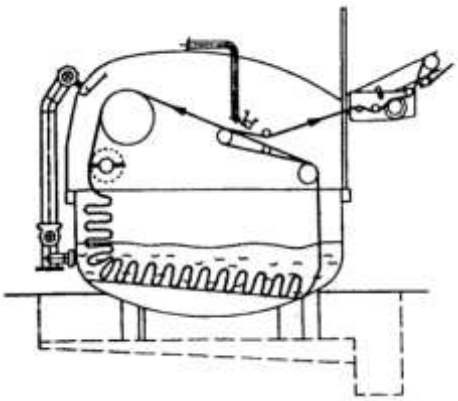
Winch Dyeing Machine

Introduction

The winch or beck dyeing machine is oldest form of piece dyeing machine. The construction is comparative simple and therefore economical to purchase and operate. It is suitable for practical all types of fabric, especially light weights, which can normally withstand creasing when in rope form as woolen and silk fabric, loosely woven cotton and synthetic fabrics, circular and warp knitted fabrics. This a dyeing machine for fabrics in rope forms with stationary liquor and moving material.

Feature and parameter:

i. *The machine operates at a maximum temperature 95-98ºC*
ii. *The liquor ratio is generally quite high (1:20-1:40)*
iii. *This is a dyeing machine for fabrics in rope form with stationary liquor and moving material.*
iv. *In winch machines, a number (1-40) of endless ropes or loops of fabrics of equal length (about 50-*



100m) are loaded with much of their length immersed in folded form inside the dye bath.
v. *As for all forms of rope dyeing, the fabric must be fairly resistant to length ways creasing.*
vi. *A perforated separating compartment, positioned at a distance of 15-30 cm from its vertical side creates an inter space for heating and for adding reagents.*
vii. *Heating can be supplied by means of direct or indirect stem heating.*
viii. *The rope passes from the dye bath over two elevated reels. The first roller is free-running (jockey or fly roller) and the second is winch reel.*
ix. *The winch reel not only controls the rate of movement of the fabric rope, but also the configuration of the rope in the dye bath.*
x. *The winch reel does not grip the fabric positively, but by the weight of the wet fabric and the friction between the reel and fabric.*

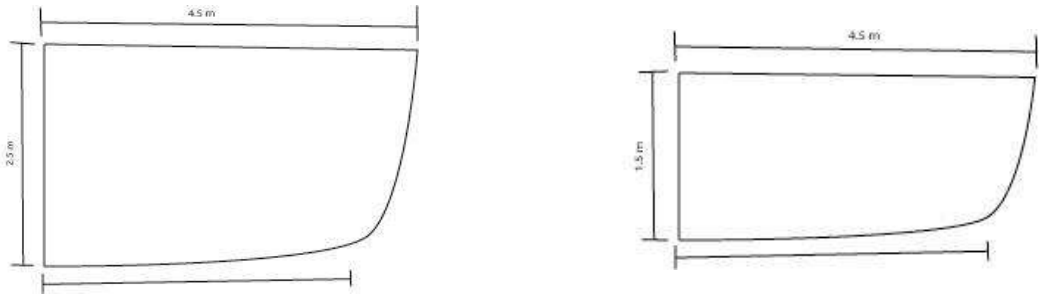
xi. *Now-a-days stainless reels with corrugated and broken surface for increase frictional forces are used.*

xii. *The maximum motion speed of the fabric must be approximately 40m/min.*

xiii. *The winch dyeing method is suitable for all fabrics, expects those which tend to originate permanent creases or which could easily distort under the winch stretching action.*

Lay-out of a winch dyeing machine

Old winches were made of wood, but now- a- days are made of high-quality stainless steel(AISI type 316 or equivalent) with welded joints, ground and polished. The shape and size of the vessel and reel very. Considerably depending on the type of fabric to be processed. Most of the winch machines are about 2.5meters in length and 0.5 meter (single rope) to 4.5 meter (40 ropes) in width.



