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Studies On Contamination Removal With Different Electronic Yarn Clearers

H. R. Shah
Faculty of Textile Technology
D.K.T.E Society's, Textile and Engineering Institute, Ichalkaranji Maharashtra, India
Ms. Madhuri V. Kakde
Research scholar
D.K.T.E Society's, Textile and Engineering Institute, Ichalkaranji Maharashtra, India

Abstract:

There are probably no processing stages within the value adding textile chain which to date have not been confronted with the issue of foreign matter contamination in cotton. In this respect 'Electronic Quality Control' systems are the key to improve woven fabric quality, contributing significantly to the success of the textile products. From the concept of the necessary evil, today a winding machine with electronic yarn clearing has become something like a final yarn quality controller in the spinning department of a modern mill. In the present study an attempt has been made to find out the clearing efficiency of different electronic yarn clearers which are normally used in textile industry namely, Loepfe Zenit Yarn Master, Uster Quantum 2, and Uster Quantum 3 electronic yarn clearers irrespective of the color of the yarn and foreign matter. The clearing efficiency is normally assessed on the basis of number of contaminants detected by electronic yarn clearers out of total number of contaminants present.

Keywords: *Foreign matter contamination, Electronic quality control, Electronic yarn clearers, clearing efficiency, Loepfe Zenit Yarn Master, Uster Quantum 2, Uster Quantum 3.*

1.Introduction

As prevention is better than cure, it is always more desirable not to generate contamination at all than to have to clean it at different stages of processing. To achieve this problem, all concerned industries have to work together. Contamination is the "Presence of extraneous and undesirable substance in yarn which leads to impure the quality of final textile product". According to recent survey by ITMF [1], Indian cottons are amongst the most contaminated cottons in the world so; producing yarns from Indian cottons of world class quality is a greater challenge. This challenge can be met with selection of suitable cottons, appropriate work practices and proper use of modern machines and technologies.

In past many researchers have investigated about the sources, effects and remedial measures of contamination. Prof. Chitra Joshi Ajmeri et al [2] had given in there paper digital online systems for yarn clearing and quality control in modern winding. They states that, removal systems in the Blow room line focus on the bulk of the contamination. Such systems have not been designed to detect and remove small particles. The removal of such parts is carried out by electronic yarn clearers equipped with the appropriate (FF) foreign fiber channel on winding machine. K P Chellamani et al [3] had studied color contamination in grey and white bleached knitted fabrics. They found these color contaminations are visible only after bleaching. They are not visible in grey fabric stage but stain caused by pink bollworm on cotton and mixing of 'kum kum' materials worn by the factory workers with cotton lint in ginneries as well as during mixing preparation in the textile materials are visible. Human hair, pesticide residues, workers 'chew tobacco', and colored synthetic materials are visible in white bleached fabrics.

In the present study an attempt has been made to find out the clearing efficiency of different electronic yarn clearers. The clearing efficiency is normally assessed on the basis of number of contaminants detected by electronic yarn clearers out of total number of contaminants present. Here the electronic yarn clearer with three type's viz. Loepfe Zenit Yarn Master, Uster Quantum 2, and Uster Quantum 3 were studied to find out its clearing efficiency on contamination removal.

2.Material And Methods

In the present study ring spun Cotton yarns with of 15 and 30 Ne were studied. To find the efficiency of the electronic yarn clearers, one must know how at many places the

contaminants are present and how many are removed. Therefore, in the present study prepare to spin the cotton yarn on Reiter Compact K40 ring frame and the yarn can be contaminated deliberately such that, the ring frame can be stopped during spinning and the yarn can be spotted with Red, Blue, and Yellow color dye spots in light, medium, and dark shades. The number of spot present and removed during winding can enable to find the efficiency of electronic yarn clearers.

The ring bobbins with different types of contamination like light, medium dark, and dark colored fibers processed on the Schlafhorst Autoconer 338 winding machine equipped with Loepfe Zenit Yarn Master and on the Orlikon Schlafhorst Autoconer X5 machine equipped with Uster Quantum 2 and Uster Quantum 3 Yarn clearer.

3.Experimental Plan

In order to study electronic yarn clearer, color and shade for clearing efficiency at three different levels (Table 1). Symmetric factorial experiment of 3^3 is one of the experimental designs to select the combinations of the three different parameters and three levels with two replicates i. e. for two counts and each of the parameter is selected for the study of clearing efficiency. In this way 54 different combinations were prepared for the study.

Factor / **Level**	**Electronic yarn clearer**	**Color**	**Shade**
1	Loepfe EYC	Red	Dark
2	Uster Quantum 2 EYC	Blue	Medium
3	Uster Quantum 3 EYC	Yellow	Light

Table 1: Factors and levels used in factorial experiment

4.arent Yarn Specifications

The properties of fibers in the mixing of MECH cotton and dye color shade variations for spotting the yarn are laid down in Table 2 and Table 3, respectively.

Specifications	15's k	30's k
Blend %	100	100
Hank	1.0	1.0
50% span length (mm)	14.85	14.85
2.5% span length (mm)	30.5	30.5
Uniformity ratio	48.48	48.48
Mic. value	3.52	3.52
Strength (g/tex)	22.2	22.2
Elongation %	4.68	4.68

Table 2: Fiber properties

shade	Red (reactive red M5b, cold brand) (mg)	Blue (reactive blue M5b, cold brand) (mg)	Yellow (reactive yellow M5b, cold brand) (mg)	Urea weight (mg)	Water (ml)
Dark	750	750	750	750	50
Medium	500	500	500	500	50
Light	250	250	250	250	50

Table 3: Dye shade variation table

5.Results And Discussion

The ring bobbins with Red, Blue, and Yellow color in dark, Medium, and light shade dye spots of about 1 cm to 2 cm spot length were collected for winding to check the clearing efficiency of electronic yarn clearers. 20 ring bobbins were produced with contaminations for each electronic yarn clearer and for each color and shade. In each bobbin there are 20 color dye spots. The collected ring bobbins were tested for the effectiveness of electronic yarn clearer on winding at regular settings which are normally used in industry.

