A completion report of Minor Research Project 2009-10 and 2010-11

Dr. Pratap Patil

Measurement of Inverse Creep of some textile yarns by using an Optical Instrument.

I. INTRODUCTION.

Creep has been known and studied for textile materials for decades. In comparison, a newly observed phenomenon of inverse creep seems not to have received much attention. A new instrument has been fabricated to measure creep and inverse creep in textile materials particularly yarns. Creep and Inverse creep measurements of few of the textile yarns like nylon multifilament yarn, Polyester multifilament yarn, Cotton and wool yarn at different levels of stress have been studied, using the new instrument and results are reported in the present paper.

Almost all textile materials are made up of polymers. They are viscoelastic in nature and exhibit phenomena like creep, stress relaxation, inverse relaxation and inverse creep. A material under constant stress shows continuous increase in strain with time. The phenomena are known as creep. On the other hand if the material is strained and kept at constant strain, stress in it decreases continuously with time. This phenomenon is known as stress relaxation. The phenomena in which applied strain in viscoelastic material is partially reduced, giving rise to increase in stress with time is known as inverse relaxation. This phenomenon has been studied for some textile materials.

Inverse creep is a phenomenon, which is found to occur in viscoelastic materials when the applied stress is partially reduced. At this reduced stress, the strain in the material goes on reducing continuously with time, though it is still under stress.
Inverse creep values depend on the material and also on its stress history. During weaving of a fabric, weft threads are inserted in between the warp threads, which are along the direction of the fabric production. A weft thread undergoes variation in stress during weaving. It is at high stress when it is being laid down in the

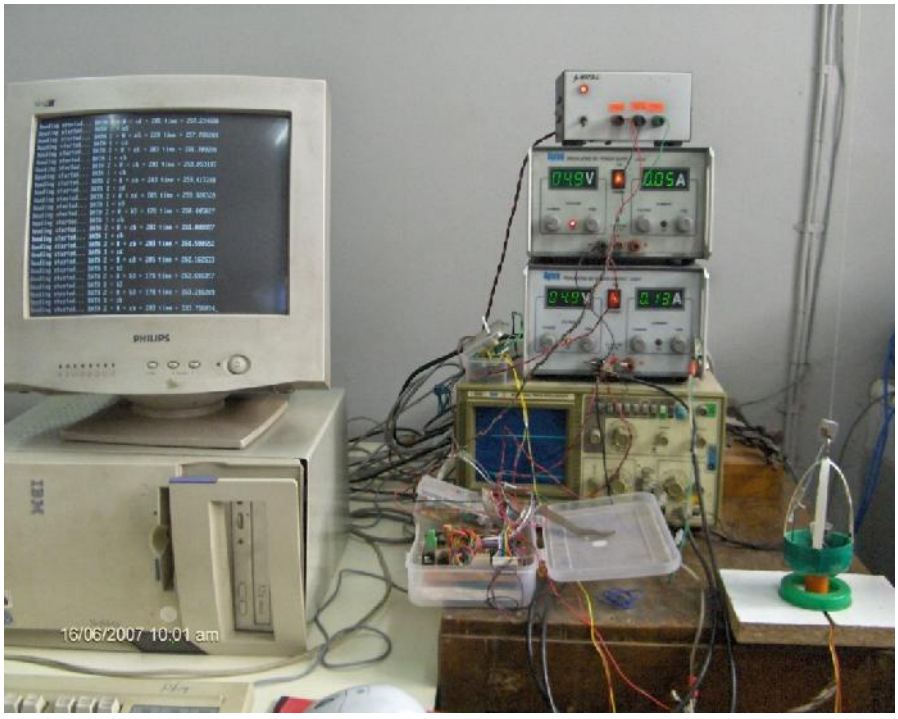
fabric. But the stress may not reduce to zero, once the thread is lead down and thus giving rise to the phenomenon of inverse creep. Variations in inverse creep behaviour for the same higher and lower stress levels in a given yarn can lead to fabric defect. Any phenomenon in a polymeric substance where applied stress is getting partially reduced will give rise to inverse creep.