A-Side *B-Side*

Fig: Schematic Profiles of the beck of a winch machine

Most winches are fitted with an overflow duct at the back so that rinsing can be carried out in liquor flow from front to back. The fundamental schematic lay-out of a winch dyeing machine is shown in figure where one can see the principle constituent elements which are:

1) *A tank with a trapezoidal cross- section (A) with one of the sides curved divided in two compartments separated by a perforated wall in the larger compartment the cloth is placed, laid in a suitable fashion, while in the smaller compartment the pipes for the water and steam arrive and the addition of dissolved chemical products and dyes is effectuated.*
2) *A motor element (B) called "winch" situated in the upper part of the machine and which may be elliptical or circular with a rotary motion by means of which it causes the movement of the cloth in the underlying bath.*
3) *Dividing fingers (C) which maintain the different cloth ropes apart and prevents them becoming entangled while being pulled by the winch.*
4) *A roller (D) which at times can be transform into a further winch according to it type of article; its task is to accompany the textile during its route from the back towards the winch.*
5) *Other devices which enable the following effect to be obtained :*

5.1. Metal or wooden lid with windows to close the upper part of the machine at prevent excessive evaporation.

5.2. Autoclave which encloses the winch and permits dyeing at high temperature.

5.3. Circulation pumps which permits the uniform of dye concentration and temperature in the entire volume of the bath.

Geometrical forms of winch

The winch is generally built in geometrical forms: circular, polygonal and elliptical. Each of these is suited to for certain dyeing sectors according to the peculiarity of the article being processed. Thus for example, the circular winch is preferable for the treatment of woolen articles since it causes a more gentle movement of the textile. Reading to a minimum the lengthening and the telling of woolen articles. On the other hand, elliptical winches are preferred in. the processing of cotton and viscose rayon articles. There is however, the tendency to construct the winches so much less elliptical the lighter the articles to be treated are.

Types of winch machine

Winches are of two types:

1. *Deep- draught winches*
2. *Shallow-draught winches*

1. Deep-draught winches

(a) Deep draught winches usually have circular or slightly elliptical reels (W) with diameter ranging between 20 and 50 cm. It pulls the fabric and lifts it out of the dye bath and over the jockey (J) reel.
(b) On leaving the winch reel, the fabric falls straight into the dyebath with very little plaiting action.
(c) For woollen and heavy cotton fabrics, a deep-draught vessel with a sloping back is preferred.
(d) The depth enables long length of the bulk fabric to be accommodated and the sloping back enables piled-up fabric to be pushed easily towards the front of the machine.

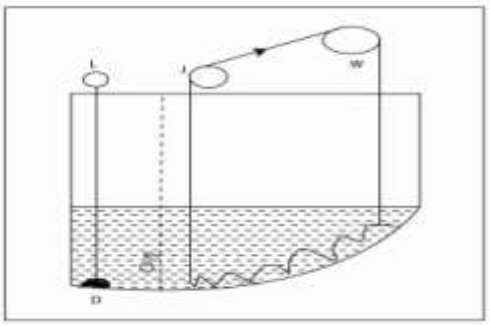


Fig: Deep-draught Winch

(e) The dye liquor is usually 1 meter deep.
(f) as the fabric falls into the liquor from the winch at the back of the machined it tends to bunch up and lie in a heap for a short time. This creates creasing problems for man-made thermoplastic fibers.

1. Shallow-draught winches

(a) Shallow draught winches handle lighter fabric better and have elliptical winches of about 2 meters circumference and 2:1 axis ratio.
(b) Elliptical winches (W) provide more mechanical action and a plaiting action as the fabric falls into the dyebath.
(c) The size of plait increases with reel size.
(d) Reels with adjustable cross-section are also available.
(e) The dyeing of filament viscose, acetate and nylon fabrics require shallow draught winch to minimize creasing.
(f) The depth of liquor is reduced (to about 75 cm) to decrease pilling pressure.

