DESIGN ANALYSIS OF TENSILE CREEP TESTING MACHINE

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ABSTRACT

The plan, examination, and development of a pliable downer test gadget are canvassed in this concentrate to decide the jerk bend of rapidly crawling thermoplastic polymers like Teflon and light metals like aluminum and lead. The applied burden component, the intensity move and observing, the casing, and the example handle make up the device's four principal frameworks. The warming chamber's protection is made of buffalo board, and the best temperature it can endure is 200°C. The maximum load capacity is of 40 Kg without tipping the machine. Every sample intended for the testing on the apparatus must be constructed with such a thickness of 1 mm to 3 mm, gauge length of 30 mm to 40 mm, and total length of 60 mm to 80 mm. Polypropylene material was used as the test specimen for creep tests, which were performed at varying loads and various different temperatures for a period of two hours. The results demonstrate that, at constant loads and varying temperatures, elongation increases over time while the creep rate decreases as temperature rises. Second, over a period of two hours, creep tests were performed on Polypropylene material test specimens under different strains of 1 kg, 2 kg, and 3 kg at a constant temperature of 100°C.The findings demonstrate that the extension and creep rate increase as the load is increased at fixed temperature and under varied loads. With the use of stress relaxation, these creep curves exhibit great compatibility with experimentally obtained data.

Keywords: Design, analysis, construction, Polypropylene material, tensile creep test, load mechanism, heat transfer, monitoring mechanism,

• INTRODUCTION

Creep is a phenomenon that occurs when a material undergoes progressive deformation at high temperatures and constant stress. It is primarily caused by the migration of vacancies towards grain boundaries that are oriented perpendicular to the direction of applied stress. Creep is both time and temperature dependent and is the result of the viscoelastic flow of polymer over time. Thermoplastics are known to exhibit time-dependent plasticity at elevated temperatures, typically between 0.4 and 0.5 of their melting temperature. Creep is typically divided into three stages, namely primary creep, secondary creep, and tertiary creep.

To experimentally determine the creep behavior of various materials, an electromechanical creep testing machine is used. In the past, these machines used a lever arm mechanism to apply load, but this was found to be inaccurate over longer periods of time. More recently, wire and turnbuckle arrangements have been employed to apply load more accurately. However, the manual recording of deflections by an observer still leaves room for human error, and the process can be time-consuming. To address these issues, modern creep testing machines are equipped with automated systems that can monitor load and strain with respect to time, providing more precise readings and improving accuracy.

Polypropylene is a widely used material due to its good chemical resistance and is commonly employed in applications such as food packaging, automobile battery cases, and disposable syringes. Investigating the creep behavior of polypropylene at different temperatures and loads is of practical use in improving the safety and reliability of these applications. This paper employs a tensile creep testing machine to study the creep behavior of polypropylene under varying temperature and loading conditions. By studying the tensile creep behavior of polypropylene, we can gain insight into the material's long-term stability in terms of size and load capacity, which is essential in predicting its service lifetime.

- .METHODOLOGY

Design of Machine Components

Machine Components Parts	
Components of Creep Testing Machine	
1.Base part	2. Column
	
3. Column Support Plate	4. Rectangular Top Plate
	
5. Extended Top angle	6. Bracket for Load Cell
	
7. Heating Chamber	8. Test piece grip
	
9. Load cell	10.Load hanger
	
11. Turnbuckle	12. Tension helical spring
	

Table 1: Machine Components Parts

Test Specimens

Test examples for Ductile Drag Testing Machine utilized are lead. The standard test example ought to be as "I" Area.

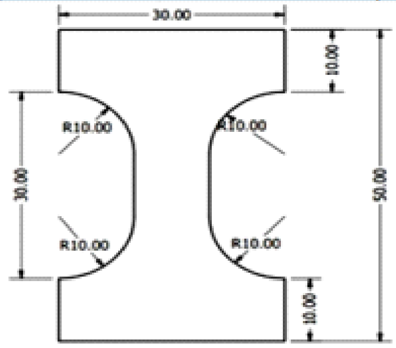


Figure 2: Test Specimens Geometry

Design Procedure

At the expected temperatures, properties like thickness (ρ), explicit intensity (Cp), warm conductivity (k), kinematic consistency (υ), and number (Pr) are taken from an information book. The test example is fixed in the grippers of the heater, which hold it during the testing time frame. The lower gripper is fixed, while the upper gripper is portable. When the test example is set up, an ideal burden is applied utilizing a turn clasp. At the point when the ideal burden is reached, the advanced temperature regulator is utilized to set the expected temperature inside the heater. Over the long run, the mix of applied temperature and burden produces creep peculiarities in the test example, which brings about prolongation of its length. At last, the external surface of the heater is thought to be at 30o C, and the actual heater is intended to arrive at a greatest temperature of 200o C.

At To=30oC.

GrL=241.62x106

(at x=L=224mm) GrLxPr = 169.37x106, Ascertaining Nusselt no, Nu=0.59x (GrLxPr)0.25 Nu=67.30

,

Nu= ,

ho= 9.00 w/m-K likewise, at Ti=200o CGrL=23.17x106, GrL*Pr=15.76x106Nu=37.17, hello =7.30 w/m-k

Ascertaining heat disseminated through mass of the heater, Where A1= 0.124m2A2=0.15m2 A3=0.164m2 K=0.087(from information book

for buffalo sheet) Qw= 60 watt, Computing heat disseminated through grippers, choosing cast steel as a material for gripper as it can

support the expected temperature, Volume=πxr2xh Where r=35x10-3m h=70x10-3m, Volume=2.69x10-4m3 , Density=7753 kg/m3

, ,

Explicit heat= 486 J/kg-KQg=mCpΔT, Accepting t=15 minutes, M= 2.31x10-3

, Qg=191.45 watt. The example to tried is in the

type of I segment.

