Jet dyeing machine diagram

Jet overflow staining machine is used for pre-treatment and staining of rope fabrics, both with liqueur and moving materials; the architecture and design of the system and the proportions of alcohol are similar to those of a jet machine. The main difference is the fabric transport system, driven partly by the motorized reel and partly by the sequential flow of alcohol. The jet nozzle, based on venturi tube, is replaced by a vessel containing alcohol; alcohol enters a simple section of the pipe and then flows through the transport channel along with the fabric rope. Overflow Jet Dyeing Machine These machines are designed for use in delicate knitted fabrics and fabrics that are made of natural and synthetic fibers. They are also widely used in the manufacture of carpets. The main difference between jet machines and jet overflows is that in jet machines the fabric is transported through the bath, which flows at high speed through the nozzle, while in an overflowing coloring machine there is a gravitational force of alcohol overflow, which is responsible for the transport of fabrics. Parts of overcrowded jet staining machines A typical Overflow Jet staining machine works this way. The stillter, which is not powered by the engine, is usually located at the top of the machine where the fabric is hung. The longer length of the fabric is made to hang from the starting side of the inlet compared to the inlet side. Using gravity, the longer length of the fabric is pulled down tighter than the shorter one. Therefore, the fabric is soaked in the bath without any tension. The following diagram illustrates the workflow well. Scheme of overcrowded jet coloring machines No evaporation losses – Since the coloring vessel is closed, there are no evaporation losses resulting from the staining bath. In addition, depending on the situation, the temperature can be raised to more than 100 degrees C. No accumulation of steam condensate in the coloring bath – the latest technology suggests that the dye is heated by a steam-driven heat transducer. This technology, in addition to being very efficient, ensures that there is no accumulation of steam condensate in the dye. Low alcohol proportions – staining is carried out at relatively low alcohol proportions, eg. Excellent contact with staining alcohol – Excellent contact with dye liqueur with fabric rope results in better and improved level dyes. Computer control - Machines are operated by a computer and thus operator error is eliminated. Jet Dyeing Machine Multi Nozzle Soft Flow Coloring Machines (A) Multi Nozzle Soft Flow Coloring Machines (B) ASF Coloring Machine HT. Hp. Soft Flow Coloring Machines Weight Reduction Machines Economy Top Tube Soft Flow Coloring Machine Economy Machine Colouring Machine It has been found that, when using restraint, it is not some inherent problems. So jet coloring machines, when they appeared in the 70s, were specially designed to overcome these shortcomings. In the Jet coloring machine, the reel is completely eliminated. There is a closed piping system, in which there is a fabric. For the transport of fabric through the tube, a stream of dye liqueur is supplied by a constricitis. Jet creates turbulence. This helps to penetrate the dye along with preventing the walls of the tube from touching the fabric. Since the fabric is often exposed to relatively higher concentrations of alcohol in the transport pipe, such a small dye bath is needed at the bottom of the dish. This is enough to move smoothly from back to forward. Water jet dyeing machines typically use a powered reel along with a jet nozzle. The following diagram explains how a jet dyeing machine works: Types of jet staining machine: When deciding on the type of coloring machine, they are usually taken into account when distinguishing. They are as follows. The shape of the area where the fabric is stored, i.e. a long-shaped machine or a compact J-box machine. The type of nozzle with its specific positioning, that is, above or below the bath level. Depending on these criteria, differentiation of the following types of jet machines can be considered as the development of a conventional jet dyeing machine. 