TECHNICAL BULLETIN

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TRI 3009

SMALL LOT DYEING

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INTRODUCTION

Cotton Incorporated presents in this bulletin recommendations for mills to consider in satisfying today's discerning consumer for rapid delivery of fashion products. This requirement presents untold problems for the textile industry -- particularly the continuous dyer -- and requires a change in the philosophy of volume production.

GENERAL

In the commodity fabric business, it has been common practice for continuous dye lots to consist of 50,000 or more yards per color. With a production speed of 100 yds./min., approximately 8½ hours would be required to complete this 50,000-yard order.

With fashion changing more rapidly today, textile mills are asked to dye much less yardage per color -- perhaps less than 1,000 yards. This means that if a speed of 100 yds./min. is used, only 10 minutes or less would be required to complete the dyeing. Clearly, the demand for precise control is much greater if the time for dyeing is so short, not to mention the difficulties in maintaining a satisfactory efficiency level. If a dye range runs continuously at 100 yds./min., the maximum number of 50,000-yard lots that can be dyed in 24 hours is 2.88. On the other hand, 144 lots can be dyed if they are 1,000 yards each. Obviously, these numbers are far from realistic, but they do help to emphasize the added demand for control. The greatest question facing a continuous dyer today is "how do we maintain satisfactory efficiency?" Efficiency can be defined as the ratio of time spent dyeing first-quality fabric vs. the total time used to produce the dye lot (including cleanup, strike-off or rework time needed).

For example, if a mill normally requires 45 minutes downtime between lots for cleanup and strike-off, then a 50,000-yard lot run at 100 yds./min. would consume 500 minutes dyeing and 545 minutes total time, equaling 92% efficiency.

If the same downtime is required with a 1,000-yard lot, the dyeing time would be 10 minutes and total time 55 minutes, equaling only 18% efficiency.

It may be possible for the added cost to be passed along to the consumer to help offset the additional expenses in manufacturing; but this is only a partial answer, and downtime must be reduced to provide acceptable running cost for small lots.

Therefore, a concentrated effort is imperative to improve the efficiency of small lot dyeing.

EFFICIENCY IMPROVEMENTS

Reduce Strike-Offs

Strike-offs are very time consuming yet sometimes necessary to insure the closest reproduction of a laboratory shade prediction to production. If correlation between lab and production can be established such that strike-offs are eliminated, substantial savings can be realized. There are two machine companies, Aztec and Werner Mathis, supplying laboratory ranges for this purpose. These machines are also finding a great deal of use in providing swatches for color lines and other sample needs. Also, by utilizing computer

analytical capability, data can be generated to fine tune laboratory and production dyeings to a high degree of reproducibility. Some mills are currently operating in this manner.

Reduce Cleanup Time

Automated cleanup systems have an important role in improving efficiency. Companies such as Kusters, Benninger, Wakayama, Kyoto, and others have introduced padders that drain unused dye or chemicals, rinse, dry, and prepare for the next dye lot automatically. These units are designed to require only minutes between lots.

Also, other features to reduce cleanup time include the use of Teflon or ceramic covered rollers and large quick drop drains for wash boxes. With these changes, no striking, and 3-7 minute turnover between lots, significant improvements in efficiency will be realized. The ultimate goal with these systems is to avoid stopping the range between dye lots. Nonstop dye lot changing helps to maintain better equilibrium throughout the range.

For example, if downtime between lots is 3-7 minutes, and a 1,000-yard lot at 100 yds./min. takes 10 minutes for a total of 13-17 minutes, then the efficiency would approach 59-77% compared to 18% efficiency with current continuous dyeing practices.

These numbers may appear somewhat optimistic, but the benefits are too great to ignore. Today, many plants must exist on dye lot sizes averaging 1,500 yards, so downtime must be minimized to maintain profitability or, in some cases, to stay in business.

EQUIPMENT UTILIZATION (FLEXIBILITY)

A normal thermosol range is made up of a pad/predry/dry section, thermosol section, chem pad/steam section, and oxidizing/washing section. Small lot dyeing requires optimum utilization of the entire range. Therefore, if each component can be utilized independently of the other, maximum flexibility and utilization can be realized. Also, this provides more opportunities for quality control checks, which should help reduce reworks.

Some systems today are being set up as follows

- two pad/predry/dry ranges
  speed - max - 60 yds./min.

- one thermosol range
  speed - max - 120 yds./min.

- two chem-pad/steam ranges
  coupled with wash oxidize sections
  speed - max - 60 yds./min.

