **Rinse:** cold

Note: Addition of detergent accelerates the wetting process.

◀ Tinting and Dyeing

After wash, a garment is tinted or dyed. Tinting is used change the hue or tone of indigo. It gives the denim garment a worn or used look. This process takes from 5 to 15 minutes, and is followed dye-fixing and clean-up of superficial dye.

Comparison of Different Dye Types

Dye Type	Cost	Shade Options	Cycle Time	Process Effects
Direct Dyes	Economical	Wide range of shades	Short Cycles	Ease of application
Reactive Dyes	Costly	Wide range of shades	Long Cycle	Water Consumption High
Pigment Dyes	Cost Efficient	Limited to dull shades	Short to Long Cycle	Machine contamination, but hard to obtain consistency, harsh hand feel

◀ Softening

Since denim is a heavy fabric, it needs softening. A major problem encountered during this process is yellowing, which is the change in shade or loss of whiteness. All organic polymers (like cotton) are prone to yellowing. Indigo-dyed fabric, in particular, is very prone to yellowing.

Cause: It is difficult to pin-point the exact causes of yellowing. Among the many causes is exposure to light, impurities, incorrect process temperatures, or a combination of the same.

Reducing the risk of yellowing: It is impossible to eliminate yellowing.

However, it can be minimised by keeping in mind the following:

- Ensure bleaching and bleach neutralisation residues are minimised or eliminated.
- Minimise back staining.
- Avoid the use of chemicals which create yellowing.
- Avoid leaving garments damp any longer than necessary.
- Control drying and curing conditions.

Other Fashionable Denim Washes

Overdyed: A stoned trouser is over dyed to create variety of shades and effects.

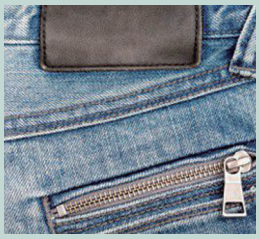
Damaged: Trousers are partially destroyed. This can be done by very aggressive chlorine bleach or by the American variation of shooting at the trousers with bullets. As part of the proof, some jeans manufacturers incorporate the empty bullet cartridge in the trouser pocket.

Scrubbed: The surfaces of the trousers are scrubbed with brushes in this process, to effect suede and partially fluffy appearance.

Wash-down Effect on Different Types of Sewing Thread

Critical Wash Process	Spun Polyester Thread	Corespun Thread
Bleach wash – mild wash with sodium hypochlorite	Minor fading in shade. Some grey shades can have complete change in tone under unstable wash conditions.	No colour change in vat dyed cotton cover.
Bleach wash – strong Bleach with calcium hypochlorite	Most disperse dyed colours fade completely under strong bleach conditions.	Unaffected in most cases. Mild fading observed in selected dark shades under strong bleach.
Pumice stone washing	Seam weakens by 5%. Some degree of seam abrasion at waist belt and pockets. The looper thread abrades at a noticeably higher rate and can cause broken stitches.	The high tenacity polyester filament core provides complete protection for seams against abrasion. Seam appearance is excellent.
Enzyme wash with pumice stones	Severe seam abrasion at waist belt, back rise, back york and bottom line seams. Poor seam appearance. 30% chance of total seam breakage at stress points.	Seam strength and seam appearance remain intact. Vat dyed cotton cover retains the shade under normal conditions.

Thread Recommendations for Denim

Brand	Image	Description
COATS *dual duty*		Coats Dual Duty offers excellent wash-down characteristics making it ideal for jeans.
COATS *dual duty rugged*		Coats Dual Duty Rugged is dyed using specially selected dyestuffs which are able to withstand most wash down applications which use bleach (sodium hyperchlorite and calcium hyperchlorite). This makes Coats Dual Duty Rugged ideal for the production of denim apparel.
COATS *dual duty multicolour*		Available in all Coats Dual Duty global sizes, especially in heavy tex sizes, providing a unique look for topstitching or for stitching pocket detail.
COATS *dual duty true indigo*		Coats Dual Duty True Indigo was developed to respond to customer requests for a sewing thread that will achieve a faded effect similar to that on denim fabric after popular wash down processes such as a rinse, medium stone wash, double stone wash and bleach wash.
COATS *epic*		Coats Epic is a superior corespun sewing thread engineered to meet a wide range of applications.
COATS *epic rugged*		Coats Epic Rugged is produced in a selected shade range for denim, using special selected dyestuffs which withstand colour change when subjected to the bleach treatments used in denim wash down processes.
COATS *epic multicolour*		Coats Epic Multicolour is a high performance corespun thread that has been space dyed for multi-colour stitching.

Embroidery Recommendations for Denim

Brand	Image	Description
COATS *sylko*		Coats Sylko is a trilobal polyester thread for machine embroidering.
COATS *sylko metallic*		Coats Sylko Metallic is a highly engineered composite thread for machine embroidery.
COATS *brio metallic*		Due to its unique braid construction and attractive seam appearance Brio Metallic can be used for a wide variety of applications, including sewing decorative seams in severe sewing operations on jeans and leather goods.

Please **contact** your local Sales Office to find out more about Denim.