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Analysis of Package Weight Variation on Winding Machine

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Abstract -*The spun yarn is sold in the market in the form of cones or cheeses, not in the form of ring bobbin. For the longer length of yarn on package, it is wound on package by winding operation. In winding, even though the length of yarn is fixed, the weight of yarn package varies because of some reasons. Weight variation in package is creating problem in selling the yarn packages. The experiment is concerned with the study of package to package weight variation and to find the causes for the weight variation. A considerable amount of work was done on package weight variation in the past and some interesting conclusions were drawn. In this experiment, the study is carried to find out what amount of variation is there & whether it is significant or not. It was found that package weight variation from doff to doff is significant. The details of results, statistical analysis and conclusions are discussed in concerned sections.*

Key Words: Winding Cones, Weight variation, Doff, Relative humidity, Winding Head

1. INTRODUCTION

The package of yarn produced on a ring spinning frame i.e., the ring cop is not a marketable package. The spinning mills all over the world generally wind cones of yarn which are packed after conditioning in bags or cartons and sell it to the end-user in the local market or exported on consignment basis. Cones of yarn are wound on the winding machines. In producing a cone package of yarn, the winding machines perform many functions.

Winding the yarn on cones with good winding - off properties, as long a length of yarn as possible, extraction of all faults unacceptable to the end-user, introduction of minimum number of splices into the yarn, paraffin waxing of the yarn, achievement of high machine efficiency, detection and elimination of mixed yarn, winding constant length of yarn on each cone are the main functions, and a modern winding machine should fulfill all these requirements which are equally important. However, the point of interest to the spinner as well as the end-user is the constant length of yarn is wound on each cone which, after conditioning weighs 4.1666 Lbs (1890 Gms). On packing 24 such cones, a bag or carton with net yarn weight of 100 Lb (45.37 Kg) will be produced.

1.1 Literature Review

Dr.H.R.Sheikh [1], in his study mentioned that variations in the count of material are minimized at each processing stage in the spinning process by the application of on-line and off-line quality control techniques. However, variations in the count of yarn below and above the actual count are unavoidable and give rise to the variations in the net weight of yarn of constant length, wound on each cone. Variations in paper cone weight were studied by using 4-ply paper cones for winding yarn for the local market and 5-ply paper cones for the export. During the process of manufacture, variations in the weight of paper cones were introduced which gave rise to the variations in the gross weight of wound cones of yarn.

These yarn cones in general will have a moisture content level of 6.5%, which corresponds to a moisture regain of approximately 7%. The cones of yarn which are passed for conditioning in the packing room are either stacked on the floor in such a manner that the cones at the bottom were also exposed to the humidified air. The best practice was to creel yarn cones on pegs in the packing room ensuring more effective all round exposure.

In another studies [2], the rejection during package of finished yarn cones because of package weight variation was observed. It was concluded that the potential factors which had bearing on yarn weight, were as follows: count, empty cone weight, moisture content %, & length of yarn wound onto cone. The contribution of empty cone weight variation, count, & moisture content was negligible towards the gross weight variation; and variation in the length of yarn on the cone appears to be the potential cause for variation in gross cone weight.

Gungor Durur [3], in his thesis mentioned about slippage between grooved drum and package. Due to a number of reasons, slippage may vary as the package radius increases. As package diameter increases, the deformation is likely to increase. The amount of slippage may depend on: Type of yarn being wound, Yarn count, Yarn tension, Surface between driving drum (steel, Bakelite, chromium plate etc.), & Pressure between the drum and the package. Due to slippage length of yarn wound on package is not correct. Therefore the weight variation in package may occur.

Milind Koranne [4], in his book mentioned that some end use applications like warping and TFO twisting demands preselected length on winding package. Ideally all packages in a warping creel should be of exact length so that no yarn wastage takes place. Packages with excess length are left with some yarn on the package at the end of last beam or section. Such packages require rewinding for utilization of left over yarn. In TFO twisting, optimum utilization of volume of pot is necessary which demands an exact feed package diameter. When two packages are put in TFO pot one above the other, they should have equal length so that both exhaust simultaneously.