This setup would have a capacity of 3-3.5 million yards/month in dyeing cotton or a blend of cotton/polyester.

COMPACT RANGES

If small lot dyeing is considered to be the larger portion of one's business, then a compact range may be the solution. A typical range could have a 90 ft. steamer and 2.5-3.0 times this length (225-270 ft.) for washing. A compact range, such as supplied by Benninger, Greenville Machinery Corporation, and others, may have a 15, 20, 30, 45, or 60 ft. steamer with 2.5-3.0 times the steamer length in washing.

The speed of a range is generally dependent upon the steaming capacity, so as the length of the steamer is reduced, the speed of the range is reduced. It is possible that better efficiency can be realized on a compact range than on a full-sized range, thereby providing equal or more production (not to mention the savings of wasted leader and floor space). Nevertheless, in order to have adequate efficiency on a compact range, strike-offs, reworks, and cleanup time must be minimized.

At ITMA 1991 in Hannover, Germany, Monforts presented two units for uniform on-line control of color that should be compatible with a compact range. The "Matex Color" padder, with a continuously variable crown coupled with a microwave instrument for measuring pickup, controlled moisture from side/center/side. Additionally, on-line color measurement and control are possible with the use of the "Monformatic" color control unit that incorporates the McBeth Eagle Eye.

Automatic color dispensing systems for both laboratory and production are now available from many suppliers. These units, when integrated into the overall dyeing process, offer controlled addition of dye(s) to the mixing tank and from there to the dye bath.

BATCH DYEING IN OPEN-WIDTH

Batch dyeing can be considered small lot dyeing. The primary forms of batch dyeing which would produce products similar to that of a continuous range are cold pad/batch, jig, and beam dyeing. These methods have limited ranges of application; but with careful evaluation of the products to be manufactured, they may be a valuable alternative to a continuous range. Most companies who are aggressively attacking the problem of small lots are supplementing their continuous production with cold pad/batch and jigs. Utilization of the washer independent of the steamer is useful and essential for cleaning unfixed color following cold pad/batch or jig dyeing. It should be noted, however, that correlation (hand and appearance) of a batch dyed fabric may differ from a continuously dyed product.

DYE AND CHEMICAL ALTERNATIVES

Careful consideration should be given to dye classes and methods of application chosen for a particular product. Dyestuff and chemical suppliers are constantly reviewing and modifying application methods to simplify the dyeing process. Dyeing and resin treating simultaneously may be possible if the product end use permits.

SUMMARY

Several factors have been presented for consideration in small lot dyeing. Ultimately the customer perception of product integrity must also be considered when comparing the aesthetic and physical characteristics of fabrics processed by continuous, semi-continuous, or batch methods. Distribution of a sample dyed by one method and the commercial production by another method suggests careful analysis by the mill and preferably approval by the customer.

Small lot dyeing methods should be selected jointly by merchandising and production. If business consists primarily of small lots, short or split ranges are good options. If small and large lots are to be run on the same equipment, modifications should be made to optimize laboratory-to-plant correlation, machine cleanup, chemical changeover and water usage.

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Cotton Incorporated is a research and promotion company representing cotton worldwide. Through research and technical services, our company has the capability to develop, evaluate, and then commercialize the latest technology to benefit cotton.

- Agricultural research leads to improved agronomic practices, pest control, and fiber variants with properties required by the most modern textile processes and consumer preferences. Ginning development provides efficient and effective machines for preservation of fiber characteristics. Cottonseed value is enhanced with biotechnology research to improve nutritional qualities and expand the animal food market.

- Research in fiber quality leads to improved fiber testing methodology and seasonal fiber analyses to bring better value both to growers and then mill customers.

- Computerized fiber management techniques result from in-depth fiber processing research.

- Product Development and Implementation operates programs leading to the commercialization of new finishes and improved energy and water conserving dyeing and finishing systems. New cotton fabrics are engineered -- wovens, circular knits, warp knits, and nonwovens -- that meet today's standards for performance.

- Technology Implementation provides comprehensive and customized professional assistance to the cotton industry and its customers -- textile mills and manufacturers.

- A fiber-to-yarn pilot spinning center allows full exploration of alternative methods of producing yarn for various products from cotton with specific fiber profiles.

- The Company operates its own dyeing and finishing laboratory, knitting laboratory, and a laboratory for physical testing of yarn, fabric, and fiber properties including High Volume Instrument testing capable of measuring micronaire, staple length, strength, uniformity, color, and trash content.

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