1. Overflowing staining machine 2. Soft flow staining machine 3. Airflow Dyeing Machine Jet Dyeing Machine Advantages: Jet Dyeing Machine offers the following striking advantages that make them suitable for fabrics such as polyesters. Low water consumption Short staining time Can be easily operated at high temperatures and pressure Relatively low alcohol ratio, usually varies between 1:4 and 1:20 Fabrics are handled carefully and gently Soft Flow Coloring Machine: In soft flow dyeing machine water is used to keep the fabric in circulation. The difference between the concept of this device and conventional nozzles that work with the hydraulic system is that the fabric rope is kept in circulation throughout the processing cycle (from loading to unloading). There is no stopping the circulation of alcohol or fabric for the usual drainage steps and filling. The principle of working behind the technique is very unique. There is a system for fresh water to enter the vessel via a heat exchanger into a special exchange zone. At the same time, the contaminated liqueur is allowed through the drain without any contact with the fabric or for that matter in a new bath in the machine. The most important features of the soft flow staining machine: significant savings during processing. Water saving, which is about 50%. Excellent separation streams result in optimal heat recovery and a clear possibility of further use or dedicated treatment. The principle of soft flow coloring machine: Textile material can be stained by batch, continuous or semi-continuous process. Batch processes are the most common method used for dyeing textile materials. There are three general types of batch staining machines: 1. In which the fabric is circulated 2. In which the dye bath is circling 3. In which both the bath and the material circulate. The jet dyeing machine is the best example of a machine that circulated from both fabric and dye bath. Jet staining is used for knitwear. For terry towels, a gentle flow of staining is applied. In a jet dyeing machine, the fabric is transported by a high-speed stream of dye liquid. As you can see in the figure, this pressure is created by venturi. The powerful pump circulates the dyed bath through the heat exchanger and fabric chamber. The guide tube of the fabric helps in the circulation of the fabric. Types of soft flow coloring machines: Several commercial popular brands along with their respective technical specifications are discussed here. The categories are not exhaustive as such. Multi Nozzle Soft Flow Coloring Machine: Technical Features: 1. Very low alcohol ratio - about 1:1 (Wet fabric) 2. It can reach a high temperature of up to 140°C 3. Easy to dye 30 to 450 g/mt.sq. fabrics (woven & knitted fabrics) 4. Number of nozzles with very soft flow 5. No pilling effect 6. Large capacity High pressure high pressure soft flow staining machine: Technical features: 1. Compact body made of stainless steel. 2. High performance heat exchanger for quick heating/cooling. 3. Compact body made of stainless steel. 4. Heating speed - about 4°C/Min to 900°C - about 3°C/Min to 135°C At a steam pressure of 6 bar. Cooling speed - about 4°C/ Min At water pressure 4 bar and 15°C. 6. The maximum operating temperature is 135°C. Maximum working pressure 3.2 bar. Control manual, as well as automatic. 9. Durable stainless steel pump. Soft flow staining machine 1. Vigorous mixing of the fabric and staining of the preparation in the fabric increases the rate of staining and uniformity. Minimizes creases because the fabric is not kept in any configuration for a very long time. The lower liqueur ration allows for shorter staining cycles and saves chemicals and energy. 2. In soft flow staining machines, the fabric is transported by a stream of dye liqueur. However, the transport is aided by a driven lift reel. 3. These machines use a stream at a lower speed than conventional jet dyeing machines. 4. Soft flow machines are softer on fabric than conventional Jet. Photo courtesy: 1. Deluxeknittingmill.com This This was originally published in a texting student blog run by Mazharul Islam Kiron. M. Gopalakrishnan, ... D. Saravanan, in Water in Textiles and Fashion, 2019In the past, knitted fabric coloring machines were used for dyeing knitwear, with a material-to-alcohol ratio of 1:20. The soft flow staining machine only needs 4 l of water for every 1 kg of processed fabric. Now a new range of m:L dyeing machines with a ratio of even less than 4 is available. In soft flow dyeing machines, fabrics are circulated with alcohol, which needs a certain amount of alcohol. Air flow staining machines resemble soft flow staining machines, except that fabrics are circulated