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AN INVESTIGATION TO THE INFLUENCE OF SIZING MACHINE SETTINGS ON THREAD PROPERTIES

by

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بحث تاثير ضبطات ماكينة البوش على خواص الخيوط.

الخلاصة:

غرض هذا البحث هو محاولة بحث تاثير الضبطات المختلفة لماكينة البوش على الخواص الميكانيكية والاحتكاكية للخيوط المبوشة وكذلك نسبة البوش المكتسبة. بينت النتائج وجود أرتباط كبير بين قيمة الشد فى المناطق المختلفة ودرجة حرارة التجفيف وضغط العصارات وخواص الخيوط المبوشة بما يتطلب أعادة التقييم للضبطات المستخدمة للحصول على افضل النتائج.

ABSTRACT:

The objective of the present work is to investigat the influence of the sizing machine settings on the tensile and frictional properties of the sized yarn as well as the %size add-on. A significant effect on the properties the sized yarns was found due to the tension in the different zones, drying tempereature and squeezing pressure.

1. INTRODUCTION:

The warp threads are subjected to a high-repeated abrasion and tensile stresses during weaving. This may cause a warp break, the matter which reduces both, loom productivity and fabric quality. For high speed weaving it becomes necessary to have a well prepared warp threads to withstand high stresses during weaving. This is also important to improve the economics of the weaving process, because cost of the weaving machine is high (about 250,000 L.E. for a Sulzer weaving machine).

Generally, the quality of yarn from spinning has a large influnce on the performance of warp threads during weaving. However, the yarn preparation for weaving, specialy the sizing process, determines to a large extend the properties of warp threads which are required to produce a high quality fabrics on a high speed loom. It has been reported [5] that, for a high production loom, the warp threads should fulfil the following requirements:

1-Sufficient resistance to abrasion and adequate thread strength.
2-High and even residual stretch and even tension.
3-Slight hairiness and curliness.
4-No crossings in the thread run.

The yarn, after sizing, should have more than 70% of its original stretch. It has been shown[3] that, the increase in the sizing stretch causes an increase in the warp end breakage rate during weaving. The increase in size encapsulation and size pentration up to 30% results in a reduction in the relative warp end breakage during weaving. A high size pentration will have a bade effect on end breakage rate.

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Truter[4] showed that the tensile strength of a sized yarn was not significantly reduced by high squeezing pressure. But he could not find a definite tendencies with regard to the abrasion resistance of sized yarn. With respect to hairiness he observed a slight reduction in hairiness with dense warps as the high squeezing pressure was used. Also, it has been reported[6] that thread hairiness rduces with the increase of squeezing pressure.

Miyamoto[2] mentioned that the use of high squeezing pressure reduces the amount of size attached on outside of thread, then warp ends do not stick each other at the drying . Cocequently, the dividing force is small and the amount of hairiness and dropped fibers is reduced.

With respect to the influence of the previous processes on sizing, Bauer[1] discussed the factors which are required to optimise warp sizing . He mentioned that the winding and warping processes are important and must be taken into account for a good sizing.

Generally , the requirement of the residual stretch after sizing is influenced by the applied tension on warp threads at different zones of the sizing machine. The abrasion resistance and strength of sized yarn are affected by the nature of the size material and degree of sizing . This is also controlled by the applied squeezing pressure as well as the drying temperature.

The objective of the present work is to investigat the influence of the sizing machine settings on the tensile and frictional properties of sized yarns . The settings of the sizing machine which are considered in this work are:

1-Yarn tension,
2-Squeezing pressure, and
3-Drying temperature.

2-EXPERIMENTAL WORK:

The course of this experimental work was done in El-Nasr Spinning, Weaving and Dyeing at Mehalla Kubra. The Sucker sizing machine Model W.L.1982 was used to prduce the samples of sized yarns at different setting conditions. Figure(1) shows a schematic diagram of this machine. The sizing machine was normaly running to size a warp cotton yarn, Ne.20/1 (Size 77) . The average twist factor was 3.7 and the average breaking strength was 13.3 gm./tex. The total number of warp threads was 2365 and the warp width in the sizing machine was 140 c.m. The native starch was used as a sizing agent. The settings of the sizing machine for normal running condition were as follows:

1-yarn tension, let-off.....400 N., inlet.....200 N.
wet........300 N.,
dry.......500 N.
winding.....1050 N.
2-squeezing pressure, top rllers.....11.5 KN.
side rollers.....3.9 KN.
3-drying tempreature, teflon cylinders ...130 C.
steel cylinders....130 C.

