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EFFECT OF DOSING AND RUN TIME (IN RESPECT TO CYCLE TIME) ON THE LEVELNESS PERFORMANCE OF KNIT DYED FABRIC

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ABSTRACT

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Dyeing is one of the most desired quality of any export oriented knitted goods. Dyeing depends upon the inherent properties of fibres, quality of pretreatment achieved, purity of dyes, chemicals and auxiliaries, quality of water, P^H, machine performance, proper dyes dissolving, temperature, time, dosing and run time. Manpower involved in machine operation is also an important factor. Among the above parameters the most important technological parameters are dosing and run time (in respect to cycle time). This research paper deals only the method of reducing uneven dyeing by selection proper dosing and run time. From the result it was observed that the batches which were dyed by maintaining proper dosing and run time (in respect to cycle time) show more levelness in compared with the batches which were dyed with ordinary dosing and run time.

Key words: *dye, temperature, dose and fabric*

INTRODUCTION

Uneven dyeing is a very common dyeing fault and a great headache for the dyers. Too much difficulty has to be faced in maintaining a required degree of levelness of the dyed goods. Knitted goods are usually dyed in loop or a continuous rope form in winch or Jet dyeing machine (Broadbent and Arthur, 2001). In this method the materials are immersed in a required level of water and both the material and the dye liquor simultaneously move through the machine with the help of a pump and a separately driven reel (Winch). The time required to move the whole loop is termed as cycle time. In exhaust dyeing method cycle time is important factor. If the integer no of movement of the loop can be ensured during each dosing and run time then every portion of the rope will get same time to stay in the liquor contact. No. of contracts is the number of time of which the fabric comes into contact with the dye liquor during dyeing process. This will depend on the fabric rope speed and number of jet nozzles passages. In consequence each portion of the loop will absorb the same amount of dyestuffs. To ensure the uniform dyeing one should calculate the maximum rope length with a fabric of particular weight per square meter and rope speed has to maintain the same rope length in each jet chamber (www.chimnica.it).

If the rope length is shorter, the winch speed should be reduced, so that the same rope circulation time and nozzle contacts are ensured. As a result even dyeing of the whole loop in each nozzle will be ensured. This paper mainly concerned about selecting the dosing time and run time in such a way that the rope can move an integer no of cycle during every dosing & run time. If the loop moves a fraction no of cycle during dosing & run time then each portion of the loop will not get same time for exhaustion and fixation of dyestuff. So there will be possibilities of uneven shade. For this experiment several batches of different shades were dyed keeping all the parameters same and varying the dosing and run time. After finishing the dyed batches were inspected for comparing levelness performance by 4-point system (Kashem 2006). The batches were dyed in the following cases:

Case-1: In this case two batches of Brown & Purple color were dyed without considering the dosing time in respect to cycle time. Case-2: In this case two batches of Brown & Purple were dyed considering the dosing time & run time in respect to cycle time.

MATERIALS AND METHODS

For this experiment, the experimental batches were dyed in sclavos-5000 dyeing machine. Cycle time was determined by the following equation:

$$\text{Cycle time, } t = \frac{k}{w \times v}$$

Where,

k = Load per nozzle in kg
w = wt of one meter fabric (open width) in kg
v = velocity (Reel speed) in m/min

Dosing Time: Dosing time is the term used to denote the time required in minute for transferring the dyes or chemicals from the addition tank to the interior of the machine.

Runtime: After any dyes or chemical dosing the fabric needs some time to absorb that dyes or chemical before another chemical dosing. This time is usually known as run time in the textile wet processing industries.

The linear weight of the fabric can be determined by the following formula:

$$\text{Fabric weight per linear yard (lbs)} = \frac{N \times L \times CPI \times 36}{36 \times 840 \times Ne} \quad \text{(Anbumani 2007)}$$

Where,

N = Number of needles in the machine
L = Stitch length in inches
CPI = Courses per inches
Ne = Cotton count (Booth 1996)

For the simplification of the calculation the following formula can also be used:

$$\text{Wt of 1 meter fabric in kg} = \frac{\text{Open width of the fabric in inch} \times \text{Grey G.S.M}}{39.37 \times 1000} \text{ kg}$$

The required reel speed for this experiment was obtained from the following table (This table was supplied by supplier of Sclavos-5000 dyeing machine)

w	≤0.20	0.25	0.30	0.35	0.40	0.45	0.50	0.55	0.60	0.65	0.70
v	260	215	180	160	145	130	120	115	110	105	100

$$\text{Loop length in meter} = \frac{\text{Load per nozzle in kg}}{\text{Wt of 1-meter fabric in kg}} \text{ m}$$

RESULTS AND DISCUSSION

Case-1:

Color	Batch Qnty. in kg	Cycle Time in Minute	Loop/Rope length in meter	Recipe	Dosing Time in minute	Inspection Report
Dk purple	700	3	750	Corafix Yellow DGR=0.182% Corafix Red GDB=1.90% Corafix Dk Blue GDR=2.1%	Color dosing=25 Run time=20 ½ salt dosing=10 Run time=5 ½ salt dosing=10 Run tine=10 Soda dosing=50	Meter to meter variation was found
Dk. Brown	520	2.5	750	Corafix Yellow DGR=1.76% Corafix Red GDB=0.86% Corafix Dk Blue GDR=1.42%	Color dosing=27 Run time=17 ½ salt dosing=13 Run time=5 ½ salt dosing=13 Run tine=13 Soda dosing= 42	Meter to meter variation was found

