An investigation of Factors affect Ends-down Rate in Embroidery Machine

Sherien N. El-Kateb

Faculty of Engineering, Alexandria University, Egypt
k_sherien@yahoo.com

Abstract: In textile and garment industry, much research has been done on quality control systems to improve the output quality and fabric defects. However, little studies have been applied to embroidery technology especially analysis of parameters influence product quality. Although embroidery increases the luxury of clothes and sometimes it is a must to get smart textiles, there are some troubleshooting problems affect the product appearance and quality as end breaks during the process. This problem affects the productivity, quality and the manufacture place at market share. So, this research work introduces an analysis of most of factors have effects on down time. Samples were set according to half factorial design from five factors. The selected factors are needle size, embroidery thread type, stitch length, type and weight of fabric. Results of counted number of ends down and effect of each factor were analyzed by Regression analysis. Three estimated models were applied and the best one chosen based on least error. In conclusion, parameters have the greatest effect on ends down rate are embroidery thread and interaction between needle gauge and fabric type. Optimum levels of parameters can be selected to get least ends down rate.

[Sherien N. El-Kateb. **An investigation of Factors affect Ends-down Rate in Embroidery Machine.** *J Am Sci* 2015;11(6):39-42]. (ISSN: 1545-1003). http://www.jofamericanscience.org. 5

Key Words: Embroidery- ends down rate- half factorial design-market share-optimization.

1. Introduction:

Embroidery process is an art used to raise the appearance of cloth as well as its richness and functionality. Therefore, it enables clothes to face global market by using them at many applications. On the other hand, higher thread breaks affect output quality and then profit which influence manufacture sharing at the competitive market.

Extensive publications applied in embroidery interested in studying the effect of different designs on fabric performance. An investigation interested in evaluating the performance of different embroidered fabrics consists of variety of stitches after several washing to expect their life time [1]. According to study the effects of embroidery threads, Radavičienė et al., studied its effect on first, fabric buckling during embroidery process at three positions (before, during and after) embroidery process "inside elements" due to higher thread elongation. Second, evaluating its impact on accuracy of outcome motive dimensions using variable threads at different embroidery dimensions as well as results of measured area showed that maximum elongation obtained in the bias direction of samples during embroidery operation [2]and [3].

In addition, some researches concern in utilizing embroidery to obtain e-textiles. Zhang et al., Used E-fibers to perform embroidered circuits suitable for radio frequency (RF) and antenna showing that higher stitch density increases output surface conductivity [4]. Besides, El-Kateb produced smart clothes by embroidery using a conductive yarn to get smart e-circuits at different shapes and stitch densities applied on woven and knitted samples to measure temperature during time studying influence of these factors on heat amount concluded specifications of sample heats quickly and maintains heat longer[5].

Other related studies applied in sewing industry regarding garment quality where choosing unsuitable sewing thread affects fixing the problems and quality and [6] moreover the influence of different sewing parameters on the output seam quality which measured by tensile strength, elongation and efficiency of seams [7].

However, there is a lack of analyzing causes of ends down rate at embroidery (machine) and its effects on the outcome quality as it is studied in other textile technologies (i.e. yarn winding, warping, weaving,…etc). Thus, the aim of this research work is to study (analyze) the influence of processing and material parameters on threads down time during embroidery process.

2. Materials and Methods:

3.1. Materials

The classification of the different studied parameters; fabric type, fabric weight, needle size, stitch length, and embroidery thread count is shown in Table (1). Next, number of embroidery threads breaks is counted during embroidery process in order to complete the same pattern for all tested samples.

Table (1): Material specifications

Codes	X_1	X_2	X_3	X_4	X_5
Parameter / Level	Fabric Type	Fabric Weight	Embroidery yarn type (Ne)	Needle gauge (DBX1)	Stitch Length (mm)
L_1	Woven	Heavy	Viscose 120/2	10 (70/10)	0.75
L_2	Knitted	Light	Polyester 120/2	11 (70/11)	0.5

Where: $L_1$and L_2 refer to levels 1 and 2 respectively.

3.2. Methods

Experiments were designed according to Taguchi (Half factorial design) as it illustrated by table (2). After that Regression analysis is applied.