The sizing machine was running at speed of 80 mt/m. and the moistur was set at 6.5%. The normal running conditionsof the sizing machine were kept constant during studying the influence of various machine settings. The samples of sized yarns were taken and tested. The Uster strength tester was used to find out the tensile properties of sized yarns. To find out the frictional properties , the Rothschild F-Meter model R-1182 was used to get the coefficient of friction between the thread and ceramic guide. Also the thread to thread friction was tested on the same apparatuse.

Figure(2) shows the principle of friction measurement. The measurement of friction was carried out at speeds of 20 mt/m. & 30 mt/m. which simulate the running speed of a warp on a modern weaving machine.
The abrasion resistance of the sized yarns was found in termes of the number of cycls to breakage at speed of 1000 cycl/m. The Meyefem Type FY-10 tester was used and Figure(3) shows the principle of measurement.
The %size add on was found by weighing a 10 mt. of yarn before and after sizing.

3-RESULTS AND DISCUSSIONS:

In order to investigate the variation in the thread properties along the warp width, which might happen from the squeezing rollers. The warp width was divided into seven equal sections, each was 20 cm. The tensile properties of threades in each section was found at different squeezing pressures. Table(1) shows the results of the variance analysis of thread properties along warp width. It is clear that the variation in thread properties along warp width is not significant at confidence limits of 95% & 99%.

The results of the experimental work are shown in Figures(4 to 13) and Tables(2&3). Table(4) shows the correlation coefficient of sizing machine settings and some of thread properties. The significant effects are considered.

3.1.Effect of let-off tension on thread properties.

3.1.1.Tensile properties of threads.

Figure(4) shows the influence of let-off tension on the tensile properties of the threads. The expermintal results showed that the increase in warp let-off tension resulted in an increase in thread breaking strength ,breaking extension, work of rupture and ballistic strength. This was observed up to a value of 500 N. let-off tension. Applying tension in this zone more than 500 N., reduced the tensile properties. Also, the increase in let-off tension resulted in a better equalisation to the tension differences between the threads which resulting from the previous processes. This is shown in Figure(4) , the c.v.% of tensile properties decreased as the let-off tension was increased up to 550 N.

3.1.2.Frictional properties of threads.

Figure(5) shows the effect of let-off tension on frictional properties of threads in terms of the coefficient of friction between thread and ceramic guide and the output tension of thread to thread friction. The results showed no clear trend to the effect of let-off tension on frictional properties of sized yarns.

3.2.Effect of inlet tension on thread properties:

3.2.1.Tensile properties of threads.

The breaking strength of the threads and its work of rupture decreased as the inlet tension was increased , as shown in Figure(6). This is because the threads in the size box were highly tensed . The matter which resulted in less size pick up than the case of the threads which immersed in the size box at relaxed state. Consequently, the breaking extension increased ,as shown in Figure(6-c). At the same time the c.v.% of the thread strength , extension and work of rupture reduced as the inlet tension was increased. This is attributed to the differences in yarn tension which resulted from the previous processes.

3.2.2. Frictional properties of threads.

Figure(7) shows that the coefficient of friction between the thread and ceramic guide and the output tension of thread to thread friction increased as the inlet tension was increased. This is attributed to the poor encapsulation of sized yarn which resulted from the small amount of size pick up with the increase in inlet tension. Hence, the abrasion resistance of sized yarn reduced , as shown in Table(2).
The experimental results of %size add on was not correlated to inlet tension. This is attributed to the experminta1 method to find the %size add-on and the variation in the amount of size pick up in the size box.