Creep of textile materials has been measured by a number of researchers.

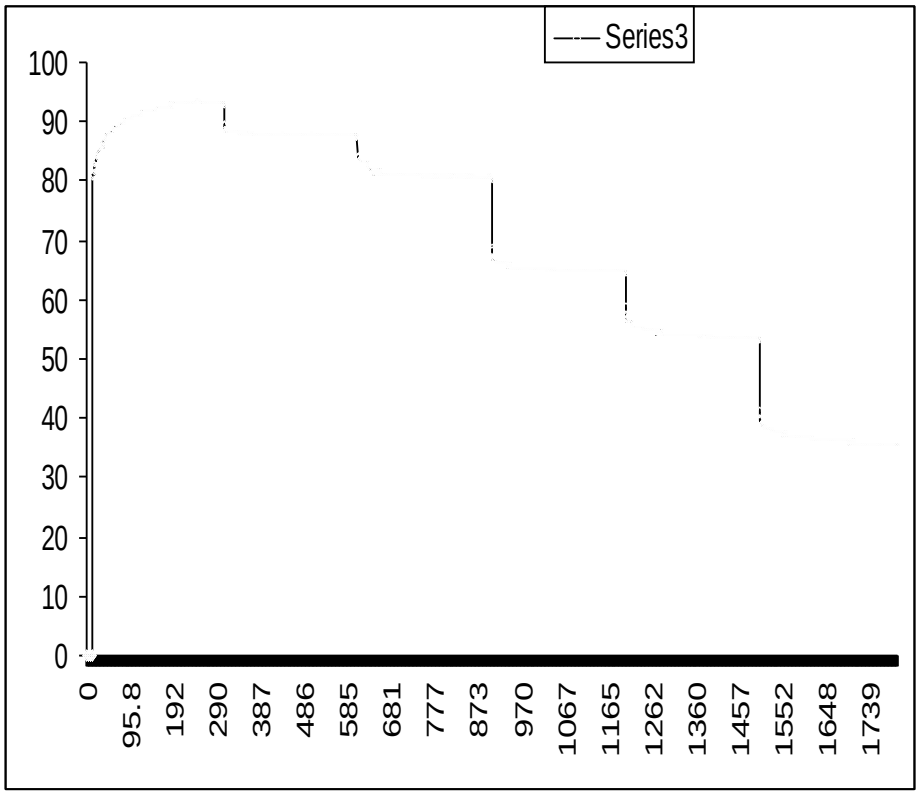
In the first attempt inverse creep can be measured by the mechanical and manual measurement method demonstrated by Dr. R. P. Nachane. However this method is cumbersome and tedious. Also, the level of accuracy in measurements is low as it depends on the personal, subjective observation.

This work was followed by Dr. R. P. Nachane and Dr. P. G. Patil. The work was totally automated by discrete electronic circuit using ultra sonic transreceiver, embedded system and Personal Computer. All are interfaced powerfully to store the creep and inverse creep data.

The acual diagram is as follows:



The automation in storing was achieved. The results were shown in graphical form.



II. Experimental methods

The peripherals which are used in the test instrument were as follows:

1. Ultrasonic Trans-receiver: Trans-receiver (Operating Frequency: 40 KHz): It is a pair of pezo-electric transducers.

2. Oscillator: It consists of Schmitt-Trigger NAND gate (IC 4031) and R-C network, which produces 40 KHz frequency signal. The output of the Oscillator is given to one terminal of the Transmitter and the same out put of the Oscillator is inverted and is fed to the second terminal of the transmitter.

3. Amplifier: It is a combination of an inverting and non-inverting amplifiers designed by Operational Amplifiers (IC 741). The appropriate gain is adjusted.

4. Buffer: This is a tri – state buffer generally known as a line driver. IC 74LS244 is specifically used for this purpose

5. Level shifter: Basically it converts an anolog signal (± 2.5V) to a digital signal (0V-5V) and consists of a common emitter amplifier. PNP transistor (SL – 100) is used.