by means of an air stream instead of water or a colouring liqueur used for soft flow staining, thereby reducing water consumption. The principle of air flow staining is based on the aerodynamic principle instead of hydraulics. Air technology is used to transport the fabric during staining, washing and even unloading. Multi-pump air flow staining machines offer higher efficiency and drastically reduce the material-to-alcohol ratio to 1:2. The main advantages of soft air flow staining machines are (Fongs, •flexible method of transporting fabrics using air;•fabric weights can be processed from 50 to 800 g per square metre;•very low material-to-alcohol ratio of 1:2 for MMF and 1:3-1:4 for natural fibres;•almost 40% energy saved compared to soft flow staining machines;•reduced process time to 25%. In modeling, simulation and control of the staining process, 2014Dyeing machines can have more than one pump. One of them is the main circulation pump, which is usually located at the base of the hearts as close as possible to the center to reduce frictional flow losses. These can be centrifugal or axial. The horn,30 pump overview stresses that regardless of the type of pump used, the pressure generated should be constant for a moderate change in flow volume. This is usually the result of leaks from the spindle columns and is also observed when long spindles are used along with high proportions of alcohol. Secondary pumps are usually centrifugal and are used to exert pressure on the entire system by sucking liquid from the bottom of the hearts and feeding it into the main pump. Cavitation, which is the result of steam bubbles forming at high temperatures on the low pressure side of the pump, can also be avoided if the entire system is pressurized even during staining at 100 °C.Other pumps for injecting dye and chemicals are also used in packaging staining machines. The number of auxiliary pumps on the machine depends on the number of injection inlets of different chemicals in the Staining.J.N. Chakraborty, in the basics and practices in textile staining, 2010A jet dye machine consists of many parts, ranging from one model to to and is complicated in construction. Various types of partially and fully flooded jet dyeing machines are popular worldwide and have been well documented (White, 1998; Paterson, 1973). The appearance of a typical jet staining machine is shown in Figure 1. Jet staining machine. [courtesy: Hisaka] The cover shall be accompanied by a loading port in the front part; the latter is opened to load the pre-measured length of the fabric in each cycle and loading is completed by stitching both ends. The machine has a large coloring tank made of stainless steel with a support tube for continuous forward movement of the fabric. The coloring tank is also connected to several other connecting pipes to circulate the dye liqueur through the heat exchanger, filter and finally reach the stream continuously. The heat exchanger on the circulation path heats up or cools alcohol with a supply of steam or cold water through narrow pipes inside it. The filter eliminates impurities in the lye derived from the material and dye solution in the form of broken threads or insoluble chemicals. The loading reel located in front of the loading port is a very polished small roller used to facilitate the smooth movement of the fabric without touching the main colouring vessel, which otherwise causes degradation as well as damage to the fabric due to high temperature and friction. A small viewing port helps visualize the smoothness of the process, that is, if the fabric has been tangled or locate the stitch marker from which the sample is to be removed to match the hue. A diagram of jet staining machines showing different parts is shown in Figure 31.20 (Star, 1985; Anon, 1979b).31.20. Various parts of jet staining machine. [courtesy of Star Industrial & Textile Enterprises Pvt Ltd] A unique part of the jet dyeing machine is the nozzle, which is a combination of several conical identical metal containers open at both ends with two different diameters (like frustum). Dye alcohol coming from a service tank or dye vessel is pumped through the upper open side of the nozzle with a larger diameter to discharge it through a narrow open end, causing a huge increase in flow rate, forcing the fabric to move along with the circulation of alcohol. No tension on the fabric ensures quality without distortion. The flow rate of