3.3. Effect of wet tension on thread properties:

3.1. Tensile properties.

Generally, the tensile properties the sized yarn were influenced to a large extend by the wet tension, as shown in Figure(8). This is because, the warp threads in the wet state, after leaving the size box, stretch fast when tension was applied. It was reported that 2/3 of the stretching during sizing processe occurs in the wet region. This resulted in an increase in the breaking strength and a reduction in breaking extension of the sized yarn when the wet tension was increased. Hence, the work of rupture as well as the ballistic strength were influenced. In the present work , a wet tension higher than 400 N. showed a bad influence on the tensile properties of sized yarns, as shown in Figure(8). This is attributed to the fiber slippage which occured at high wet tension.

3.3.2. Frictional properties of threads.

The results show no large influence of wet tension on the coefficient of friction between thread and ceramic guide. At the same time the variation in the output tension of thread to thread friction with the wet tension does not show a clear trend and it is not correlated to the results of abrasion resistance of the sized yarn.

3.4. Effect of dry tension on thread properties:

3.4.1. Tensile properties of threads.

The results show that the tensile properties of sized yarns are not influenced by the dry tension in the range of this study. This is attributed to the fact that dry tension is applied to obtain a clean threads splitting in the dry zone without thread breakages.

3.4.2. Frictional properties of threads.

The frictional properties of the threads were affected by the dry tension , as shown in Figure(9) and Table(2). The coefficient of friction between thread and ceramic guide as well as the output tension of thread to thread friction increased as the dry tension was increased. This is attributed to the splitting of the threads aganist the adhesive force of sizing material. Which resulted in a damage to the size film on the threads. This damage is expected to be large when the dry tension is high. The matter which reduced the abrasion resistance of the threads.

3.5. Effect of squeezing pressure on thread properties:

3.5.1. Tensile properties of threads

Figure(10) shows that the tensile properties of sized yarn are highly influenced by the squeezing pressure. In spite of the reduction in the % size add-on , the breaking strength of threads increased as the squeezing pressure was raised up to 11.25 KN. This is attributed to the enhancement in size pentration. Hence , the thread elasticity was influenced . the matter which caused a rduction in the ballistic strength of the threads, as shown in Figure(10-d). A reduction in the c.v.% of tensile properties was observed with the increase of the squeezing pressure, as shown in Figure(10).

3.5.2. Frictional properties of threads.

The coefficient of friction as well as the output tension reduced with the increase of squeezing pressure up to 11.25 KN., as shown in Figure(11). This resulted from the good encapsulation and the reduction of hairiness of the threads[2&6]. Hence, the abrasion resistance of threads was increased , as shown in Table(2).

3.6. Effect of drying temperature on thread properties:

3.6.1. Tensile properties of threads.

The results show that, lowering the teflon cylinders temperature or the steel cylinders temperature to 100 C, had no clear influence on the tensile properties of the threads.

3.6.2. Frictional properties of threads

The coefficient of friction between the thread and ceramic guide as well as the output tension of thread to thread friction increased as the teflon cylinders temperature was rasied, as shown in Figure(12) . This is because the outer surface of the threads dried rapidly when the temperature of teflon cylinders was high. Which caused a damage to the size film on the surface of sized yarn after completed drying and splitting was taken place. Consequantly, the abrasion resistance was influenced , as shown in Table(3). The steel cylinders temperature showed no influence on the frictional properties of the threads,as shown in Figure(13). It is important to mentioned that , for a cotton yarn, the maximum drying temperature recommended by the machinery manufacturer is 150 C. It is also recommended that the teflon cylinders temperature should be higher than the steel cylinders temperature inorder to avoide sticking of threads to the teflon cylinders.

4. CONCLUSOIONS:

The previous experimental work was done to get the trend of variation in thread properties with the sizing machine settings. From the observations and discussions the following conclusions can be drawn:

1-The variation in the yarn tensile properties along warp width due to the squeezing roller was not significant.

2-The increase in let-off tension up to 500 N.(0.7 cN/tex) imoroved the tensile properties of sized yarns as well as its coefficient of variation.