6. Embedded System Unit: An Embedded system with a Micro-Controller 89V51RD2 was used which had serial and parallel ports. IC 89V51RD2 (Philip Make) was used and run by Assembly Language Program.

The Assembly Language Program is a source program, which waits for the transmitted pulse and on receiving the latter, it starts the internal time and immediately stops the Oscillator, which disables the transmitter. In short, the receiver receives the first transmitted pulse. The moment the transmitted pulse is received by the receiver it sends the pulse to the microcontroller. On getting this pulse the timer stops and the time difference is loaded on the ports. A pulse is sent to the PC, indicate that data is available on the port. Computer receives the data and sends a pulse to the microcontroller, indicating it to have the next pulse from the transmitter. The cycle repeats again.

7. Personal Computer: Intel branded motherboard with Flash Magic Software and a Turbo-C editor is used. Flash Magic Software is used to load the Assembly Language Program in Micro Controller IC- 89C51RD2 through the serial port. The C- language program is used to load the data (time difference) in the PC. The program stores up to1000 data units in the file. And after that it opens another text file to store next 1000 data items. The data port of the Printer Port is used to transfer data items from Micro Controller Port to the PC. For Hand Shaking (acknowledgement) between Micro Controller and PC, one terminal of both Control port and Status Port is used. Microsoft Excel can be used to see the results graphically.

Incidentally a Patent application for the instrument has been filed with the Controller General of Patents, Mumbai Office, India (850 / MUM / 2007).The patent has been published on 30th May 2008.

Operating Procedures:

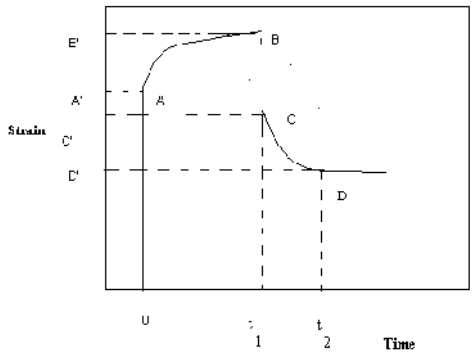
Yarn segment is caught at both the ends by clamps. One end is hooked at the top of the 3m stand. At the other end the weighing pan is attached on which the load can be added at a particular time instant.

When the load is put in the pan, the first pulse from transmitter is transmitted and instantaneously the Timer is started in the Micro-Controller. When the receiver receives the same pulse, the Timer is stopped. The Timer of the Micro-Controller computes the time duration and it puts the byte on its port. Thus time taken by the ultrasonic pulse to travel from transmitter to receiver is measured. This time is usually in microsecond. Moment the pulse is sensed by the receiver circuit, it send signal to the transmitter circuit to put off the transmission. Once the data is processed and stored in the data file by the computer, computer sends signal to the transmitter to start transmitting signal again. The time duration in the successive measurements is approximately one second. This can be reduced to few microseconds with the same Instrument.

Time lag between the transmission of the pulse by the transmitter till it is received by the receiver is converted into change in distance between the two transducers which is nothing but the displacement. Thus with the passage of time measured by the timer of the computer, displacement of the receiver and therefore, the extension in the yarn is measured to a great accuracy. (Fraction of mm)

The extension / reduction in length of the yarn are being stored in the data file of the P.C., for about every second. This text file then can be opened in MS-Excel. From the data and the corresponding graph, the creep and inverse creep behaviour can be observed.

The work with the help of Ultrasonic transreceiver was well received around the world. One international paper is published in “Journal of Engineered Fibre and Fabrics”, in USA. An Indian product patent have been filed and published.



III. CONCLUSIONS

It can be seen from the table that

1. Gradual reduction of the stress produces increase in the inverse creep values.
2. The addition of the inverse creep values is (1.30%) less than creep value (2.20%).
3. There is variation in inverse creep values.

