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Effect of Machine Speed on Type of Defect During Knitting Process of Ladies Tights

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INTRODUCTION

Quality has been identified as one of the competitive strategies for improving business performance in a global market. The best-proposed tool for better-quality products is Statistical Process Control. The paper investigates the concepts of the quality control tool - scatter diagram, correlation coefficient, and regression analysis in the production of lady's tights.

EXPERIMENTAL PART

First findings, by collected production information's with usage of check lists and Pareto charts, for both machines are that the highest percentage of defects occurs from breaking thread 2. Usually the machines work with speed of n = 500 - 650 rpm, set up by the appropriate knitting program. At the table, separated on two parts are presented the data for average speed of the machine (values x) and the defects- tearing the thread performed during that speed (values y) while knitting the pipes. The purpose of this is to see if there is a correlation between the knitting speed and defects. If so, to find the speed at which the defects are the least.

RESULTS AND DISCUSSION

For the first set of machine speed, the calculated values of the coefficient of correlation indicate a high inverse-proportional linear correlation between the average knitting speed and the tearing of the thread, i.e. the defects that occur. So, there is a linear correlation with a confidence level of 99,9 %. Next, aiming to explain the quantitative correlation between the variables, regression analysis is performed, which is designed in Figure 1. The result for the regression coefficient indicates that 92 % of the points (values for tearing of the thread) are near the regression line. The same calculation as above is performed for the second part of the obtained results, for machine speed 600 - 650 rev/min.

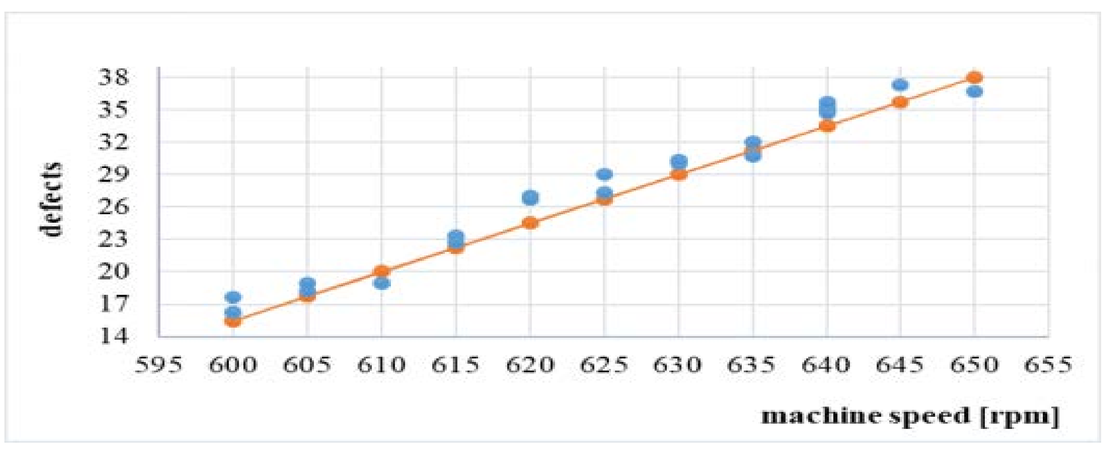
Table 2: Calculations for correlation and regression analysis

Machine speed					

The calculated value for the coefficient of correlation indicates a high proportional linear correlation between the average knitting speed and the tearing of the thread, i.e. the occurred defects. The conclusion is that exists a linear correlation between the two variables, with a confidence level of 99,9 %. The regression coefficient gives the estimate of the dependence of the defects on the speed of the knitting machine. Based on these calculations, a regression diagram between the defects (tearing of the thread) and the knitting speed of the circular knitting machine are presented in Figure 2.

