

Textile Dyeing Procedures

Textile materials can be dyed at any stage of their production procedure. The main types of methods are batch, continuous, or semicontinuous processes. The method used depends on several factors including type of material (fiber, yarn, fabric, garment) type of fibers composing the material, end use of material, and the quality expected from finished product. The machinery used for dyeing application is usually made out of type 316 stainless steel. This strong material is used because of the constant attack by the acids, bases, and other additional strong chemicals and dyes used in the process.

Many fabrics also undergo printing processes to produce patterned effects. Batch dyeing is the most common method used today. In this system, textile products are processed as individual discrete units. The dye is transferred slowly to the material from a large volume dye bath.

Three basic types of application are used 1) fabric is circulated through a still dye bath 2) dye bath is circulated through a material that is held stationary 3) both the dye bath and material are circulated. The most popular machines that carry out batch dyeing are becks, jet dyeing, and jigs. Dyeing becks consist of a trough with a slanted back to allow fabric to slide down into the dye

The fabric has been sewn together at the ends to form a loop approximately 50 to 100 meters long. It is controlled by a reel that pulls the fabric out of the dye bath and over an idle roll that functions to press off excess dye. The chemicals used are added to the beck by a compartment in the front that contains a perforated divider that serves to let the chemicals be added gradually. The compartment is heated with steam to allow better mixing and provide agitation. The advantages of the dye becks are low cost, versatility, and the encouragement of yarn crimp and fabric bulk.

The drawbacks are the amounts of water, chemicals, and energy used, and the process may cause abrasion or distortion to the fabric. Jet dyeing machines are similar to becks in that the fabric is sewn together in loops. But in jet dyeing many loops of fabric are threaded through guides and circulated at velocities from 200 to 800 meters per minute while a pump passes dye liquor through a heat exchanger located outside the machine and back inside. The machine may be heated or pressurized to aid in dyeing. It also uses less water and chemicals and energy than the dye beck.

In Jig dyeing the fabric is moved back and forth through a dye bath by being wound from a roll on one side of the jig to another on the opposite side. This is a nonabrasive method since the fabric surface is undisturbed, and usually used for worsted fabrics. This process usually takes place at atmospheric pressure, but the jig dyer at maximum can dye several thousand meters of fabric. Continuous dyeing is a system used for polyester blend woven fabrics, and also nylon carpets. In continuous systems, fabrics move constantly from one process to the other.

The steady flow reduces the time of processing cutting back on inventory build up. Speeds from 50 to 100 meters per minute are typical in this method. "The main advantages of continuous dyeing are: 1) no water pollution, 2) recovery and recycling of solvent and excess dye, 3) simple operation in changing dyeing colors. and 4) automation in color matching and tone adjustment with the use of a computer system and automatic weighing system." (Lyle, 1976) One method, called padding, involves a closed system in which the solvent is recycled eliminating the problem of pollution. The fabric is immersed into a concentrated dye solution and then sent to two weighted mangles where the excess dye is squeezed out and returned back into its container. Next the fabric may be steamed, or left to stand at room temperature for a few hours to allow the dye molecules to penetrate into the fibers.

After this process the excess dye is washed off. A continuous dyeing process is used in dyeing of carpets. A machine called a Festoon steamer can be used. The carpet is placed on guide rolls so that the surface of the carpet always faces outward. This prevents the compressing of the carpet when it is rolled in the steamer. Dyes are applied in streams and metered onto the surface.

Special effects can be produced by the way the dye is applied: (the stream can be momentarily interrupted to produce a patterned effect). A semi continuous process is one in which the production rate is momentarily interrupted for the material to soak in the dye. Pad-batch dyeing is on such method, it is mainly used for dyeing cotton fabrics with reactive dyes. The fabric is padded with the dyes and chemicals, wound on a roll, and then allowed to set from 4 to 24 hours to allow the dye to react with the fibers. The reaction can be sped up by using heat, higher alkalinity, and selecting more reactive dyes.

Scouring and bleaching of fabric can be done by a similar cold pad-batch process. There are three methods of pattern dyeing and printing: direct, resist, and discharge printing. In direct printing a design is transferred to fabric by a copper roll. In resist printing a dye repelling substance is applied to cloth that will be placed into a dyebath. This is a popular method for creating white designs on a colored background.

Discharge printing takes place by first dyeing the whole fabric, then printing a pattern on the fabric with an oxidizing or reducing agent to create a white pattern like in discharge printing.

Three popular printing procedures are roller screen and transfer printing. Roller printing is a direct method that takes place by an engraved copper roll that has been dipped into dye and had the excess scraped off. A different engraved roll is used for each color in the design. The fabric passes through the rolls and comes out printed.

The print is then set into the fabric permanently by heat. Prints can consist of up to 16 different colors and can be produced at rates of up to 100 to 150 yards per minute. Another method called screen printing, a type of resist printing, uses screens made by covering a frame with fabric made of silk, nylon, metal, or polyester filaments. Instead of the traditional method of stenciling, today a resist design is applied to the fabric by use of a photo sensitive emulsion that hardens when it is exposed to light. Like in roller printing a different screen is used for each color. Transfer printing is one of increasing popularity because it requires no water, is relatively fast, and can be carried out by less skilled workers. By transferring, complex multi designed prints can be easily transported to fabrics.

The paper has been printed with disperse dyes with sublimation temperatures around 200 degrees Celsius. The transfer takes place from the paper to the fabric due to the hydrophobic fabric having a high affinity for the dye in the vapor phase.

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