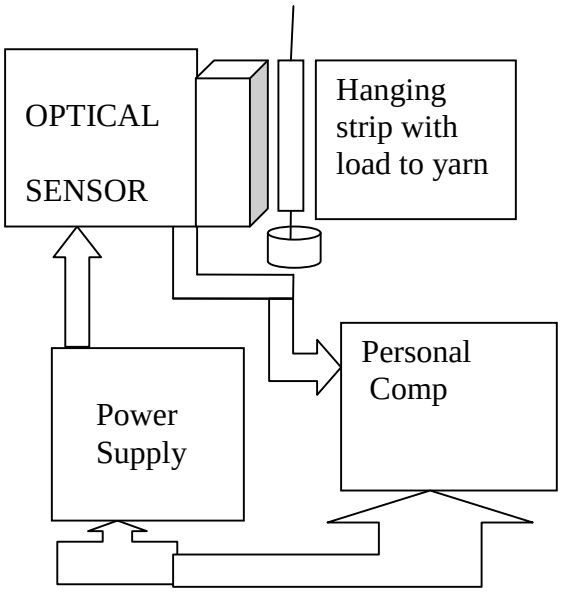
Measurement of inverse creep by Optical Instrument:

I. INTRODUCTION

The objective of the present work was to design an instrument, which can measure the instantaneous extension or contraction of the yarn by optical method. Inverse creep as well as creep behaviour of different materials can be studied by varying initial and final stress values. The instrument constitutes an IC HDNS-5008. This IC supported by some other hard ware and software by “iota measurement”. The defined distance in between the two marks on the strip. The no pixcels in between two strips are used in doing calculation of distance. The measurement of extension and contraction can be measured by this method. Automation in storing the data is achieved. Stored data can then be easily analyzed. A few textile yarns have been studied by using this device for creep and inverse creep at various levels of stress. Inverse creep and creep can be measured. This instrument can also be patented. The details of the IC and the circuit diagram are as follows:

From the above observations it is seen that the percentage inverse creep increases when the reduced stress decreases in case of all the yarns. It is evident from the results that viscoelastic materials do exhibits inverse creep and the extent of inverse creep increases as the stress is decreased. Inverse creep value is dependent on its stress history. The phenomenon of inverse creep is relatively new and has not been much studied. The author's present work is the just the beginning of this complex study. A lot more research obviously is needed to fully explore the phenomenon for different types of textile materials.

Block diagram of the Optical system:

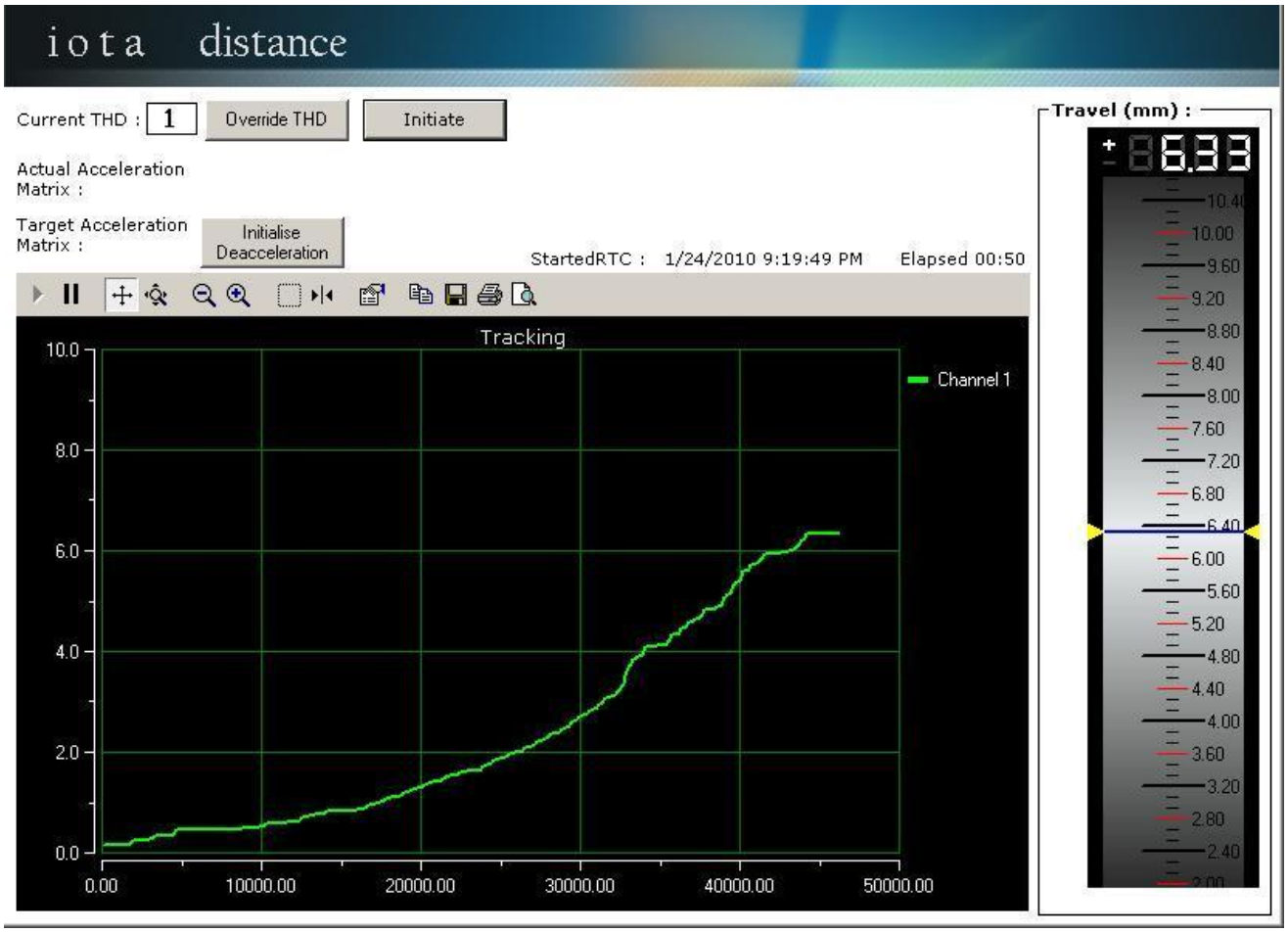


II. Experimental Procedure

The yarn is hanging to a support with a fixed load. To this only a strip has been attached. On the strip there are two marks at specific distance.(not more than 10cm) The strip is allowed to slide on the Optical eye of the optical instrument. It can record the first mark. It stores the specific no of pixels in say 5cm. The smallest extension and contraction can be recorded with the help of the sensor embedded in the IC. And on the front screen the distance and other appropriate parameters are chosen.

Automatically the extension or contraction of the yarn is recorded in the file which is being created by the software.

The graphical presentation is as follows:



III. CONCLUSIONS

1. The instantaneous extension and contraction is measured. Inverse creep and creep were measured.

2. The reproducibility of the results was observed.

   The drawbacks were

1. The range of extension cannot go beyond 10cm.

2. Software was the evaluation version cannot be further continued on the same PC for a longer time.

IV. ACKNOWLEDGEMENTS

The process of investigation of an instrument involves support of many institutes. Without their mention this work would be incomplete.

1. Central Institute for Research on Cotton Technology, Mumbai.

2. Department of Physics, R. Ruia College, Mumbai.

3. Western Region Instrumentation Center. Mumbai.

4. Tata Institute of Fundamental Research, Mumbai.

5. Department of Electronics, University of Pune, Pune.

6. Department of Electronics, K.T.H.M. College, Nasik.

References:

1. Vitkauskas A. and Matukonis A., Tech. of Textile Industry U.S.S.R. 1968, No.4 (19 – 21)

2. Vitkauskas A. and Matukonis A., Tech. of Textile Industry, U.S.S.R, 1969, No.3, (23 – 26).

3. Vitkauskas. A. and Matukonis A., Tech. of Textile Industry, U.S.S.R. 1970, No. 2, (14 – 17)

4. Nachane R.P. and Hussain G.F.S. and Krishna Iyer K. R., Textile Research Journal 1982, (483 – 484)

5. Nachane R.P. and Hussain G.F.S. and Krishna Iyer K. R., Journal of Applied Polymer Science, 1986, Volume 31 (1101 – 1110).