During the winding, observations were made with respect to the place at which the yarn broke. The number of incidences where the yarn broke at dye spot area was counted and some length of yarn containing the color spot was collected on the yarn fault board. These observations were used to deduce clearing efficiency as follows:

$$\text{clearing efficiency (CE)\%} = \frac{\text{no. of color spot detected}}{\text{no. of color spot present in yarn}} \times 100$$

The breaking of yarn at dye spot portion indicates foreign fiber contamination, which is undesirable.

5.1.Clearing Efficiency (CE %)

The experiments were carried out for 2 different counts viz. 15 and 30 Ne cotton counts. The comparison can be made between electronic yarn clearers for Red, Blue, and Yellow color in dark, medium, and light shades.

5.2.Clearing Efficiency of Loepfe Electronic Yarn Clearer for 30 Ne

Table no. 4 depict, mean values of the results of clearing efficiency of Loepfe Electronic Yarn Clearer for 30 Ne.

	Variables			**Result**
Sr. no.	**Electronic yarn clearers**	**Colors**	**Shades**	**CE % 30 Ne**
1	Loepfe Zenit	Red	Dark	**95**
2	Loepfe Zenit	Red	Medium	**84**
3	Loepfe Zenit	Red	Light	**69**
4	Loepfe Zenit	Blue	Dark	**85**
5	Loepfe Zenit	Blue	Medium	**72**
6	Loepfe Zenit	Blue	Light	**67**
7	Loepfe Zenit	Yellow	Dark	**53**
8	Loepfe Zenit	Yellow	Medium	**38**
9	Loepfe Zenit	Yellow	Light	**16**

Table 4: Mean values of clearing efficiency (CE %)

This is obvious from Table 4, which shows that the clearing efficiency for red color is 95 % and for blue color and yellow color is 85 % and 53 % respectively. This means that yarn contaminated with red color dye spots is more detected than blue and yellow colors. In other words the clearing efficiency of the sensor in Loepfe electronic yarn clearer has more sensitivity for red color in dark, medium dark and light shades.

The figure 1 shows, the main effects of clearing efficiency of Loepfe Electronic Yarn Clearer for 30 Ne. Among the color mentioned, red color has more clearing efficiency than yellow and blue colors. This can be attributed to the intensity of color. The detection intensity of the sensor is different for different color. Since, light source in the sensor which is focused on the color spot act as a wave, it may be characterized by its wavelength. According to Tristimulus Theory of Color Perception Red color has a highest wavelength of 700 nm whereas Yellow color has 580 nm and Blue color has 470 nm. Therefore, red color absorbed more fraction of light than the yellow and blue color. That's why red color spots means red color foreign fibers are more detected than yellow and blue colors foreign fibers.

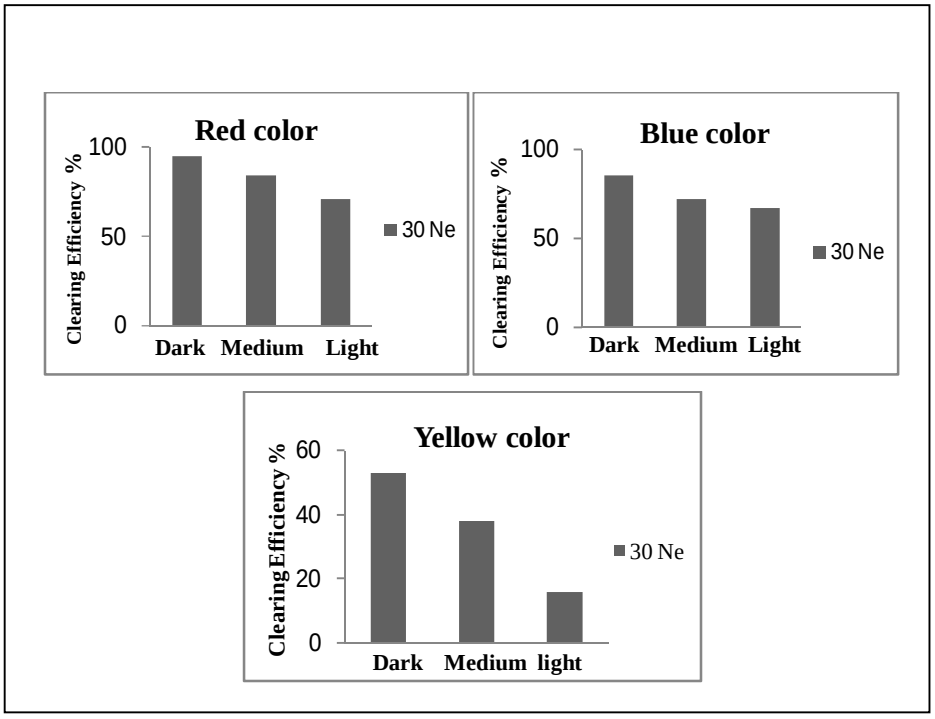

Figure 1: Effect of variables on clearing efficiency % of Loepfe EYC

It is observed that, the mean value of clearing efficiency for dark shade is more than the medium dark and light shade for each color namely red, blue, and yellow colors. This is due to the sensitivity of the sensor is more for dark shade. In other words the number of dark spots is more detected than medium and light shade spots by the clearer.

5.3.Clearing Efficiency Of Uster Quantum 2 Electronic Yarn Clearer For 30 Ne

	Variables			**Result**
Sr. no.	**Electronic yarn clearers**	**Colors**	**Shades**	**CE % 30 Ne**
1	Uster Quantum 2	Red	Dark	**96**
2	Uster Quantum 2	Red	Medium	**90**
3	Uster Quantum 2	Red	Light	**82**
4	Uster Quantum 2	Blue	Dark	**75**
5	Uster Quantum 2	Blue	Medium	**68**
6	Uster Quantum 2	Blue	Light	**62**
7	Uster Quantum 2	Yellow	Dark	**92**
8	Uster Quantum 2	Yellow	Medium	**86**
9	Uster Quantum 2	Yellow	Light	**79**

Table 5: Mean values of clearing efficiency (CE %)

Table 5, which shows that the clearing efficiency for red color is 96 % and for blue color and yellow color is 75 % and 92 % respectively. This means that yarn contaminated with red color dye spots is more detected than yellow and blue colors. In other words the clearing efficiency of the sensor in Uster Quantum 2 electronic yarn clearer has more sensitivity for red color in dark, medium dark and light shades.