There have been many theoretical and experimental studies about yarn tension and yarn package structures [5]. In these studies, tension fluctuations of yarn path from the cops to bobbins have been researched. Tension problems are investigation at the yarn balloon, yarn tensioning points, yarn guiding elements, and in the winding area. These all the problems lead to variation in yarn package weight.

2. METHODS

To study the effect of various factors on variation of weight of full winding package cones the design of experiment is done as follows. One winding machine of 60 heads is selected and after completion of each doffs gross weight of every yarn cone package has taken. In this way 8 different doffs of cones on same machine has taken at different times, thus total data of 480 readings of gross weights of yarn cones were collected. The readings of temperature & % Relative Humidity at each doff collection were recorded.

Table -1: Package weights in Grams

DRUM NO.	Doff 1	Doff 2	Doff 3	Doff 4	Doff 5	Doff 6	Doff 7	Doff 8
1	1890	1886	1896	1883	1911	1920	1900	1930
2	1875	1878	1899	1895	1889	1904	1910	1890
3	1885	1888	1908	1886	1898	1889	1900	1875
4	1887	1899	1907	1900	1909	1898	1870	1880
5	1875	1888	1895	1896	1900	1907	1895	1870
6	1881	1898	1915	1898	1889	1897	1900	1890
7	1881	1873	1886	1893	1896	1922	1881	1872
8	1880	1900	1897	1904	1882	1930	1880	1892
9	18	18	19	18	19	19	19	19
	70	93	03	95	08	15	08	04
10	1890	1888	1896	1911	1913	1886	1897	1882
11	1884	1900	1906	1902	1922	1894	1815	1909
12	1880	1903	1874	1904	1923	1930	1901	1890
13	1872	1878	1890	1905	1888	1880	1890	1906
14	1890	1899	1900	1902	1896	1903	1904	1878
15	1904	1900	1892	1905	1924	1900	1880	1872
16	1885	1891	1916	1900	1889	1920	1885	1907
17	1896	1902	1892	1894	1880	1890	1898	1901
18	1880	1901	1894	1905	1907	1903	1920	1889
19	1860	1908	1894	1885	1912	1888	1904	1886
20	1870	1884	1886	1900	1915	1889	1894	1882
21	1896	1878	1905	1903	1903	1887	1880	1894
22	1875	1875	1876	1899	1912	1886	1890	1898
23	1890	1895	1887	1889	1888	1891	1890	1914
24	1884	1898	1896	1887	1896	1905	1900	1877
25	1890	1894	1908	1910	1897	1901	1898	1931
26	1895	1908	1907	1909	1892	1890	1905	1909
27	1900	1911	1910	1908	1907	1901	1887	1951
28	1890	1898	1900	1889	1879	1894	1890	1894
29	1875	1878	1901	1902	1897	1920	1904	1910
30	1876	1908	1897	1902	1930	1910	1909	1915
31	1872	1922	1894	1897	1890	1890	1894	1903
32	1883	1903	1904	1875	1889	1890	1887	1917
33	1904	1883	1907	1898	1920	1900	1904	1915
34	1896	1891	1888	1899	1885	1880	1910	1889
35	1895	1888	1907	1902	1885	1886	1888	1905
36	1896	1878	1891	1908	1875	1878	1890	1920
37	18	18	18	18	19	18	18	19