6. Nachane R.P. and Hussain G.F.S. Patel G. S. and Krishna Iyer, Journal of Applied Polymer Science, 1986 Volume 38, (21-28)

7. Manich A.M. and De Castellar M.D. 1992, Textile Research Journal 62 (196 – 199).

8. Vengheluwe Lieven, 1993, Textile Research Journal, 63 (552 – 556).

9. Nachane R.P., Applied Polymer Science, 1994, Volume 53, (1123 – 1124).

10. Nachane R. P. and Sundaram V.,Journal Textile Institute,1995, 86 Number 1,(10 - 19).

11. Nachane R. P. and V. Sundaram, Journal Textile Institute, 1995,86 Number 1, (20 - 32)

12. Nachane R.P, Hussain G.F.S, Indian Journal of Fiber and Textile Research, Volume 23, June 1998, (81 -84).

Statement of Expenditure Incurred on Field Work

Name of the Principal Investigator: Dr. Pratap G. Patil.

Name of the Place visited	Duration of the Visit		Mode of Journey	Expenditure Incurred
	From	to		
Bengaluru			Railway	Rs.

Certified that the above expenditure is in accordance with the UGC norms for minor research project.

Signature of the Principal Investigator.

Principal

(Seal)

Annexure – III

UNIVERSITY GRANTS COMMISION

BAHADUR SHAH ZAFAR MARG

NEW DELHI – 110 002

Annual / Final Report of the work done on the Minor Research Project.

(Report to be submitted within 6 weeks after completion of the year)

1. Project report: Final.
2. UGC Reference No.: 47-701/ 08(WRO)
3. Period of the report from: 01/04/2009 to 31/03/2011.
4. Title of the research project: Design and fabrication of an instrument which can measure the Creep and Inverse Creep of some textile yarns".
5. a)Name of the Principal Investigator: Dr. Pratap G. Patil.

   b) Department/ College where the work has progressed: Department of Physics, Ruia College, Matunga East, Mumbai-19
6. Effective date of starting of the project: 01/04/2009.
7. Grant approved and expenditure incurred during the period of the report.

   a. Total amount approved: Rs. 1,10,000/-

   b. Total expenditure: Rs. 1,13,536/-

   c. Report of the work done:

   i) Brief objective of the project: "Design and fabrication of an instrument which can measure the Creep and Inverse Creep of some textile yarns by an Optical Instrument".

   ii) Work done so far: Fabricated an Instrument which can measure the Inverse creep and Creep of some textile yarns by an Optical Instrument.

   Papers published: No Paper has been published on this work.

iii. Has the progress been according to the original plan of the work and towards achieving the objective if not state reasons?: Progress has been according to the original plan of the work and the objective.

iv) Please indicate the difficulties if any experienced in implementing the project: There is restriction in the extension length of yarn.

v) If the project has not been completed, please indicate the appropriate time by which it can be completed: Project is already completed.

vi) If the project has been completed please enclose a summary of the findings of the study. Two copies have prepared.

vii) Any other information which help in evaluation of the work done on the project: No.

Signature of the Principal Investigator Registrar / Principal.