The figure 2 shows, the main effects of clearing efficiency of Uster Quantum 2 Electronic Yarn Clearer for 30 Ne. Among the color mentioned, red color has more clearing efficiency than yellow and blue colors. This can be attributed to the intensity of color. The detection intensity of the sensor is different for different color. Since, light source in the sensor which is focused on the color spot act as a wave, it may be characterized by its wavelength. According to Tristimulus Theory of Color Perception Red color has a highest wavelength of 700 nm whereas Yellow color has 580 nm and Blue color has 470 nm. Therefore, red color absorbed more fraction of light than the yellow and blue color. That's why red color spots means red color foreign fibers are more detected than yellow and blue colors foreign fibers.

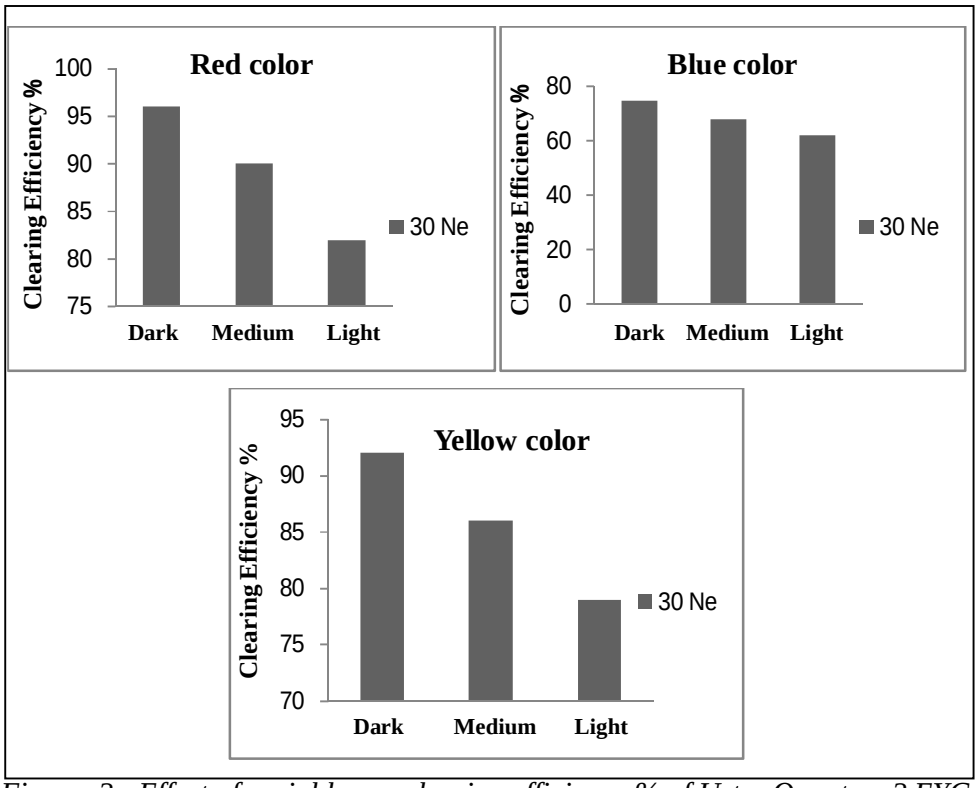

Figure 2: Effect of variables on clearing efficiency % of Uster Quantum 2 EYC

It is observed from the graph in Figure 2 that, the mean value of clearing efficiency for dark, medium, and light shades are greatly varies for red and yellow color than blue color. This means that, Uster Quantum 2 clearer is more sensible for red and yellow color in three shades.

5.4.Clearing Efficiency of Uster quantum 3 Electronic Yarn Clearer for 30 Ne

Table no. 6 depict, mean values of the results of clearing efficiency of Uster Quantum 3 Electronic Yarn Clearer for 30 Ne.

	Variables			**Result**
Sr. no.	**Electronic yarn clearers**	**Colors**	**Shades**	**CE % 30 Ne**
1	Uster Quantum 3	Red	Dark	**99**
2	Uster Quantum 3	Red	Medium	**93**
3	Uster Quantum 3	Red	Light	**86**
4	Uster Quantum 3	Blue	Dark	**90**
5	Uster Quantum 3	Blue	Medium	**88**
6	Uster Quantum 3	Blue	Light	**80**
7	Uster Quantum 3	Yellow	Dark	**95**
8	Uster Quantum 3	Yellow	Medium	**90**
9	Uster Quantum 3	Yellow	Light	**84**

Table 6: Mean values of clearing efficiency (CE %)

This is obvious from Table 6, which shows that the clearing efficiency for red color is 99 % and for blue color and yellow color is 90 % and 95 % respectively. This means that yarn contaminated with red color dye spots is more detected than blue and yellow colors. In other words the clearing efficiency of the sensor in Uster Quantum 3 electronic yarn clearer has more sensitivity for red color in dark, medium dark and light shades.

The figure 3 shows, the main effects of clearing efficiency of Uster Quantum 3 Electronic Yarn Clearer for 30 Ne. Among the color mentioned, red color has more clearing efficiency than yellow and blue colors. This can be attributed to the intensity of color. The detection intensity of the sensor is different for different color. Since, light source in the sensor which is focused on the color spot act as a wave, it may be characterized by its wavelength. According to Tristimulus Theory of Color Perception Red color has a highest wavelength of 700 nm whereas Yellow color has 580 nm and Blue color has 470 nm. Therefore, red color absorbed more fraction of light than the yellow and blue color. That's why red color spots means red color foreign fibers are more detected than yellow and blue colors foreign fibers.