	97	93	97	89	08	86	76	18
38	1892	1890	1896	1908	1928	1909	1904	1915
39	1889	1899	1890	1904	1903	1909	1901	1915
40	1880	1900	1907	1904	1899	1915	1905	1915
41	1885	1912	1896	1899	1921	1898	1890	1906
42	1884	1878	1913	1912	1918	1887	1903	1906
43	1900	1908	1910	1887	1912	1891	1909	1906
44	1878	1878	1903	1911	1886	1930	1860	1890
45	1872	1898	1893	1894	1924	1886	1896	1915
46	1887	1902	1897	1903	1913	1889	1890	1886
47	1885	1894	1917	1889	1922	1921	1901	1915
48	1886	1898	1896	1910	1889	1897	1903	1916
49	1888	1888	1887	1904	1882	1930	1909	1911
50	1892	1900	1891	1904	1901	1895	1875	1889
51	1885	1878	1896	1910	1893	1896	1910	1900
52	1900	1905	1915	1904	1913	1920	1915	1889
53	1904	1897	1907	1901	1876	1870	1875	1920
54	1909	1902	1907	1905	1892	1890	1905	1926
55	1840	1888	1891	1901	1910	1897	1920	1901
56	1880	1883	1896	1916	1887	1920	1930	1900
57	1894	1910	1896	1917	1880	1900	1901	1888
58	1895	1830	1910	1902	1905	1895	1880	1906
59	1904	1906	1906	1904	1901	1881	1908	1915
60	1885	1905	1909	1898	1889	1887	1886	1899

3. RESULTS & DISCUSSION

As per the plan, the package weight data is collected for 8 doffs on a machine with 60 heads. The nominal count was 41.5^{s}and the length set was 133521 meters, to get 1890grams net weight of yarn on package.

Chart 1 shows the variation in average package weight doff wise.

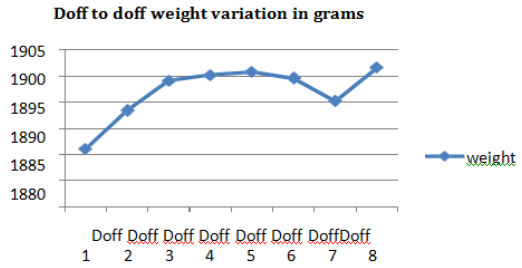

Chart -1: Doff to doff weight variation in grams

The Chart 2 shows Doff to doff wise variation in % R. H.

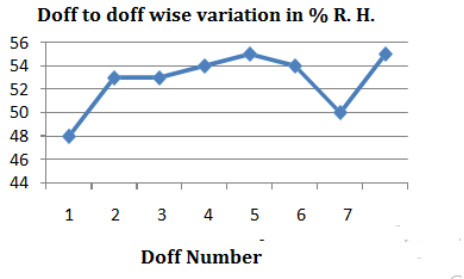

Chart -2: Doff to doff wise variation in % R. H.

From statistical analysis, it is found that, the doff to doff variation in package weight is significant but head to head variation is not significant.

The reasons for the doff to doff variation may be due to following:

1) Because of variation in back process i.e. count CV%. The count CV% of ring bobbin is in range of 1.62 to 1.66 this may be the one of the reason for weight variation.

2) Relative humidity also affects the variation in yarn package weight. If RH% is less, then at that time package weight is considerably less and if RH% is more, then weight increase in package is found, so it is one of the major reasons for weight variation.

3) Empty package weight is in range of 52 to 59 grams and the average of 20 empty package weight is 54.82 gram, which varies with CV% of 3.13%. It may also have some effect in package weight variation.

Table 1 - Two way ANOVA without replication

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Rows	12802.62	59	216.9936	1.215912	0.143373	1.353853
Columns	11581.71	7	1654.531	9.271071	1.13E-10	2.031756
Error	73704.66	413	178.4616			
Total	98089	479				

4. CONCLUSIONS:

From the statistical analysis and discussion on collected data obtained in this study, it lead to the following conclusions:

- Head to head weight variation in the package is not statistically significant.
- Doff to doff weight variation in package is significant as per statistical analysis.

This may be attributed to:

I) RH%.

II) Count CV% of ring yarn.

III) Empty package weight variation.

Thus to minimize weight variation it is very much essential to control the % R. H. of the department, & efforts must be taken to control the CV% of ring yarn.

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