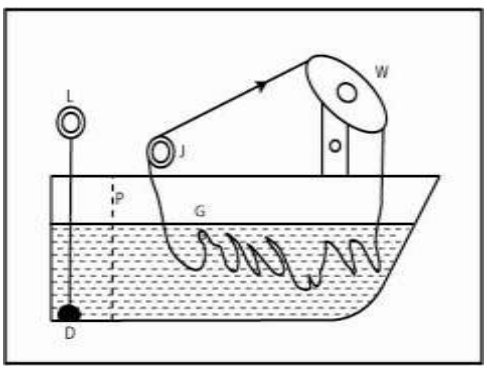


Fig: Shallow-draught winch

(g) There is no great weight of water pressing on the fabric to make creases permanently.
(h) The winch reel is driven from one side of the machine through a v- belt system permitting a variation in reel speed between 40 to 80 m/min, depending on the nature of material to be dyed.

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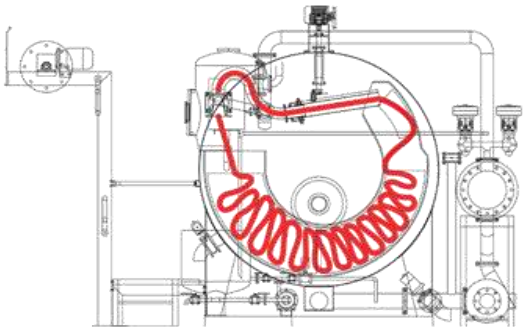
Loading of Fabric

For loading the leading end of each rope is taken and thrown over the winch reel, drawn forward and tied to the peg rail. The winch reel is started and it draws the fabric in twisting of fabric during loading should be avoided. Two ends of each rope are tied by knot opened, one end resting over the unloading reel mounted high above the front of the winch.

Action of the winch dyeing machine during dyeing


Flow Diagram

The dyeing of a textile in a winch dyeing machine comes about by the exhaust of the dye on the textile material, which is alternately in a phase of rest and a phase of movement brought into contact with the dyebath which in the majority of cases possesses itself. In winch, the of the textile material to liquor ratio is usually around 1:25. For better designed machines it is around 1:15, while for small winches it may be as high as 1:40. The rope to be dyed passes through a rack on the vertical perforated divider, which ensures the separation of the various folds of the rope and avoids possible entangling; the rope is then transferred on to a cylinder, which guides the fabric during the lifting from the vat carrying out a partial squeezing with subsequent liquor exchange. The rope (carried by the winch folds while passing through the liquor.) When the fabric is lifted from the dyebath, the liquor starts to drain back by gravity, assisted by the mild squeezing actions of the jockey and winch reel. The downward movement of liquor plays an important role in dye migration and levelling. Normally the concentration of dye in this drained liquor is appreciably less than that in the dyebath. As the fabric is plunged back into the dyebath, which stays closely associated with the part of the fabric, as it travels to the front. The rate of dyeing is controlled by the number of fabric cycles in a given time. There is no appreciable movement of the ropes in the dyebath. Otherwise, entanglements may result. However, considerable movement of liquor in the dyebath is apparent from the fact that the dye diffuses very quickly throughout the dyebath as soon as it is added in the addition chamber. The winch machine does not give very efficient movement of the fabric through the liquor as a large portion of it is always using at the bottom of the dyebath. Both dyes and chemicals are added to dyebath during dyeing and gradually mix into the remainder of the solution. All additions must be made across the full length of the machine with stirring. During dyeing the machine operates at a maximum temperature of 95-98c. Heating can be supplied by means of direct or indirect steam heating.

Winch dyeing machine with Autoloda:

British silk dyers developed a system in 1964, later known as Spiraloda or Autoloda as shown in fig. In this system the loading end of the rope (T) is attached to a loading arm (L), which is advanced slowly by a chain drive (C) at one side of the winch (W)

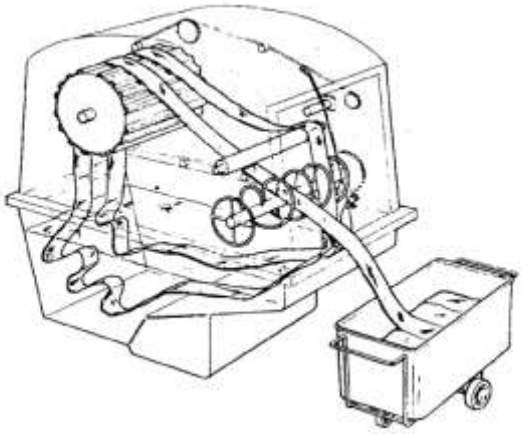


Figure 12.3 Illustration of a winch dyeing machine with Autoloda

And guide roller (G). The time taken by the arm to complete a cycle is about 1 minute

and if the winch reels speed is 70m/min, the loop length is about 70 meters.