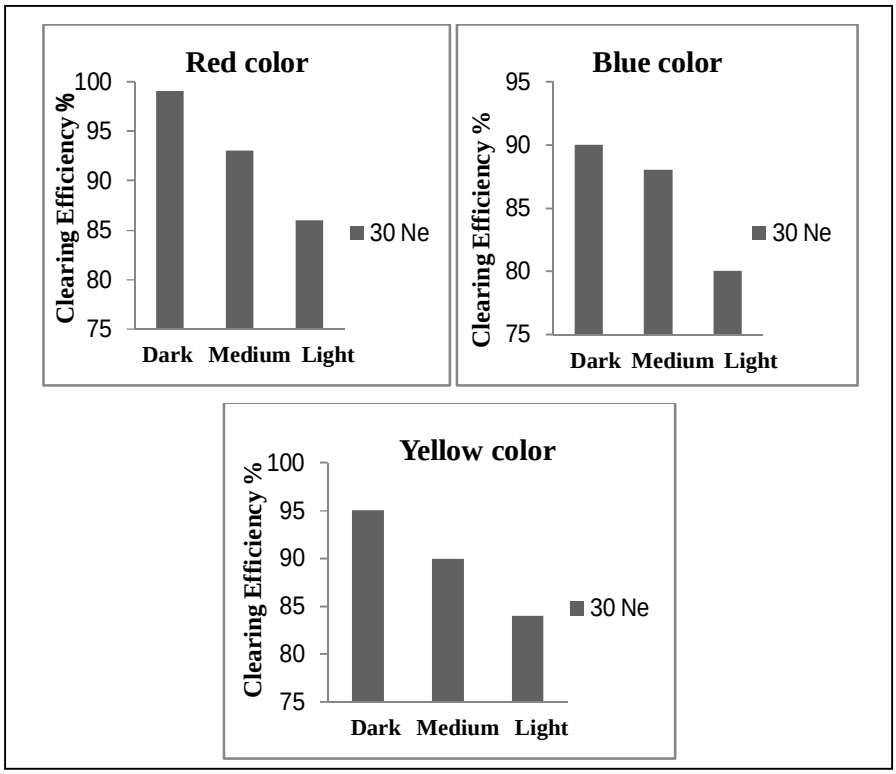

Figure 3: Effect of variables on clearing efficiency % of Uster Quantum 3 EYC

It is observed that, the mean value of clearing efficiency for dark shade is more than the medium dark and light shade for each color namely red, blue, and yellow colors. This is due to the sensitivity of the sensor is more for dark shade. In other words the number of dark spots is more detected than medium and light shade spots by the clearer.

5.4.Clearing Efficiency between Electronic Yarn Clearers for 30 Ne

The Figure 4 shows, the main effects of clearing efficiency % between electronic yarn clearers. From the figure it is clear that, Uster Quantum 3 clearer has more clearing efficiency than Uster Quantum 2 clearer and Loepfe yarn clearer for red, blue, and yellow colors in dark, medium, and light shades. The reason is that Uster Quantum 3 electronic yarn clearer has the new advanced FM sensor technology with multiple light sources to pinpoint all colored finer and shorter foreign fibers with the same sensitivity because of improvements of the optical measuring systems. In Uster Quantum 3 additionally Red LED is incorporated with green LED for sensing the colored contamination. While in Uster Quantum 2 clearer only green LED is used to detect the colored matter. It also removes really disturbing foreign fibers with the lowest number of cuts by separating foreign matter into foreign fibers and vegetable matter.

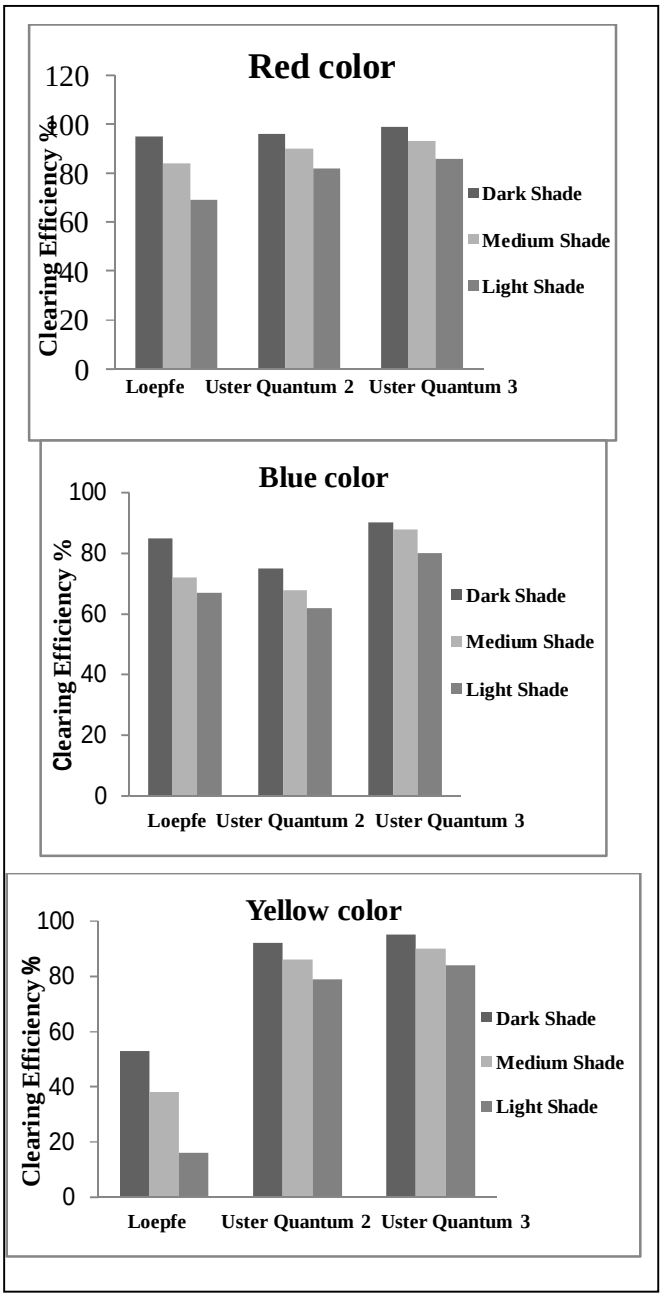

Figure 4: Effect of variables on clearing efficiency % between Electronic Yarn Clearers

In Uster Quantum 3 yarn clearer the foreign fiber sensor used is wider than before used in Uster Quantum 2 yarn clearer. In Uster Quantum 2 clearer the sensitivity starts from 5% levels but in Uster Quantum 3 it starts from 0% level means that the foreign fibers below 5% level are detected by Uster Quantum 3 yarn clearer. Thus, it detects all colors of foreign fibers including those with very low contrast or reflectance of multiple cut

length. That's why light shade spots in red, blue, and yellow colors are also more detected than Uster Quantum 2 clearer and Loepfe clearer.