3-The tensile properties and abrasion resistance of sized yarns decreased as the inlet tension was increased.

4-The increase in wet tension up to 400 N.(.56cN/tex), improved the tensile properties of sized yarns.

5-High dry tension caused a reduction to the abrasion resistance of sized yarns.

6-High squeezing pressure increased the strength and abrasion resistance of sized yarns but its elasticity was reduced.

7-Care must be taken when raising the temperature of teflon cylinders to avioed sticking of the threads to the cylinders. This would have a bad influence on the abrasion resistance of sized yarns.

It is important to mentioned that the interaction btween machine settings is expected to have a large influence on the properties of sized yarns and machine perfomance. This will be studied in further work.

Acknowledgements:

Special thanks goes to Dr.Abdel-Asim Mohamed , president of El-Nasr Spinning, Weaving and Dyeing Co., Mehalla El-Kubra , for allawing us to produce the samples of sized yarns in his company. Also deep appreciation to the engineers of the weaving section for their cooperation in producing the samples on the sizing machine.

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Table(1) Variance analysis of thread properties along warp width

Thread property	Squeezing pressure	D.F.	S.S.	M.S.	F
Breaking Load	7KN	6	53874.29	8979.05	1.3
Breaking Extension	7KN	6	2.41	0.4	0.82
Work of Rupture	7KN	6	242663.31	40443.89	1.37
Breaking Load	8KN	6	43334.29	7222.38	1.82
Breaking Extension	8KN	6	4.61	0.77	1.67
Work of Rupture	8KN	6	194913.3	32485.55	1.17
Breaking Load	9KN	6	25974.29	4329.05	0.93
Breaking Extension	9KN	6	2.65	0.44	1.0
Work of Rupture	9KN	6	164280.3	27380.05	1.12

Values of F corrospond to N1=6 & N2=63 are:
2.25 at confidence limit 95% ,and
3.12 at confidence limit 99%

Table(2) Effect of tension and squeezing pressure on yarn properties

Machine setting	Let-off tension (N)					Inlet tension (N)				
Yarn properties	350	400	450	500	550	100	150	200	250	300
% Size add-on	7.5	7.1	13.3	19	17.3	7.8	13.1	11.7	10.4	12.6
Abrasion resistance, cycles	88	109	134	76	59	250	310	179	92	77

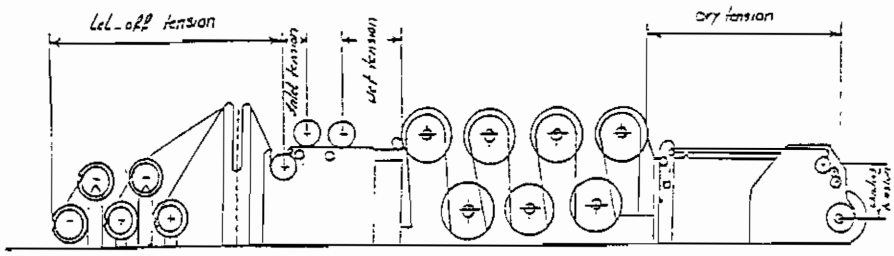
Machine setting	Wet tension (N)				Dry tension (N)					Squeezing pres.(KN)		
Yarn properties	350	400	450	500	300	400	500	600	700	8.25	9.25	11.25
% Size add-on	13.2	19.2	10.4	14.7	8.5	22.7	17.4	11.7	18	17	15.8	16.2
Abrasion resis. cycles	236	544	392	350	237	212	120	273	152	115	140	153

Table(3) Effect of drying temperature on yarn properties

Cylinder temperature C	Teflon cylinder						Steel cylinder			
Yarn properties	100	105	110	120	130	140	100	110	120	140
% Size add-on	26.4	24.2	23.4	9.6	10.7	6.4	28.8	33.2	33.3	20.
Abrasion resistance, cycles	280	240	257	583	121	172	342	430	440	55