The system enables the dyer to select the most convenient loop length for the machine. The peg rail is replaced by a continuous helix roll(S), which is rotated away from the leading end at one revolution for each revolution of the loading arm, in order to maintain equilibrium in the dye bath. The pitch of the helix determines the spacing

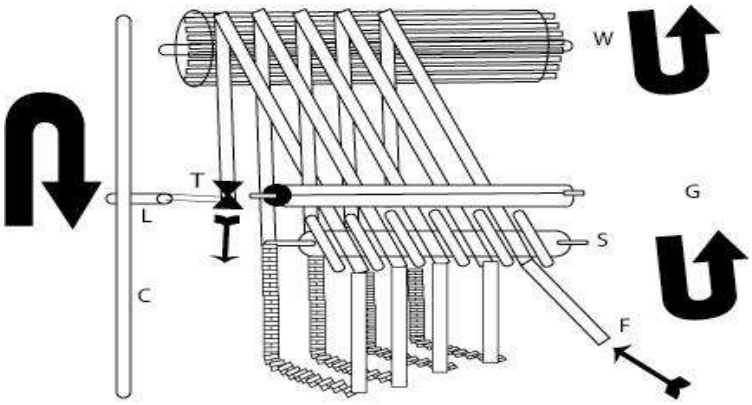


Fig: Fabric Movement in Autoloda spiral dyeing machine

of the rope and interchangeable spiral rollers of different pitch are available for fabrics of varying bulk. Apart from the saving in time for loading and unloading, less sewing less fabric wastages, the Autoloda technique enables the dyer to select the most convenient loop length for the machine. Due to uniform spacing, higher machine loading with lower liquor ratio is possible.

Other uses of winch machine:

The winch or beck dyeing machine is quite simple and serves for all pre-dyeing treatments (scouring, bleaching, washing-off and softening process). This is one of the oldest systems used for finishing treatments, but it proves to be still extremely functional thanks to its flexibility, above all for scouring and bleaching treatments to be carried out on small production runs. Scouring efficiency is high due to greater mechanical action caused by constant reformation of length ways folds. Many fabrics varieties, such as tubular knitted fabrics are, therefore successively scoured in these machines. This machine can also be used for carrying out continuous washing processes; the fabric is loaded from one side {Aside}, driven through the machine with a spiral motion (by means of the rack) and then unloaded from the opposite side (B side).

Drawbacks of winch machine

The deficiencies are:

- *Formation of running creasing during dyeing may not be removable even by Stentering.*
- *Considerable longitudinal tension exercised on the goods resulting in elongation and deformation.*
- *Rapid heating and cooling promoting deformation.*
- *Dimensional stability not ensured even if the material is heat-set before dyeing.*
- *Long liquor ratio hampering economy of dyeing.*
- *Risks of entanglement of fabric ropes.*
- *Difficulty in maintaining uniform temperature throughout the dye bath.*

Conclusion

Until 1960s the machines used for dyeing fabrics in batches were the winch, jigger and beam. When polyester was first introduced as a textile material, conventional pressure free winch beck equipped with a hood was mainly used for dyeing using carriers. Soon it become evident that dyeing above 100ºC would be necessary to eliminate the use of carriers and accelerate the diffusion of the dyes for cutting down dyeing time. This promoted machine manufacturers to construct high temperature or high pressure modification of the existing winch dyeing machines. The dye bath is essentially a normal winch dyeing machine and a kier, on a track which can be pushed into position so that the dye bath is totally enclosed, in a pressure resisting container. Although many High temperature machine constructions were in the market, there was no ideal dyeing machine for circular knitted polyester textures goods. Winch dyeing results in thicker fabric with fuller handle more fabric cover and better crease recovery. Open width threading of the fabric in a winch machine is possible for heavy materials such as carpets and for fabrics that might be crushed in rope form.

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