alcohol through the nozzle is controlled by adjusting the nozzle valve, which in turn helps to control the movement of the fabric. Synchronized adaptive control technology with two-disassociated O-type jet dyeing machines is better in this context (Cheng, 2003). Newer versions introduce translational motion technology (Melocchi and Francesco, 2003), dye adsorption control design et al, 2003) and high-speed staining technology (Hinge, 1981) also influences influences Coloring. Cotton fabric can be dyed in restraint or jigger. If the fabric is thinnest and there is a chance of damage, avoid using a jigger, as the fabric is dyed in a jigger at an open width and energized. On the other hand, the processing of open width in the jigger results in effective dye-fiber contact with an even shade; the appearance of staining remains free from traces of creases. Staining in the hoist reduces the risk of damage, but does not create a bright shade that is produced in the jigger. Polyester fabrics, in particular those dressed and shirts, may be dyed in jet dyeing as well as in HTHP beam dyeing machines. Staining in jet staining machines is a faster and efficient process; a well-aligned shade is produced with a serious problem of crease marks on the fabric, which even creates problems in removal during finishing. Staining in the beam staining machine involves wrapping the fabric on beams with optimal and consistent tension, another cloudy moire effect (faulty staining) is created, which can only be corrected by recreating the fabric in the jet staining machine. Fabrics stained in a beam staining machine do not create crease marks, and develops a fuller handle.S.M. Shang, in process control in textile production, 2013Flow and jet staining machine are distinguished by the speed of the fabric inside the machine. In general, the working speed of the fabric below 350 m/min is classified as an overcrowded coloring machine, and more than 350 m / min is called a jet dyeing machine. There are four main shapes of overcrowded or jet staining machines (Shang and Zhuo, 2003), which is shape O (Fig. 13.24), Shape U (Fig. 13.25), up-L-shape (Fig. 13.26) and down-L-shape (Fig. 13.27). A comparison of these machines is listed in Table 13.21.13.24. Scheme of the coloring machine in the shape of O.13.25. Diagram of the Staining Machine in the shape of U.13.26. Diagram of the L.13.27-shaped staining machine. Diagram of the L-shaped staining machine. Comparison of machines for overflow and jet stainingForm m-LDown-LFlow or jetOverflow or jetOverflow onlyFlow or streamMaximum frequency of fabric operation (m/min)< 350 (overflow) or > 350 (jet)< 350< 350< 350 (overflow) or > 350 (stream)Nozzle pressureHigh (stream) or low (overflow)LowLowHigh (jet) or low (overflow)Friction between fabric and machineHigh (stream) or low (overflow)LowHigh (jet) or low (overflow)Alcohol ratio1:5-8 1:5–81:6–101:6–10Maximum staining temperature (°C)135100135135Fabric style stack inside machineCooth (tight)Staining (tight)Waving (loose)Accessibility for for pure polyester; overflow to the cotton or cotton mixturefor knitTo cotton, polyester, nylon and mixtures; both knit and wovenFor pure (thin) polyester, nylon, mixture or fabric easily with crease marksFor an overcrowded coloring machine, friction between the fabric and the machine, as well as between the fabric and the liqueur, is smaller than in the jet staining machine, because the force of pushing alcohol produced by the nozzle is delicate. Overflow staining machine is especially suitable for those fabrics that are not able to withstand high voltage and high friction, such as cotton knitwear and their mixtures, as well as elastic fabrics. Knitted fabrics should be stained with overflowing staining machines to reduce plundering and maintain dimensional stability. This is because the force of pushing the nozzle liqueur into the fabrics is moderate and the slippage between the fabric and the elevator drum is small. The jet dyeing machine is more suitable for clean synthetic fabrics, especially thin fabrics and easy folded fabric. In modeling, simulation and control of the staining process, 2014For the packaging staining machine described above, a clear definition of system geometry is shown in Fig. It is assumed that the dye liqueur circulates through the packaging during staining, and the direction of flow is perpendicular to the layers of yarn in the package. Figure 4.4 shows the simplified