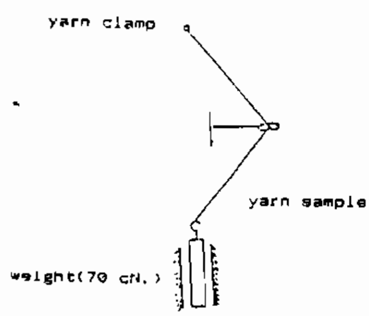
Table(4) The correlation coefficient of sizing machine settings and yarn properties

Yarn property / Machine setting	W.R.	C.V. %	B.Str.	C.V. %	B.Ex.	C.V. %	Ballisic Strength	Coeff.of Friction	O/P Tension	%Size add-on	A.R cycl
Lat-off Tension	.44	-.48	.39	-.14	.42	-.46	.50	-.52	.08	.88	-.38
Inlet Tension	-.06	-.96	-.63	-.79	.63	-.77	.22	.02	.35	.92	-.87
Wet Tension	.23	-.38	.52	-.51	.05	-.69	-.23	-1.0	.16	-.15	.19
Dry Tension	-.26	.60	-.68	-.35	.42	-.54	-.10	.78	.67	.23	-.28
Squeez Pressur	.95	-.84	1.0	-.98	.05	.10	-.81	-1.0	-.98	-.50	.93
Teflon Temp.	-.16	-.70	-.31	-.22	-.10	.22	-.08	.95	.50	-.94	-.24
Steel Temp.	-.44	.11	-.87	-.19	.25	.61	-.56	-.97	-.71	-.68	-.75

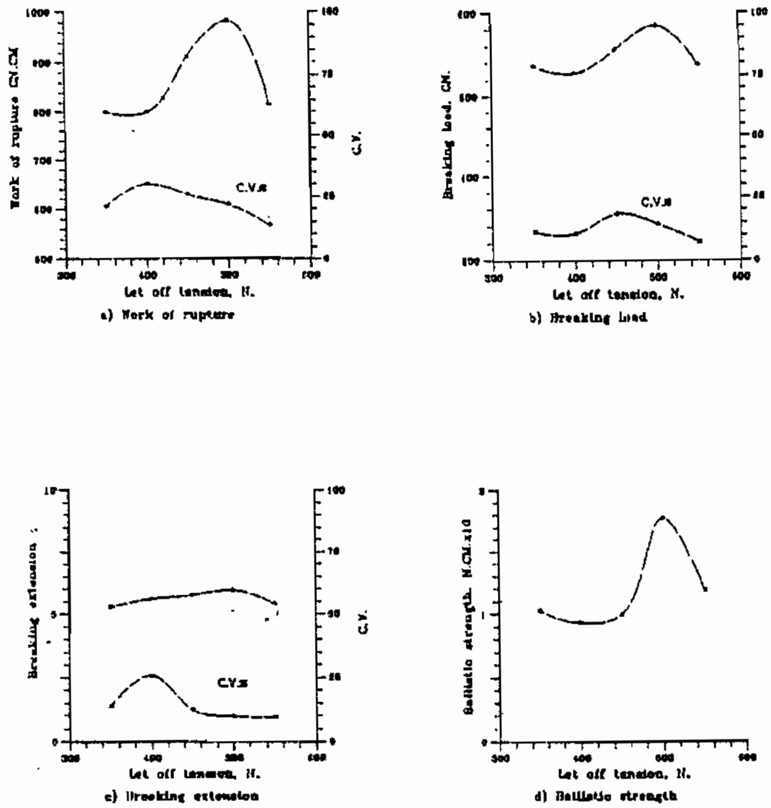


Figure(1) The sizing machine

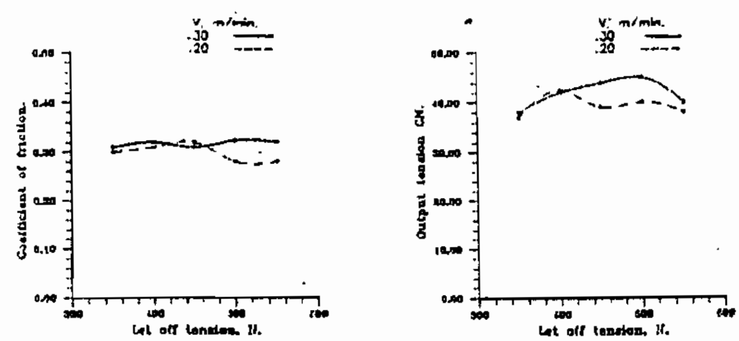
Figure(2) Principle of friction measurement