Table (2): Experimental design" half factorial"

	Studied Factors				
Runs	X_1	X_2	X_3	X_4	X_5
1	1	1	1	1	1
2	1	1	1	-1	-1
3	1	1	-1	1	-1
4	1	1	-1	-1	1
5	1	-1	1	1	-1
6	1	-1	1	-1	1
7	1	-1	-1	1	1
8	1	-1	-1	-1	-1
9	-1	1	1	1	-1
10	-1	1	1	-1	1
11	-1	1	-1	1	1
12	-1	1	-1	-1	-1
13	-1	-1	1	1	1
14	-1	-1	1	-1	-1
15	-1	-1	-1	1	-1
16	-1	-1	-1	-1	1

4. *Results and Discussion:*

In this section end breaks are analyzed and the effect of each factor affects them is introduced.The outcome results at table (3) present the number of actual ends down. Regression analysis is carried out to study the significant effect of main factors and their interactions according to their P-values shown in table (4). As a result, X_3 has the most significant effect in negative direction and X_1X_4 follows it where they have significant *P*-values. The outcome R Square by this analysis is 0.973, which refers to goodness of fit of this model. According to have non-significant factors illustrated by high P-values, three models were proposed to check the real contribution of factors. Each model consists of factors according to set P-value. The selected models are first, second and third models have all factors which have p-value less than 0.3, 0.005, and 0.1 in series. Regression analysis applied between selected factors at each model and ends down rate besides estimated error.

***Table (3):** Outputs of Ends down rate*

Runs	E.D. (Response)
1	4
2	7
3	1
4	19
5	4
6	8
7	13
8	14
9	5
10	2
11	11
12	7
13	4
14	1
15	11
16	10

Table (4): Outputs of Regression analysis for all factors and Ends down

	Coefficients Half effect ½ Δ =½[(av.L_1)-(av.L_2)]	***P*-value**
Intercept	7.5625	0.006
X_1	1.1875	0.175
X_2	-0.5625	0.432
X_3	-3.1875	0.031
X_4	-0.9375	0.245
X_5	1.3125	0.15
X_1X_2	-0.4375	0.527
X_2X_3	0.6875	0.355
$X_1 X_3$	0.1875	0.776
$X_2 X_4$	-0.8125	0.294
$X_3 X_5$	-1.1875	0.175
$X_1 X_4$	-2.3125	0.057
$X_2 X_5$	0.6875	0.355
$X_1 X_5$	0.9375	0.245

(R Square=.0.973).

Table (5): Estimated number of ends down by three models:

Y1= 7.56+ (1.18*X1) - (3.18*X3) - (0.94*X4) + (1.31*X5) - (0.81*X2X4) - (1.18*X3X5) - (2.3*X1X4) + (0.94*X1X5). **(R Square=.0.91)** ....**[Eqn.1]**

Y2=7.56 + (1.18*X1) - (3.18*X3) + (1.31*X5) - (1.18*X3X5) - (2.3*X1X4)
(R Square=.0.81)…………………..... **[Eqn.2]**

Y3=7.56 - (3.18*X3) - (2.3*X1X4)
(R Square=.0.62)…… ………… …. **[Eqn.3]**

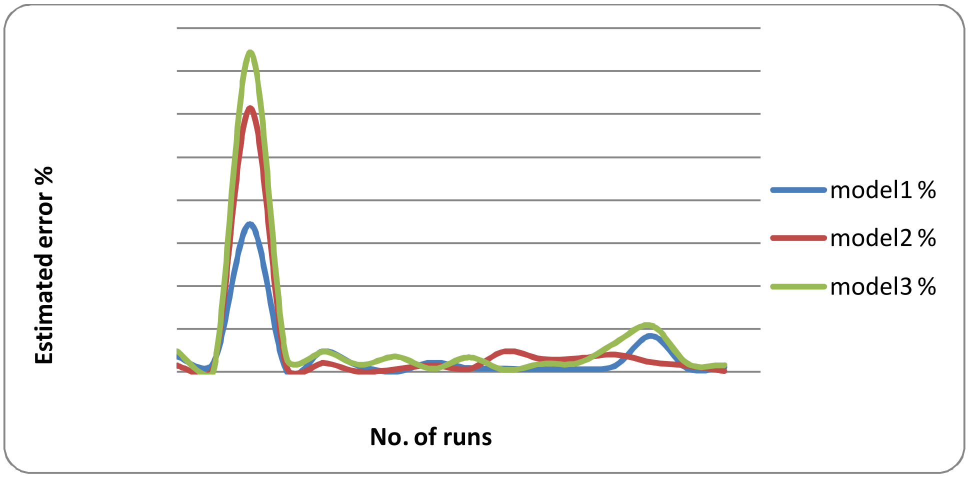

Figure (1): A comparison between the estimated models.