two-dimensional geometry of the system.4.3. Flow through the package.4.4. Flow through the packaging in two dimensions. To simplify calculations, it is assumed that the process of both mass transfer and flow behavior is the same for both sides along the symmetrical axis. Therefore, the geometry of the system can be further simplified to the geometry shown in Figure 1. Only the left side of the symmetric axis line is considered system geometry described in this document.4.5. System geometry in two dimensions.N.A. Ibrahim, in the Manual of Textile and Industrial Staining, 2011Staining guide can be carried out at different stages of processing textile materials, i.e. textile staining. Colouring machines may be classified respectively (Bellini et al., 2002; Chaudhury, 2006; Nair and Pandian, 2008). 1lit. Loose fiber staining machine. (ii) Hank/pitch/yarn rope staining machines. (iii) Jigger/press/jet/beam/pagle mangle fabric dyeing machines. (iv) Rotating drum/side paddle for dyeing clothing. 1lit. Discontinuous method; batch in the form of a rope (winch, stream) or in open width (jigger) (Anis and Eren, 2003; Hyde, 1998; Moorhouse, 1996; Yang and Li, 2000). (ii) Semi-discontinuous systems. (iii) Continuous systems for high production. The most popular sequences for semi-solid range for fabric staining are: Pad → cold batch → washPad → preheating → hot batch → washPad → dry → development jiggerThe most friendly for the continuous range of pad-steam for dyeing fabrics is: Pad → dry → washer → steam fastening → wash with your other hand, Thermosol staining of fabrics containing polyester includes the following steps: → for pre-drying (using an IR preheater to avoid migration) → drying (using steam cylinders) → dye fixing at 200-220 °C for Circulation systems(ii)Textile handling systems(iii)Both dye circulation systems and textile material handling systems. Closed (high pressure/high temperature) or open systems depending on the type of material and process to be carried out. Factors influencing the choice of staining methods, for individual mixtures to guarantee the best dyes include (Aspland, 1997; Broadbent, 2001):•Minimum use of natural resources, as well as consumption of chemicals, i.e. For the correct selection of staining machines, it should be taken into account (Bellini et al., 2002; Nair and Pandian, 2008):•Textile protection•Uniform penetration, level dyeing, increased build-up and maximum dye fixing•Right dyeing for the first time and reproducibility•Environmental and economic aspects. Mixed staining is a major challenge due to differences in: the nature of the components of the mixture, the substantivity of the dye, the staining conditions, the type of auxiliary staining used, as well as the process of staining, that is, batch, semi-continuous and continuous staining. On the other hand, as mentioned earlier, Whereas the classification of textile fibres on the basis of the substitutability of colouring dye can be divided into four main groups, namely (Aspland, 1997):(i)Group A: acidic and pre-metallised acid dyes for colouring wool, silk, nylon and polyurethane through ion interaction and non-polar forces van der Waals (Doughty, 1986; Kue and Fang, 2006; Zhao and Others, 2004). (ii) Group B: Basic colours for acrylamili and modacrylamine, cation coloured polyesters by creating electrostatic bonds (coulombic) (Holme, 2002; Kuo and Fang, 2006). (iii) Group C: Cellulose dyes, e.g. cellulose dyes, Bone, 2001; Carlough and Mesharos, 1989; Chao et al., 1998; Shukla et al, 1998). (iv) Group D: Dispersion colours for polyester, cellulose acetate, nylon and polyurethane by hydrophobic bond (Afifi and Sayed, 1997; Aspland, 1993; Carlough and Mesharos, 1989; Choi and Towns, 2001; Doran, 1999; Holme, 2002; Hook, 1992; Qian and Song, 2007). When it comes to staining mixtures, the most demanding task is to obtain solid shades, regardless of the ingredients of the mixture. Some of the most commonly used fibre mixtures and the choice of suitable colouring and staining methods for these representative fibre mixtures are listed in Table 4.5.Table 4.5. Choosing dye and processes for some representative fiber blendsFibre blendsDye selectionBramia methodColor of the taste effect1. AA mixesPolyamide/woolActs and complex dye (with anion retarder)Single class/exhaustion (acid-leveling or neutral pH metal complex)Solid/polyurethane acid Sourdoughs or 1:2 complex metal dyes (with retarder for controlling up