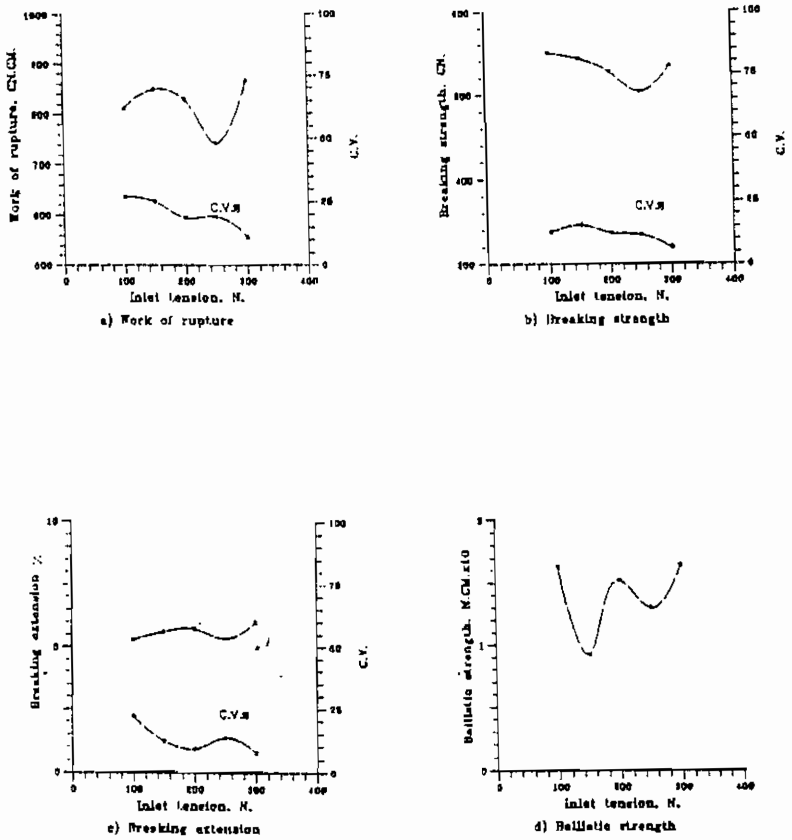
Figure(3) Principle of abrasion resistance measurement



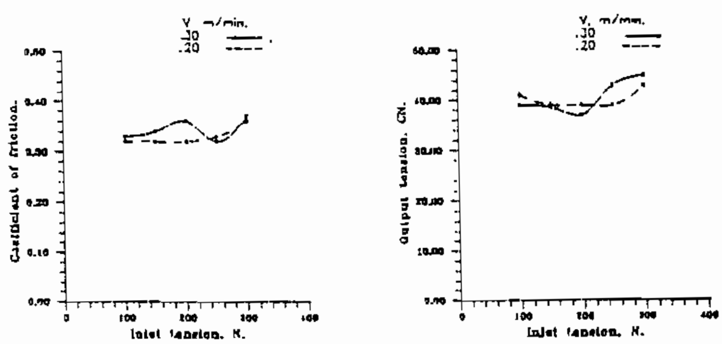
Figure(4) Effect of let-off tension on tensile properties of threads