For Loepfe electronic yarn clearer the clearing efficiency is less than Uster Quantum 2 clearer and Uster Quantum 3 clearer shown in Figure 4. The clearing efficiency for yellow color and for light shades in red, blue, and yellow colors is very much less than Uster Quantum 2 clearer and Uster Quantum 3 clearer. This is due to the fact that, the light used in the sensing head TK YM Zenit FPC sensed very less spots of light shades.

In Loepfe electronic yarn clearer the yarn body is illuminated sequentially from several angles in order to fully evaluate the faults. The signals resulting from reflection and transmission are computed so that yarn diameter differences are compensated and foreign matter made visible. In Loepfe electronic yarn clearer foreign matters are detected using the SIRO principle in which classification of foreign matters is based on the evaluation of differences in contrast. Very often very light color contamination like light red, light blue, and light yellow in smaller length up to 1 cm were observed in S1 and S2 classes and are not objectionable in the fabric. And the experiments were carried out at 64% closer settings normally used in industry for local yarn. So, these non objectionable light color spots may not be detected by the clearer. Since, these faults are force the winders to compromise on the quality and production.

From the result of 3^3 symmetrical factorial experiments it is clear that there is significant effect of electronic yarn clearers, colors, and shades on the clearing efficiency.

5.5.Clearing Efficiency of Loepfe Electronic Yarn Clearer for 15 Ne

It is clear from the below table (Table 7) that the clearing efficiency of Loepfe electronic yarn clearer has maximum efficiency for red color in dark shed i.e. about 96%. It has very least clearing efficiency for yellow color in light shed i.e. 16 % for 15 Ne while Table 4 depict the clearing efficiency for 30 Ne which is about 96% for red color in dark shed and 21% for yellow color in light shed. The change in count does not have statistically significant effect on clearing efficiency %. There is visible indication that the extent of contamination present in the yarn has effect on clearing efficiency %, as observed from Figure 5.

	Variables			**Result**
Sr. no.	**Electronic yarn clearers**	**Colors**	**Shades**	**CE % 30 Ne**
1	Loepfe Zenit	Red	Dark	**96**
2	Loepfe Zenit	Red	Medium	**90**
3	Loepfe Zenit	Red	Light	**71**
4	Loepfe Zenit	Blue	Dark	**87**
5	Loepfe Zenit	Blue	Medium	**80**
6	Loepfe Zenit	Blue	Light	**68**
7	Loepfe Zenit	Yellow	Dark	**53**
8	Loepfe Zenit	Yellow	Medium	**43**
9	Loepfe Zenit	Yellow	Light	**21**

Table 7: Mean values of clearing efficiency (CE %)

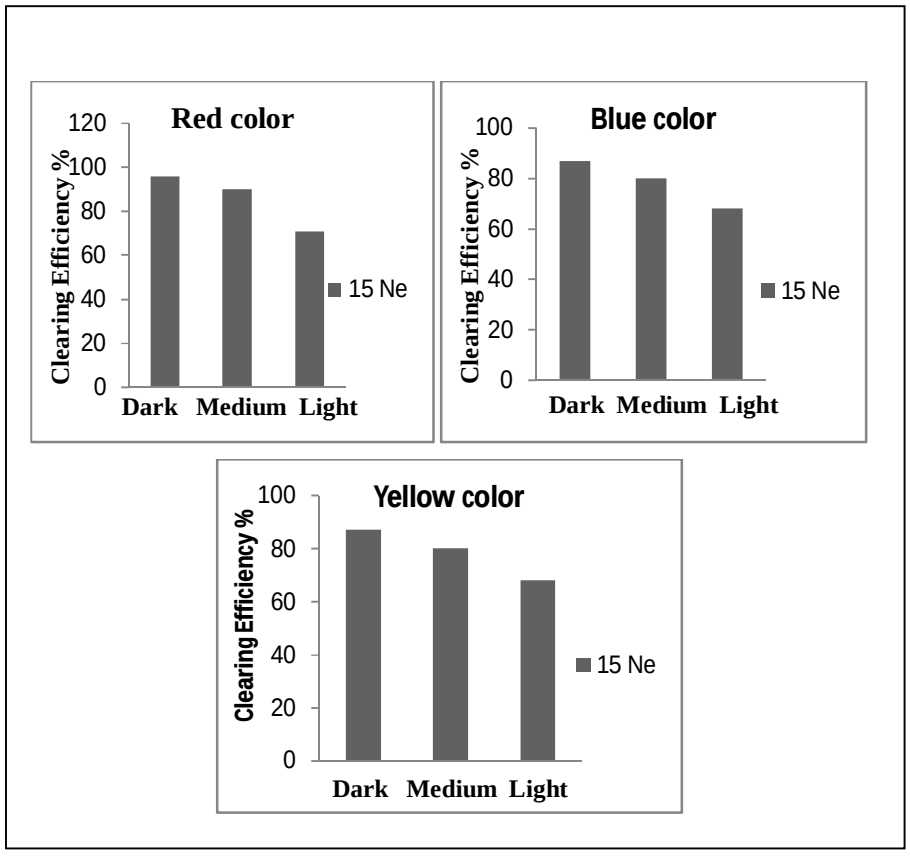

Figure 5: Effect of variables on clearing efficiency % of Loepfe EYC

The reason for non significance may be attributed to the fact that the foreign matters are not all bound the same in the yarn compound. The probability of binding is greater for coarse yarns than for fine spun yarns. As the rule of thumb is the coarser the yarn, the larger the number of fibers in the yarn cross section. But the foreign matters bound in the yarn can only be classified according to their actual length using the classification algorithm because they appear as broken fibers. Analysis shows that the changes in color and shade parameters have significant effect on clearing efficiency %. The reason for significance is due to the wavelength differences in colors and may be on the sensitivity of the sensor in the clearer for that particular shade.