Annexure VIII

UNIVERSITY GRANTS COMMISION

BAHADUR SHAH ZAFAR MARG

NEW DELHI – 110 002

PROFORMA FOR SUBMISSION OF INFORMATION AT THE TIME OF SENDING THE FINAL REPORT OF THE WORK DONE ON THE PROJECT

1. Name and Address of the Principal Investigator: Dr. Pratap G. Patil.
   Address: EMP 40 / 701,
   Thakur Village, Kandivali East,
   Mumbai 400101.
2. Name and Address of the Institution: R. Ruia College, L. N. Road,
   Matunga East, Mumbai 400 019.
3. UGC Approval No. AND date:
4. Date of the Implementation: 01/04/2009.
5. Tenure of the project: Two Years.
6. Total grant allocated: Rs. 1,10,000/-
7. Total grant received: Rs.85,000/-
8. Final expenditure: 1,13,000/-
9. Title of the project: “Design and fabrication of an instrument which can measure the Creep and Inverse Creep of some textile yarns by an Optical Instrument”.
10. Objectives of the project: To measure the Creep and Inverse Creep of some textile yarns.
11. Whether objectives were achieved? Yes. It can measure the Creep and Inverse Creep.

12. Achievement from the project: 1. The instrument has justified the presence of inverse creep in some textile yarns.

13.Summary of the findings:

For Nylon Multifilament Yarn:

There are two types of Nylon Multifilament Yarns which were tested. One is of Denier 70 Denier and the other is 111 Denier.

For Nylon Multifilament Yarn of 70 Denier and 24 Filaments:

(NYLON PR05 2525252517 D70F24)

EXPERIMENT NO.1

The initial load is 145.4 gm (117 + 28.4gm) gm. Table No. I give the stress history and corresponding inverse creep values at different reduced stress values.

Obs. No.	Point on Curve	Time (sec)	Load (gm)	Stress (mN / dtex)	Ext/Cont (mm)	Inverse Creep (%)
1	O	0	28.4	3.6	0	-
2	A	0.8	145.4	18.3	149.2	-
3	B	300	145.4	18.3	166.2	-1.70
4	C	300.8	120.4	15.2	160.9	-
5	D	600	120.4	15.2	159.5	0.14
6	E	600.8	95.4	12.0	153.3	-
7	F	900	95.4	12.0	151.8	0.14
8	G	900.8	70.4	8.9	138.6	-
9	H	1200	70.4	8.9	136.1	0.25
10	I	1200.8	45.4	5.7	118.9	-
11	J	1500	45.4	5.7	116	0.29
12	K	1500.8	28.4	3.6	102.4	-
13	L	1800	28.4	3.6	98.7	0.36

TABLE NO III: The stress history and corresponding inverse creep values at different reduced stress values. (*Negative sign indicates the Creep in the Yarn)

Conclusions

For few moments the pan is hanged without any load in it. A load of 117 gm is added to the pan for 300sec. So the total load is 117gm + 28.4gm = 145.4gm. The stress is 18.3 mN/dtex. Increase in load elongates the yarn. There are two parts to the extension. One is immediate extension and the other is followed by the first one and it is delayed extension. The immediate extension is 149.2mm and the delayed extension is 17mm. Hence the total extension is 166.2mm. As the contraction is considered as positive, the extension is referred as negative.

The delayed extension is called as Creep. And it is 17mm, which is 1.7%. So the creep is 1.7%

After 300.8sec, 25gm are removed from the pan. So the load is 120.4gm which is 15.2 mN/dtex. Partial removal of the stress gives rise to the sudden contraction and the delayed contraction. The delayed contraction is called as Inverse creep and it is 1.4mm, which is 0.14%.

Further 25 gm of load is removed for 3 more times and at last 17 gm of load was removed. This partial reduction gave rise to inverse creep of 0.14%, 0.25%, 0.29%, and 0.36%.

It can be seen from the table that

1. Gradual reduction of the stress produces increase in the inverse creep values.
2. The addition of the inverse creep values is (1.18%) less than creep value (1.70%).
3. There is variation in inverse creep values.

14. Contribution to the society: One can select the best quality of the yarn so that the weaving of the yarn would be of best quality and the would create best fabric material.

15. Whether the Ph.D. Enrolled/ Produced out of the project: No enrollment and no Production of Ph.D.

16. No. of publications out of the project: No publications.

Principal Investigator Registrar / Principal