Table 1: Machine speed and defects and calculation for correlation coefficient

No.	x	y		x^2	y^2
1	540	23	12420	291600	529
2	550	22,7	12485	302500	515,29
3	555	22	12210	308025	484
4	560	20,3	11368	313600	412,09
5	565	18,3	10339,5	319225	334,89
6	570	17	9690	324900	289
7	575	16,7	9602,5	330625	278,89
8	580	15,7	9106	336400	246,49
9	585	15	8775	342225	225
10	590	15,3	9027	348100	234,09
11	595	13,3	7913,5	354025	176,89
12	545	23,7	12916,5	297025	561,69
13	540	21,3	11502	291600	453,69
14	555	21,7	12043,5	308025	470,89
15	560	19,7	11032	313600	388,09
16	565	17,7	10000,5	319225	313,29
17	570	16,7	9519	324900	278,89
18	575	16,7	9602,5	330625	278,89
19	580	15,3	8874	336400	234,09
20	585	14,7	8599,5	342225	216,09
21	590	15,7	9263	348100	246,49
22	595	13	7735	354025	169
23	560	19,3	10808	313600	372,49
24	580	15,7	9106	336400	246,49
25	580	14,7	8526	336400	216,09
sum	**14245**	**445,2**	**252464**	**8123375**	**8171,8**
26	600	16,3	9780	360000	265,69
27	605	18,3	11071,5	366025	334,89
28	610	19	11590	372100	361
29	615	23,3	14329,5	378225	542,89
30	620	26,7	16554	384400	712,89
31	625	27,3	17062,5	390625	745,29
32	630	30	18900	396900	900
33	635	30,7	19494,5	403225	942,49
34	640	35,3	22592	409600	1246,09
35	600	17,7	10620	360000	313,29
36	610	19	11590	372100	361
37	605	19	11495	366025	361
38	615	22,7	13960,5	378225	515,29
39	620	27	16740	384400	729
40	625	29	18125	390625	841
41	630	30,3	19089	396900	918,09
42	635	32	20320	403225	1024
43	640	35	22400	409600	1225
44	645	37,3	24058,5	416025	1391,29
45	630	30,3	19089	396900	918,09
46	600	16,3	9780	360000	265,69
47	640	34,7	22208	409600	1204,09
48	620	26,7	16554	384400	712,89
49	640	35,7	22848	409600	1274,49
50	650	36,7	23855	422500	1346,89
sum	**15585**	**676,3**	**424106**	**9721225**	**19452,33**



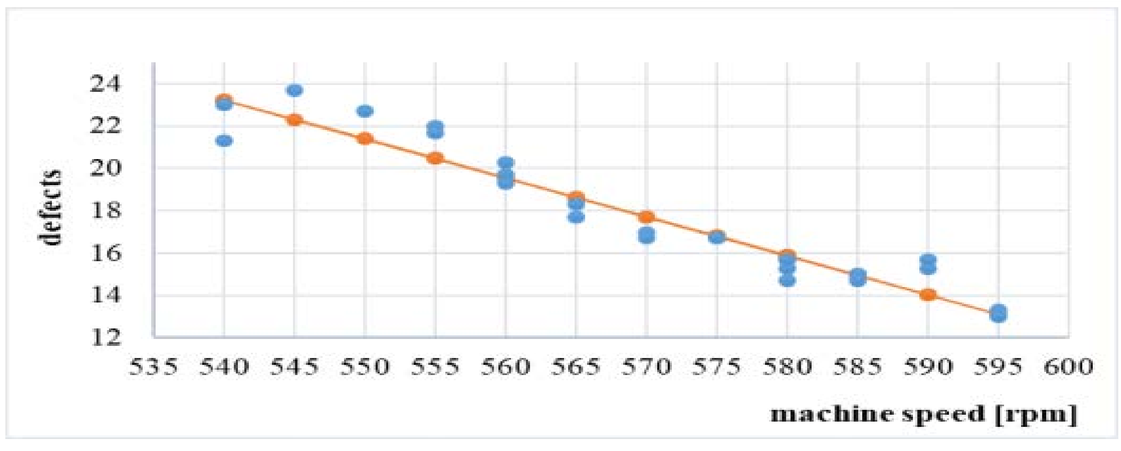


Figure 1 and 2: Regression between knitting speed and occurred defects

CONCLUSION

For the first set of machine speed, with increasing of knitting speed from 540 to 595 rpm, the number of defects reduces. For second set of machine speed, with increasing the machine speed from 600 to 650 rpm, the number of defects increases. The regression coefficient indicates that 98 % of the points lie close to the regression line. As the knitting process is a complex production process where many factors and correlations exist, optimum machine speed should be determined, resulting in stable process, lower production costs and increased productivity.