5.6.Clearing Efficiency of Uster quantum 2 Electronic Yarn Clearer for 15 Ne

Table no. 8 depict, mean values of the results of clearing efficiency of Uster Quantum 2 Electronic Yarn Clearer for 15 Ne.

	Variables			**Result**
Sr. no.	**Electronic yarn clearers**	**Colors**	**Shades**	**CE % 30 Ne**
1	Uster Quantum 2	Red	Dark	**97**
2	Uster Quantum 2	Red	Medium	**90**
3	Uster Quantum 2	Red	Light	**84**
4	Uster Quantum 2	Blue	Dark	**78**
5	Uster Quantum 2	Blue	Medium	**70**
6	Uster Quantum 2	Blue	Light	**62**
7	Uster Quantum 2	Yellow	Dark	**94**
8	Uster Quantum 2	Yellow	Medium	**88**
9	Uster Quantum 2	Yellow	Light	**80**

Table 8: Mean values of clearing efficiency (CE %)

It is clear from Table 8 that the clearing efficiency of Uster Quantum 2 electronic yarn clearer has maximum efficiency for red color in dark shed i.e. about 97 %. It has less clearing efficiency for blue color in light shed i.e. 62 % for 15 Ne. It has also higher clearing efficiency for yellow color than blue color about 94 % near about the red color while Table 5 depict the clearing efficiency for 30 Ne which is about 96% for red color

in dark shed and 62 % for blue color in light shed which is similar to the clearing efficiency of Uster Quantum 2 electronic yarn clearer for 15 Ne. The Figure 6 is the effect of variables on clearing efficiency % of Uster Quantum 2. These results show that the count does not have significant effect on clearing efficiency %. The reason for non significance may be attributed to the fact that the foreign matters are not all bound the same in the yarn compound. The probability of binding is greater for coarse yarns than for fine spun yarns. As the rule of thumb is the coarser the yarn, the larger the number of fibers in the yarn cross section. But the foreign matters bound in the yarn can only be classified according to their actual length using the classification algorithm because they appear as broken fibers.

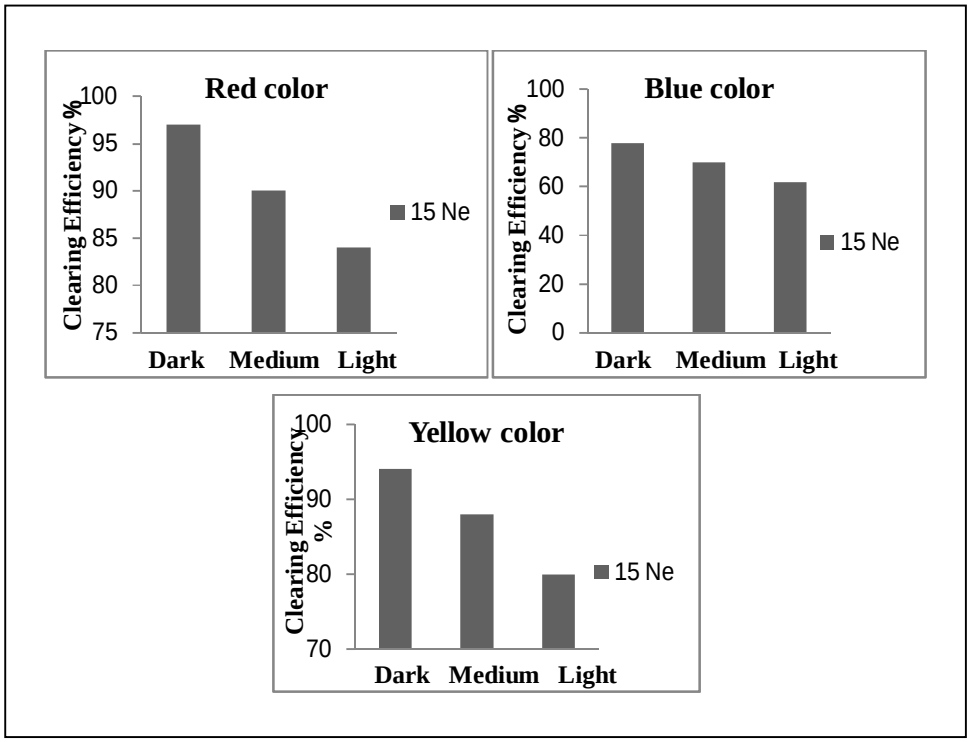

Figure 6: Effect of variables on clearing efficiency % of Uster Quantum 2 EYC

Analysis shows that the changes in color and shade parameters have significant effect on clearing efficiency %. The reason for significance is due to the wavelength differences in colors and may be on the sensitivity of the sensor in the clearer for that particular shade.

5.7.Clearing Efficiency of Uster quantum 3 Electronic Yarn Clearer for 30 Ne

	Variables			**Result**
Sr. no.	**Electronic yarn clearers**	**Colors**	**Shades**	**CE % 30 Ne**
1	Uster Quantum 3	Red	Dark	**99**
2	Uster Quantum 3	Red	Medium	**96**
3	Uster Quantum 3	Red	Light	**86**
4	Uster Quantum 3	Blue	Dark	**95**
5	Uster Quantum 3	Blue	Medium	**89**
6	Uster Quantum 3	Blue	Light	**83**
7	Uster Quantum 3	Yellow	Dark	**96**
8	Uster Quantum 3	Yellow	Medium	**94**
9	Uster Quantum 3	Yellow	Light	**84**

Table 9: Mean values of clearing efficiency (CE %)

Table 9 shows the clearing efficiency % of Uster Quantum 3 electronic yarn clearer for 15 Ne. It has maximum efficiency for red color in dark shed i.e. about 99 % similar to the clearing efficiency % for 30 Ne shown in Table 6. It has somewhat less clearing efficiency for blue and yellow color in light shed i.e.83 % and 84 % respectively for 15 Ne. similar results were found for 30 Ne in yellow color.