Case-2:

Color	Batch Qnty in Kg	Cycle Time in Min	Loop/Rope length in m	Recipe used	Dosing Time in min	Inspection Report
Dk purple	700	3	750	Cora Yellow DGR=0.182% Cora Red GDB=1.90% Cora Dk Blue GDR=2.1%	Color dosing=24 Run time=21 ½ salt dosing=12 Run time=6 ½ salt dosing=12 Run tine=12 Soda dosing=45	Ok (No meter to meter variation was found)
Dk. Brown	520	2.5	750	Cora Yellow DGR=1.76% Cora Red GDB=0.86% Cora Dk Blue GDR=1.42%	Color dosing=25 Run time=15 ½ salt dosing=10 Run time=5 ½ salt dosing=10 Run tine=10 Soda dosing= 40	Ok (No meter to meter variation was found)

Discussion about case-(1)

In this case each dosing & run time were selected without considering the cycle time which is described below:

Color dosing=25min=3X8+1
Color run time=20min=3X6+2
½ Salt dosing=10min=3X3+1
Run time=5Min=3X1+2
½ Salt dosing=10min=3X3+1
Run time=10Min=3X3+1
Soda dosing=50min=3X16+2

From the above expression it is observed that during color dosing the whole loop in a nozzle will travel 8 times in 24 min and in remaining 1 min 250m (750/3=250m/min) of the whole loop will travel in the nozzle. On the other hand during color run time the loop will travel 6 times in 18 min and in remaining 2 min 500m of the whole loop will travel in the nozzle. So 250m and 500m 0f the loop will get more time to absorb dyes stuff. So dye absorption will uneven through out the whole loop. In the same way during every dosing and run time the loop will travel a fractional no of turns through the liquor which will cause uneven absorption and uneven fixation. Finally uneven dyeing will result in.

Discussion about case-(2)

In this case each dosing & run time were selected considering the cycle time which is described below:

Color dosing=24min=3X8
Color run time=21min=3X7
½ Salt dosing=12min=3X4
Run time=6min=3X2
½ Salt dosing=12min=3X4
Run time=15min=3X5
Soda dosing=45min=3X15

From the above expression it is seen that each dosing and run time of this case has been selected considering the cycle time (3.0). For selecting this type of dosing and run time whole loop will travel an integer no of turns through the liquor. So each meter of the loop will get same time for dyes exhaustion and fixation. As a result a smooth even dyeing will be occurred throughout the whole loop.

		Found points for uneven shade											
Color	Batch No.	1-10 m	10-20 m	20-30 m	30-40 m	40-50 m	50-60 m	60-70 m	70-80 m	80-90 m	90-100 m	Point/ 100m	Category
Dark purple	1	5	6	6	6	6	6	5	6	6	7	59	B
	2	6	6	5	6	7	7	6	7	8	7	65	C
	3	6	5	7	6	4	5	6	7	4	8	58	B
Dark Brown	1	5	6	5	6	5	6	5	6	6	5	55	B
	2	6	6	5	6	6	7	6	7	8	7	64	C
	3	6	5	7	4	4	5	6	4	4	8	53	B

		Found points for uneven shade											
Color	Batch No.	1-10 m	10-20 m	20-30 m	30-40 m	40-50 m	50-60 m	60-70 m	70-80 m	80-90 m	90-100 m	Point/100 m	Category
Dark purple	1	2	3	4	5	4	3	6	5	4	2	38	A
	2	3	5	2	4	5	5	4	3	5	3	39	A
	3	5	5	4	3	2	5	4	4	2	3	37	A
Dark Brown	1	4	3	5	4	2	5	5	4	3	5	40	A
	2	5	4	3	4	3	4	5	4	4	3	39	A
	3	2	4	3	4	4	5	3	4	4	3	36	A

CCMS report for the dE value of the samples of case-I & case-II					
Case-I			Case-II		
Color	No. of samples	dE value (D65 10 deg)	Color	No. of samples	dE value (D65 10 deg)
Dark purple	1	1.11	Dark purple	1	0.72
	2	0.65		2	0.74
	3	0.85		3	0.65
	4	1.0		4	0.45
	5	0.89		5	0.86
Dark brown	1	1.45	Dark brown	1	0.84
	2	0.52		2	0.45
	3	0.96		3	0.57
	4	1.45		4	0.64
	5	0.50		5	0.89

CONCLUSION

From this experiment it is found that the samples of case-2 show noticeable even dyeing in a comparison to that of the case-1. This finding has been clarified from the inspection report and CCMS report mentioned in this paper. The samples were inspected in four point system on the basis of levelness performance and found that the samples of class-I were of “B” and C” classes whereas those of case-II were fallen into “A” class. On the other hand from CCMS report it is clear that the values of dE of the samples of case-II are within the acceptable limit whereas some of these values of the samples of case-I exceeded the acceptable limit. As samples from the different parts of a roll were taken for dE value measurement in CCMS so the exceeded values of dE of the samples of case-I indicate the shade variation in different places of the samples. It can be concluded from this research work that by selecting each dosing and run time as the multiple of the cycle time, uneven dyeing of the knitted goods can be reduced dramatically.

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