Thusly, choosing Teflon as the material for example as its jerk temperature is 130.72oC. which is in the reach.

Adding all the intensity disseminated QT=252.25 watt, this energy is consumed by the components of the Heater; subsequently we need to

consider warming loop having wattage near the got result.

5. Plan of Turnbuckle

Stage 1:- Choice of Material for turnbuckle, Treated steel Sut = 465 MPa, Syt = 270 MPa

Stage 2:- Choosing M8 assigned Turnbuckle for Max load application, d = 8mm, dc = 6.466 mm, P= 400N

Malleable Pressure σt = 12.18 N/mm2, Torsional second Mt = 313.6N-mmshear stress, τ = 5.91 N/mm2

The chief shear pressure is given by, τ max = 8.486 N/mm2, Variable of wellbeing, f s = 15.90

The component of wellbeing is palatable. Consequently, the ostensible measurement and pitch of the strung part of the pole ought to be 8mm

what's more, 1.25 mm individually. Comparing shear obstruction of the strung to the strain in the bar, $\pi dclr$ = P, τ = 27 N/mm2

, $\pi dclr$ = P,

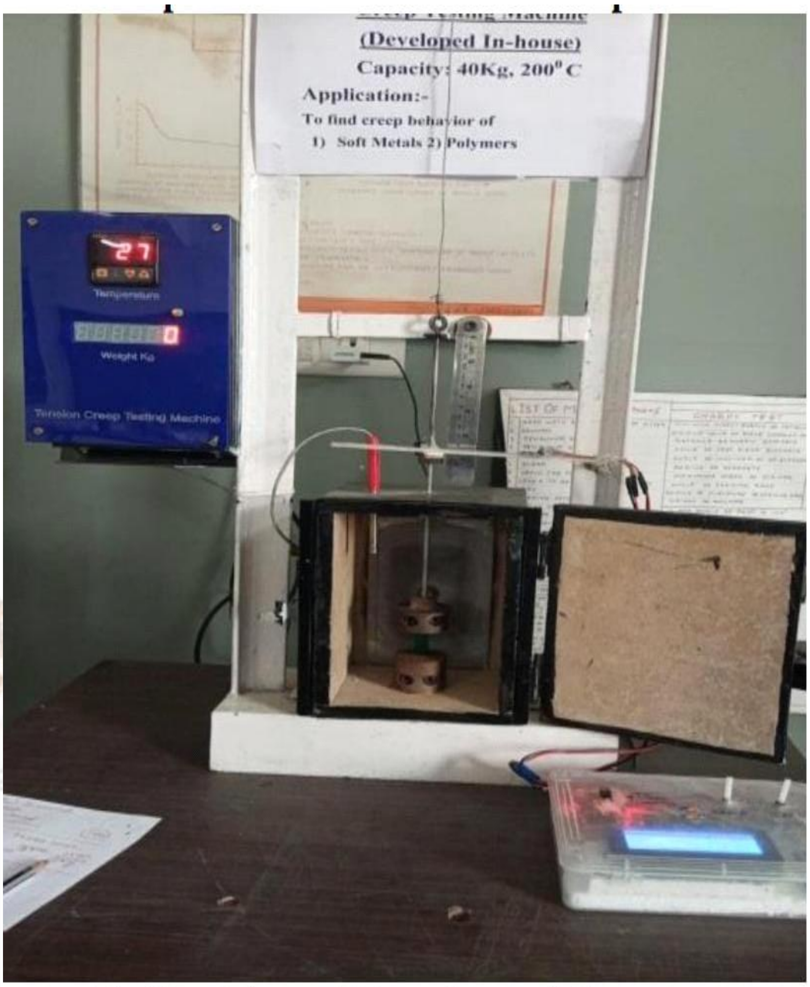
π x 6.466 x l x 27 = 400 l=0.73 m, l=d=8mm, l= 1.25d = 1.25x8, l = 10mm, expected to be as 9mm.

MODELING AND ANALYSIS

Material	Lead
Steady Temperature	70˚ C
Consistent Burden	3kg
Time (min)	Deflection (mm)
0.00	00
60	0.5
115	1.0
170	1,5
197	2.0
205	2.5
207	2.6
212	2.7

Table 1.

Figure 1: Lead Sample, Ex



Actual Experimental Setup of Creep Testing Machine

• CONCLUSION

This project's goal was to alter the tensile creep testing apparatus that a previous set of students had designed and built. Some restrictions found in the earlier machine were removed, and the machine's capacity was increased.

In order to solve the complicated engineering problem of creep behaviour including polymers like polypropylene and soft materials like lead, basic engineering knowledge of mathematics, science, engineering foundations, and engineering specialisation was applied.

The transitory steady state, rapid creep, and third phase of creep must all be analysed while studying research material. To reach meaningful conclusions, both the long-term and short-term creep behaviour of polymers were examined.

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