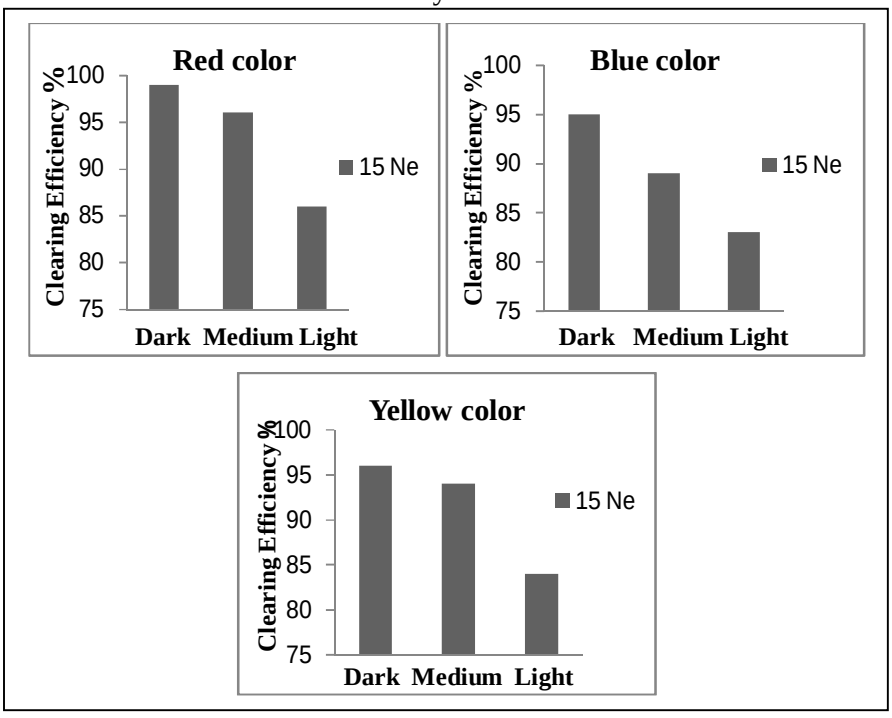

Figure 7: Effect of variables on clearing efficiency % of Uster Quantum 3 EYC

The Figure 7 shows the main effect of variables on clearing efficiency % of Uster Quantum 3 electronic yarn clearer. Among the color and shade mentioned, Uster Quantum 3 has more clearing efficiency % for red color in dark shade and has least clearing efficiency % for yellow color in light shed. Analysis shows that the changes in color and shade parameters have significant effect on clearing efficiency %. This is due to the intensity of color detection by the clearer. Although, from Figure 3 and 7 shows that the clearing efficiency % of 30 Ne and 15 Ne for Uster Quantum 3 electronic yarn clearers for colors, and shades remain unchanged. This is due to the foreign matters bound in the yarn can only be classified according to their actual length.

5.8.Clearing Efficiency between Electronic Yarn Clearers for 15 Ne

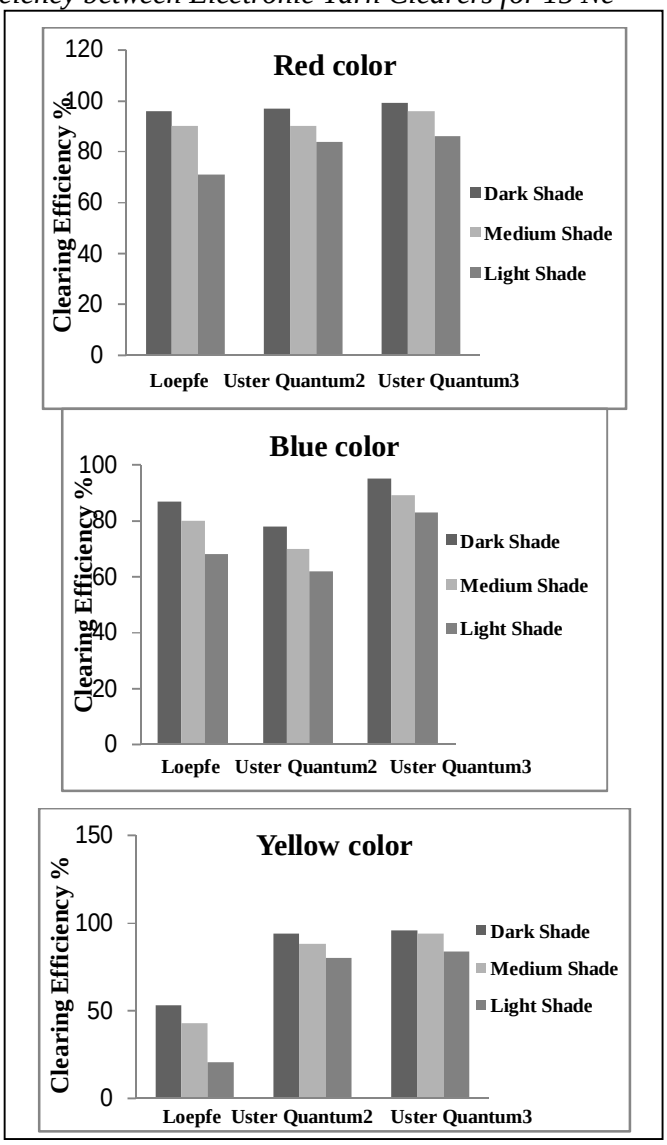

Figure 8: Effect of variables on clearing efficiency % between Electronic Yarn Clearers

The Figure 8 shows, the main effects of clearing efficiency % between electronic yarn clearers for 15 Ne. From the figure it is clear that, Uster Quantum 3 clearer has more clearing efficiency than Uster Quantum 2 clearer and Loepfe yarn clearer for red, blue, and yellow colors in dark, medium, and light shades. The reason is that Uster Quantum 3 electronic yarn clearer has the new advanced FM sensor technology with multiple light sources to pinpoint all colored finer and shorter foreign fibers with the same sensitivity because of improvements of the optical measuring systems.