capture)Single class/exhaustionSolid2. AB blendsWool/modacrylicPremetized or grinding acid dyes/primary dyes (with non-iion anti-irinative)One bath/exhaustionTurning or contrastWool/poly for primary dyeing Acid dyes metal-encapsulated at the halfway point or grindingActive and primary dyes (with non-ioic anti-precipitant)Single class (at pH 6-7) One bathPolish – reserve, i.e. leave whiteKontrastPolyamide/acrylicEquix for airing or 1:1 complex metal dyes/base dyes (with non-iance anti-precipitant)Basic dyes pH 4-5 → pre-metallized dyes with suitable pHOne bath (pale shades) Two stages (full depth of shades)Solid or contrast3. Ac blendsWool/cottonBaryesacid/low-sulfonated direct dyesOne-bath/exhaustionSolidChlorinated wool/cottonAcid dyes/direct dyes/direct dyes (with non-ion retarder)One-bath/exhaustionSolidWool/viscoseMilling acid dyes → direct dyesOne -bath/exhaustion Solid or contrastWool/flax Acid dyes → reactive dyesWiem steps/exhaustionConstant/cellulose fibres Reactive dyes at pH 4-5 → salt and alkalisTransistly metallised or grinding acid/salt-controlled dyes directly dyesSingle class/exhaustion One bath/exhaustionStalSolidSolidPolyuretan/cottonTransiturally metallised or grinding acid dyes/direct dyes in pH 8One-bath/exhaustionStedpolyamide/cellulose fibresDefeated metallised or milling acid/salt dyes directly dyesPad SolidSelected pre-metallized or milling acid dyes/reactive dyesPad-dry-themofix-acid shock (continuous)SolidSelected 1:2 metal dyes folded then vatPad-dry-steam dyes, Pad-dry-chemical pad-steam (continuous)Solid4. AD mixes woolen/polyester acid dyesSe sects/dispersion dyes (at pH 5-6, with carrier)One bath/exhaustion (pale-medium shades)Solid5. CBOkaton mixtures/basic colouring polyester dyes/basic dyes (anti-ejaculation)One bath at 120 °C/exhaustionTurned or contrastColet/acrylicDide/migrated primary (anti-elective) dye)One bath/exhaustionSol wares or contrast Dyespod articular at boiling water → vat dyes at 50 °CFor-bath/exhaustion Solid or contrast Dyes → VAT dyesFor-dry steam, Pad-dry-chemical washer-steam Solidbasic dye → reactive dyesPad-dry steam, Pad-dry paraSolid6. Cc blendsCotton/linenDirect or dyes vatOne-bath/exhaustionSted or shadowSmed dyes (low salt, at boiling water)One bath/exhaustionSolidCotton/polynosicSelected highly reactive dyesAdditional-batch technique (continuous)SolidViscose/polynosic Viscose/lyoDirectcell, reactive or vat dyesOne-bath/exhaustionSolid or shadow7. CD cellulose blends /polyesterSelected reactive /disperse dyesVerkie (cellulose first) on the beamSolid belceSolid shades)8. DA blendsPolyester/woolSelected dispersion dyes/selected 1:2 metal dyes Sedated bath at 105 °C (with carrier)/exhaustionSolidTwo-bath (dispersion staining at 120 °C → metal dyes or minced acid dyes in tossStryp/woolSelected dispersion dyes/dyesone-bath acid milling in with ester carrier)Dyes with ester)SolidTriacetate/nylonDisorder (at 105 °C) → 1:2 metal complex (at boiling water)Two baths (full Solid paintsPolyester/nylonAccessive at neutral pH at 70 o C → indirect energy dissipation dyes at 120 o CTwo-lot (darker shade)Solid or contrasting9. DB blendsProser/acrylicDisperse/primary dyes (with non-irradiant and anti-irinative medium)Single-shower or contrast dyes at 120 °C → primary dyes (with cation retarder) Two-stageSolid or contrastAcetate/acrylic Primary dye at boiling water (with cation retarder) → dissipate dye at 80 °CTwo-bath (full depth)Solid10. Dc blendsPolyester/celluloseDevelopment/reactive, direct, vat or sulfurOne or two baths/exhaustion (beam, stream, high temperature hoist or jigger)SolidSelected dispersion dyes /highly reactive dyes (with NaHCO3 + urea)Pad-dry-themofix (continuous)SolidDisperse dyes → then highly reactive dyesPad-dry-themofix-pad-batch (continuous)Solid vinailo sulphic dyes → dispersion dyes at 130 o CPad-batch-beam or jet (continuous SolidDisperse dye → then low reactivity dyes Selected vat dyes, or solubilised sulphur dyesPad-dry-themofix-pad-steam (continuous)SolidAcetate/celluloseReading disperse dyes energy / salt - controlled direct dyeOne-bath in pH 6 –dyes 7 and 80 °C/exhaustionStedtriacetate/celluloseFore source of dyes at 120 °C — > direct dyes at 90 °CFor-gradual/exhaustible Solid or contrasting (11). Three-component mixtures Nylon/wool/polyurethane (AAA)1:2 composite metal dyes (with suitable release and leveling agent)Single class/exhaustionSolidSource:adapted from Shore, 1998Asim K. Roy Choudhury, in sustainable