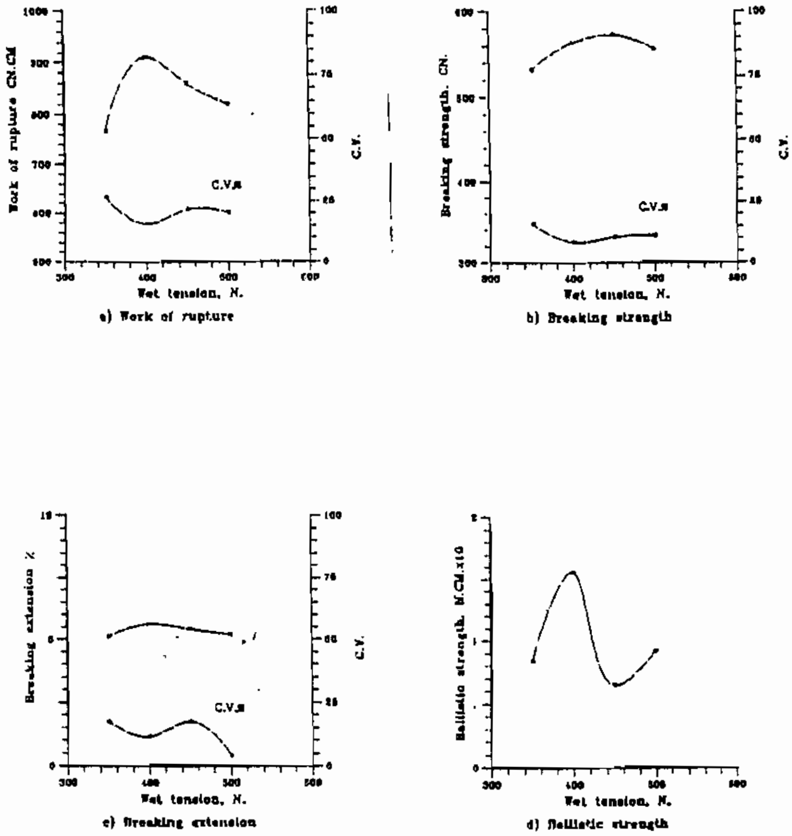
Figure(5) Effect of let-off tension on coefficient of friction and output tension



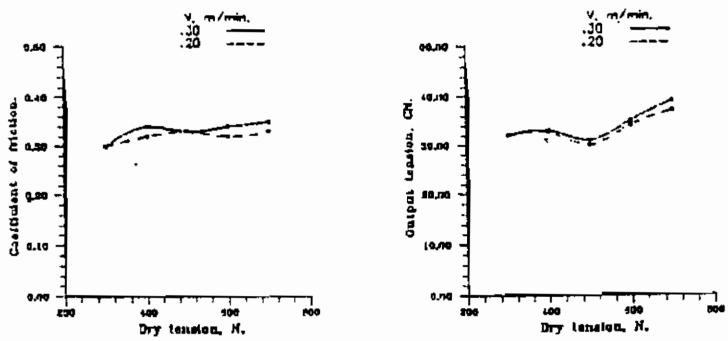
Figure(6) Effect of inlet tension on tensile properties of threads



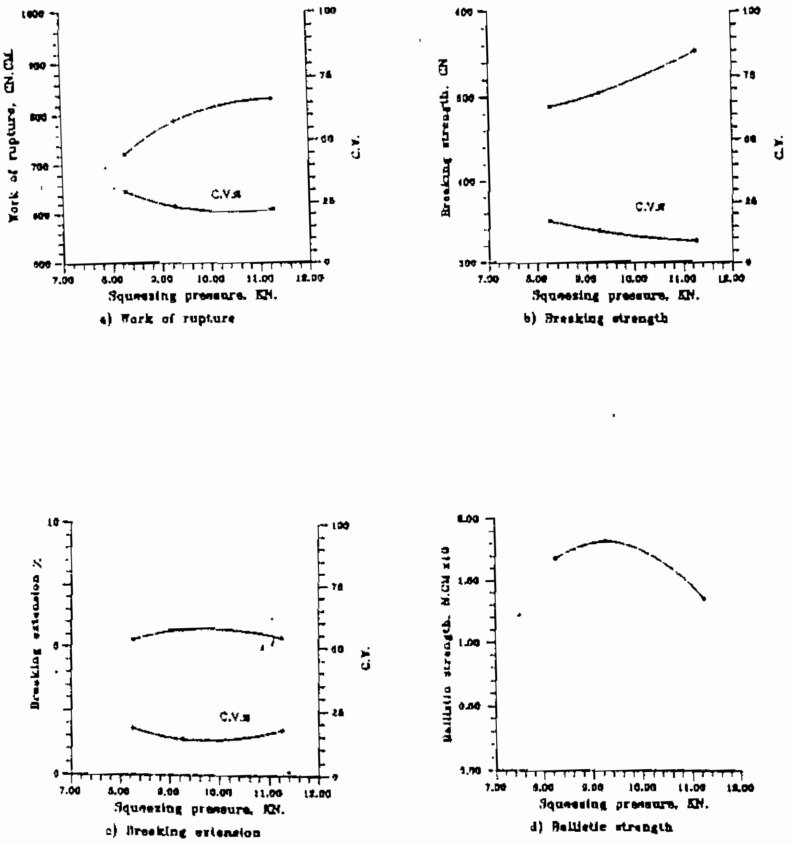
Figure(7) Effect of inlet tension on coefficient of friction and output tension