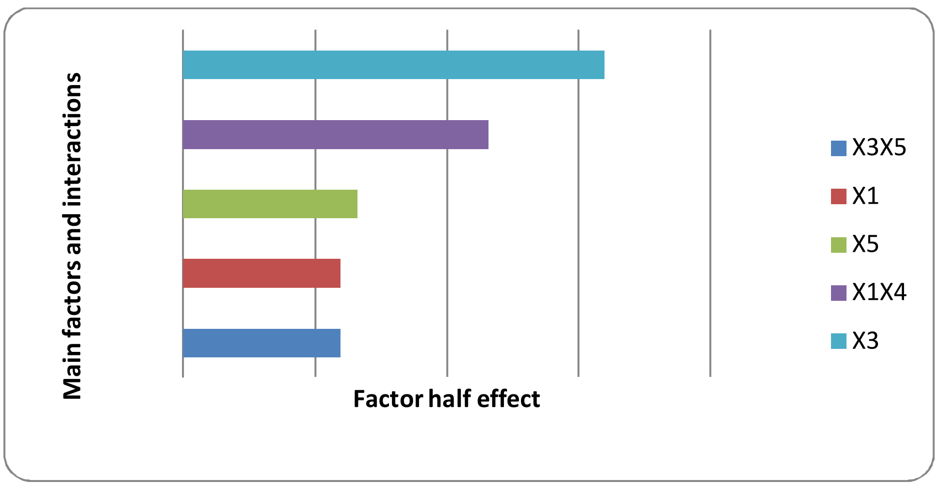

Figure (2): Rank of effective (major) parameters on ends down rate

Table (5) shows the Estimation equations of Ends Down rate for three proposed models to test the validity of affecting factors by evaluating the output errors shown in figure (1). Thus, the estimated model (2) introduces the least error which means that the real effective factors are introduced by this model. Figure (2) displays the rank of factors affecting the ends down rate obtained by model (2) which are (X_3, X1X4, X5, X1and X_3X_5) in successive.

The parameter effect is calculated by summation of ends down per each level; as a result, the higher effect values refer to higher number of end cuts as it is shown in table (6).

Table (6): The relation between studied factors and their effect

Parameter	**av(+)** Level 1	**av(-)** Level 2
X_1	8.75	6.375
X_2	7	8.125
X_3	4.375	10.75
X_4	6.625	8.5
X_5	8.875	6.25

So, the optimal parameters required are at less effect values as selecting both of (X_1 and X_5) at high level but all of (X_2, X_3,X_4) at low level.

Conclusions:

1- Both of sewing yarn and interaction of fabric type and needle size are the most significant factors which affect the down time.

2- The best estimate model is the second one which consists of input factors as fabric type, sewing thread type, stitch length and interactions between first thread type and stitch length and second fabric type and needle size.

3- Finally, it should embroider heavy knitted fabrics by viscose fine yarn using fine (small gauge) needle at less stitch length in are optimal parameters specification to obtain least thread cuts during processing.

References:

1. El Gholmy S., Bondok,N. Geiheini, A., “Optimization of Embroidery Design on Denim Fabrics", 5th International Textile, Clothing & Design Conference– Magic World of Textiles, DUBROVNIK, CROATIA, October 2010.
2. Radavičienė S., Jucienė M., Juchnevičienė Ž., Čepukonė L., Kleveckas T., And Narvilienė V., “The Influence of the Properties of Embroidery Threads on Buckling of Fabric Inside of the Embroidered Element” Materials Science (MEDŽIAGOTYRA) ISSN 1392–1320. Vol. 18, No. 4, 2012.
3. Radavičienė S., and Jucienė M., “Influence of Embroidery Threads on the Accuracy of Embroidery Pattern Dimensions”, FIBRES & TEXTILES in Eastern Europe, Vol. 20, No. 3 (92), 2012.
4. Zhang L., Wang Z., and Volakis J., “Embroidered textile circuits for microwave devices” Antennas and Propagation Society International Symposium (APSURSI) IEEE, 2012.
5. El-Kateb S., “Prediction of Smart Fabric Temperature by Ann and Regression Analysis”, Autex Conference, Boursa, Turkey, 2014.
6. Anderson k.,“ Selecting the Correct Sewing Thread”, www.techexchange.com, August 2009, visited at 2015.
7. Abou Nassif N., “Investigation of the Effects of Sewing Machine Parameters on the seam quality”, Life Science Journal, http://www.lifesciencesite.com, 2013.

4/26/2015