fibres and textiles, 2017Politr 2017 The fabric is usually dyed in pressure dyeing machines (jet dyeing machines) at 130°C. Economics can be achieved by reducing staining time using selected optimised designs for colouring machines/processes or by using low molecular weight dispersion dyes (to avoid uneven staining over a shorter staining period) (Baldwinson, 1985); The use of compatible dye, which are adsorbed at the same rate, is also important when choosing a dye. To reduce the staining time of polyester, should be started at the highest possible temperature and the rate of temperature rise should be the highest possible without limiting the level. A critical temperature test has been developed, in which visual estimates of the temperature are made, at which 50% of the exhaustion of a certain amount of dye is achieved within 20 minutes. According to clariant, the critical temperature zone for high temperature staining is the temperature zone, where the last 80% 80% is depleted into polyester fiber (Clariant (India), 1983). Level coloring can be achieved if the heating rate is controlled by this temperature zone. In conventional jet dyeing machines, the maximum heating rate is 2°C per minute, whereas for fast jet staining this speed is usually 6°C per minute, and in advanced machines such as Hisaka and Callebaut de Blicquy Jet-Dyeing, 8-10°C per minute. Below the critical temperature, the temperature can be increased at a higher speed. In fast jet staining, the speed can be 6°C/min and in the critical temperature zone it can be around 2°C/min. In conventional machines, the maximum heating speed can be 2°C/min, which in the critical zone is to be further reduced to 1-1.5°C/min. To further reduce the staining time, you can select high-speed fast-fixing dispersing dyes so that you can achieve satisfactory diffusion and fixation within 10-20 minutes in a fast dyeing machine compared to a much higher time (up to 50 min) of conventional dyes in conventional jet machines. The total staining cycle can be reduced to 50-70 min compared to 180 min in a conventional process (Sherrill et al., 1981).M. Ferus-Comelo, in the Manual of Textile and Industrial Staining, 2011The flow of dye thorn in a colouring machine, which is usually produced by the pump, causes the macroscopic velocle speed of the dye molecule on its way to the fibre, which can be called convection diffusion (Breuer and Rattee, 1974, p. 105). Immediately on the surface of the fabric, however, there is no macroscopic flow. Therefore, the speed of the liquid increases from zero on the surface of the fiber until it reaches the value of the mass phase. An area where the speed has not reached the speed of the mass phase may be interpreted as a liquid layer extending from the surface of the fabric to a certain distance to the dye. This hydrodynamic boundary layer, defined as an area where the liquid veloquial is less than 99% of the bulk flow rate, in turn results in a gradient of dye concentration. The concentration gradient area is sometimes called the diffusion boundary layer and is about one-tenth of the thickness of the hydrodynamic boundary layer (McGregor and Peters, 1965). The last part of the dye molecule path from liquid to fibre surface is therefore limited to diffusion by this liquid layer. Therefore, the rate of up capture of the dye may be reduced if the mixing of the dye is not high enough to transport the dye faster to the surface of the fibre than the rate at which it is arranged by the fibre. The effect of alcohol flow on the degree of exhaustion has been known for a long time (Armfield, 1947) and has since been confirmed several times (Alexander and Hudson, 1950; 1972; Etters and English, 1988; Vickerstaff, 1954, p. 144). The effect of the boundary layer on the speed of exhaustion can be explained mathematically under certain assumptions. Assumptions. fixed diffusion factor, langmuir type or Freundlich type sorption isotherm and infinite bath, it can be shown that the overall diffusion speed depends on the dimensionless variable L (L is introduced under one of the boundary conditions in the solution of the Second Law of Fic) (McGregor and Peters, 1965). In the case of isotherm, Langmuir L becomes: [5.18]L=DslDfδK([D]sat[D]sat−[D]f,eq)For the Freundlich isother (n = 0.5) L becomes [5.19]L=DslDfδK2([D]f,eq+[D]f)The smaller the L value is the more the system is controlled by the diffusion of the liquid, the greater the effect