In Loepfe yarn clearer the clearing efficiency for yellow color in dark, medium, and light shade has very low clearing efficiency than Uster Quantum 2 and Uster Quantum3 for 15 Ne. Similar results were found for yellow color in three shades in Loepfe clearer for 30 Ne shown in Figure 4. From this it is clear that the count does not have significant effect on clearing efficiency %. The reason is that the foreign matters bound in the yarn can only be classified according to their actual length.

6.Summary

The effect of electronic yarn clearers viz. Loepfe, Uster Quantum 2, and Uster Quantum 3, colors viz. red, blue, and yellow and shades viz. dark, medium dark, and light on the clearing efficiency was observed in the present study. It is found that, there is significant effect of electronic yarn clearers, colors, and shades on clearing efficiency. The clearing efficiency for Uster Quantum 3 yarn clearer is 99 % for red color in dark shade. Also for blue and yellow color in dark, medium, and light shade it has highest efficiency than Uster Quantum 2 and Loepfe electronic yarn clearer. This indicates that, Uster Quantum 3 electronic yarn clearer sensed more colored foreign fibers of variable length in highly contrast colors. Loepfe electronic yarn clearer has very much less clearing efficiency for yellow color and for light shade in red, blue, and yellow colors. It is also found that, there is no significant effect of count of yarn on clearing efficiency. The clearing efficiency of 30 Ne and 15 Ne for electronic yarn clearers, colors, and shades remain unchanged.

	Variables			Results	
Sr. no.	**Electronic yarn clearers**	**Colors**	**Shades**	**CE % 30 Ne**	**CE % 15 Ne**
1	Loepfe Zenit	Red	Dark	95	96
2	Loepfe Zenit	Red	Medium	84	90
3	Loepfe Zenit	Red	Light	69	71
4	Loepfe Zenit	Blue	Dark	85	87
5	Loepfe Zenit	Blue	Medium	72	80
6	Loepfe Zenit	Blue	Light	67	68
7	Loepfe Zenit	Yellow	Dark	53	53
8	Loepfe Zenit	Yellow	Medium	38	43
9	Loepfe Zenit	Yellow	Light	16	21
10	Uster Quantum 2	Red	Dark	96	97
11	Uster Quantum 2	Red	Medium	90	90
12	Uster Quantum 2	Red	Light	82	84
13	Uster Quantum 2	Blue	Dark	75	78
14	Uster Quantum 2	Blue	Medium	68	70
15	Uster Quantum 2	Blue	Light	62	62
16	Uster Quantum 2	Yellow	Dark	92	94
17	Uster Quantum 2	Yellow	Medium	86	88
18	Uster Quantum 2	Yellow	Light	79	80
19	Uster Quantum 3	Red	Dark	99	99
20	Uster Quantum 3	Red	Medium	93	96
21	Uster Quantum 3	Red	Light	86	86
22	Uster Quantum 3	Blue	Dark	90	95
23	Uster Quantum 3	Blue	Medium	88	89
24	Uster Quantum 3	Blue	Light	80	83
25	Uster Quantum 3	Yellow	Dark	95	96
26	Uster Quantum 3	Yellow	Medium	90	94
27	Uster Quantum 3	Yellow	Light	84	84

Table 10

Analysis shows that the parameters considered have significant effect on clearing efficiency the reason for significance may be attributed to pattern of sensitivity of electronic yarn clearers.

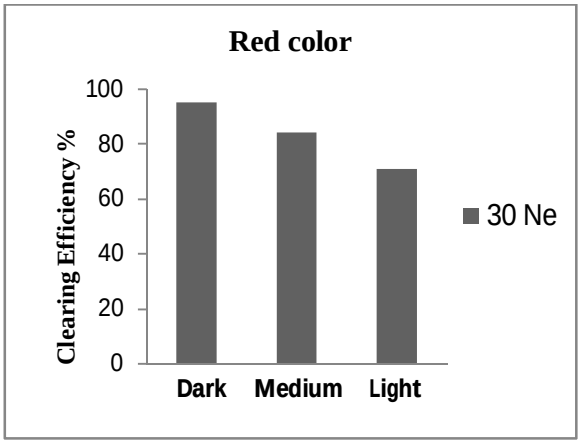

Figure 9

	Variables			
Sr. No.	**Electronic yarn clearers**	**Colors**	**Shades**	**CE%**
1	Loepfe EYC	Red	Dark	28
2	Loepfe EYC	Red	Medium	34
3	Loepfe EYC	Red	Light	40
4	Loepfe EYC	Blue	Dark	46
5	Loepfe EYC	Blue	Medium	34
6	Loepfe EYC	Blue	Light	28
7	Loepfe EYC	Yellow	Dark	46
8	Loepfe EYC	Yellow	Medium	40
9	Loepfe EYC	Yellow	Light	40
10	Uster Quantum 2	Red	Dark	46
11	Uster Quantum 2	Red	Medium	28
12	Uster Quantum 2	Red	Light	25

Sr. No.	Electronic yarn clearers	Colors	Shades	CE%
14	Uster Quantum 2	Blue	Medium	26
15	Uster Quantum 2	Blue	Light	34
16	Uster Quantum 2	Yellow	Dark	28
17	Uster Quantum 2	Yellow	Medium	35.5625
18	Uster Quantum 2	Yellow	Light	
19	Uster Quantum 3	Red	Dark	
20	Uster Quantum 3	Red	Medium	
21	Uster Quantum 3	Red	Light	
22	Uster Quantum 3	Blue	Dark	
23	Uster Quantum 3	Blue	Medium	
24	Uster Quantum 3	Blue	Light	
25	Uster Quantum 3	Yellow	Dark	
26	Uster Quantum 3	Yellow	Medium	
27	Uster Quantum 3	Yellow	Light	

Table 11

7.Reference

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