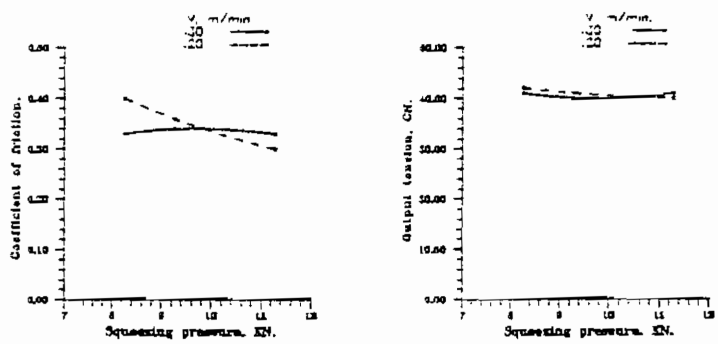
Figure(8) Effect of wet tension on tensile properties of threads



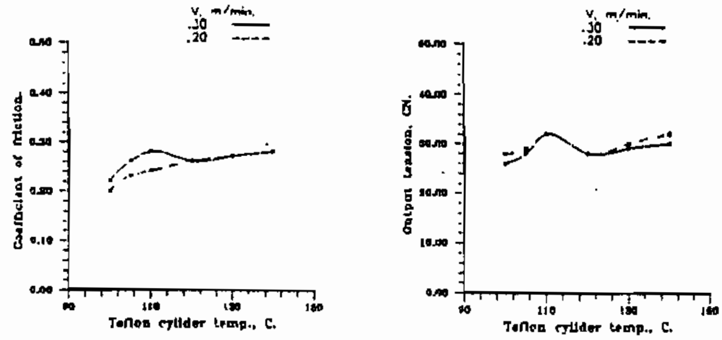
Figure(9) Effect of dry tension on coefficient of friction and output tension



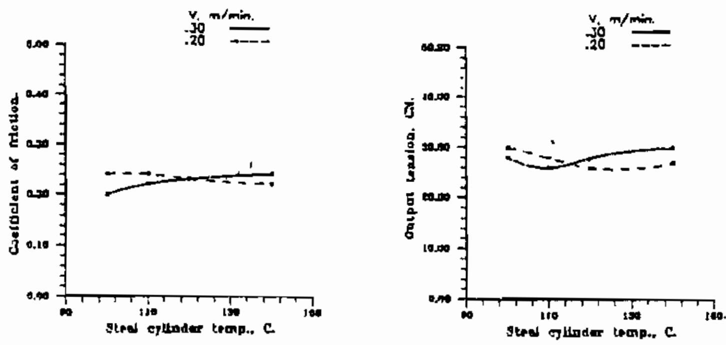
Figure(10) Effect of squeezing pressure on tensile properties of threads



Figure(11) Effect of squeezing pressure on coefficient of friction and output tension



Figure(12) Effect of teflon cylinders temperature on coefficient of friction and output tension, steel cylinder temp. 130 C



Figure(13) Effect of steel cylinders temperature on coefficient of friction and output tension, teflon cylinder temp. 130 C