of the boundary layer on the dye up rate. Equations show that L is reduced by increasing the thickness of the boundary layer, e.g. by increasing the thickness of the δ the The bulk flow rate, v0, and the thickness of the boundary layer can be quantified if you apply a sheet model of a plane immersed in a flow parallel to its axis. In this system, the average thickness of the boundary layer is (McGregor and Peters, 1965):Here the average thickness of the boundary layer is used because δ is a function of x and δ is therefore averaged by x. , i.e. equations [5.20] and [5.21] also show that L becomes smaller for a high partition coefficient, i.e. 5.20% and [5.21]. The staining process would therefore be more sensitive to changes in the flow rate of alcohol under conditions of high substitute. Note that the L value usually changes during the staining process because neither the substypity nor the diffusion factor are constant. For L-values greater than ten, the system is for practical purposes determined only by the diffusion of the film. Commercial colouring machines are estimated to have an L value of around 20 and will therefore have little impact on boundary layer phenomena (Etters, 1994). The initial model for which the L parameter was derived was applied only to the infinite dye, i.e. the colouring agent. Since then, the model has been extended to include transient (initially solid and then constantly reducing dye concentrations) and finite (constantly decreasing dye concentrations) dyes (Etters, 1991). The model was helpful in explaining polyester staining with dispersion paints (McGregor and Etters, 1979). Experiments with C.I. Reactive Blue 109 on printed cotton fabric could only partially confirm the relationship expressed in equations [5.20] [5.21] (Etters and English, 1988). Tests showed, as expected, that a higher mixing rate led to a shorter half-staining time, which is the time needed to achieve a 50% sorption equilibrium. On the other hand, changes in dye concentrations did not have a significant effect on half the time. The explanation provided by the authors is that the relatively low partition coefficient values obtained for the range of dye and salt concentrations used in the experiments indicated high L values, indicating that the up capture is a diffusion of the film and not a limited liquid diffusion. This would explain why staining systems with higher baffling coefficients, such as acid dye on wool, show a rate of dye up capture that may be sensitive to dye concentrations. A similar model was suggested by Gooding et al., which found from measurements from the channel flow cell that for some dye the adsorption rate is controlled by a porous surface layer (Gooding et al., 1998). They confirmed that higher flow rates increased the rate of adsorption. They also found that high concentrations of dye in the liquid phase block the passage of dye through the porous surface layer and reduce the rate of adsorption.J.N. Chakraborty, in Basics and Practices in Textile Coloring, 2010Fig. 28.1(a) shows the commercial paddle coloring machine and cross-sectional view in Fig. 28.1(b) (Hilden, 1988). In a large vat with the help of a rotating paddle there is a slow circulation of both alcohol and clothing. This machine offers relatively low efficiency and is slow in filling, heating, cooling and emptying, resulting in longer lead times and a higher alcohol ratio requirement to facilitate circulation and equality (Hilden, 1988; Collishaw and Parkes, 1989). One limitation of this machine is the lack of coloring bath cooling devices, which defeated in two-bladed coloring machines equipped with heat exchangers below the false bottom. Fully enclosed overhead paddle machines, recently developed, consist of a horizontal cylindrical vessel with doors along the upper sides and a horizontal paddle stretching the length of the machine parallel to and along the axis of the vessel. Perforated and closed steam pipes are located under the perforated false bottom. It has a circulation pump that withdraws hot alcohol from under the false bottom and injects it through a stream placed along the side of the machine, just below the alcohol level, to help with the movement of the goods, shown in Figure 1. Paddle staining machine. [Source: Parktek]28.1b. Paddle section view.28.2. Scheme of the oval machine for staining the spatula. Alcohol and goods are transferred around the island. (Source: Finolex) Finolex)