Creep Life Prediction of Particle Reinforce Composite Material (Al&Sic) Using Experimental Technique and Computational Method

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Abstract- **Investigation of Creep behavior for Aluminum reinforced with silicon carbide whiskers material using dynamic mechanical analyzer (DMA) since it is a metal matrix composite temperature sweep methodology is applied for various stress levels and the results thus obtained from the experiment are compared with finite element methods and it was found that the results have been in close agreement**

Index Terms- **Creep behavior, Creep in Metal Matrix Composite**

1. INTRODUCTION

Creep in a material occurs when it is subjected to constant stress at elevated temperatures results in the permanent deformation of the material. Automotive components, gas and steam turbines, and other products that operate at high temperature are subjected to creep. The lifetime of these components depends on thermal and mechanical loading. The creep damage can no longer be neglected when the loading temperature exceeds the creep temperature typically determined as 0.4 times the melting temperature of the material. Thus one of the critical factors in determining the lifetime of components is also their creep resistance. Due to the thermal loads materials slowly but constantly creep even at low mechanical loading, so rupture is possible. Rupture can be defined by some limit value of strain. It can be shown that the creep damage is determined by knowing the time to rupture depending on stress level and temperature.

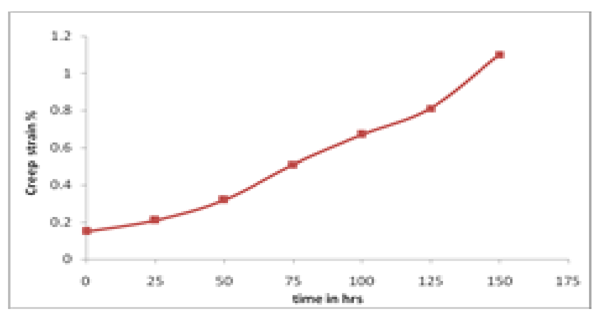
2. EXPERIMENTAL PROCEDURES

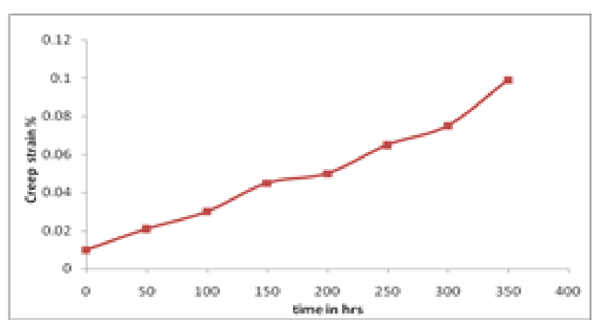
Dynamic Mechanical Analysis, otherwise known as DMA, is used to test the creep behaviour of the aluminium silicon carbide specimen of length (L)=75mm, Width (W) =12.5mmThickness (T) =3.5mm with temperatures ranging from 58-244C^0,and experimental creep values are tabulated as shown below

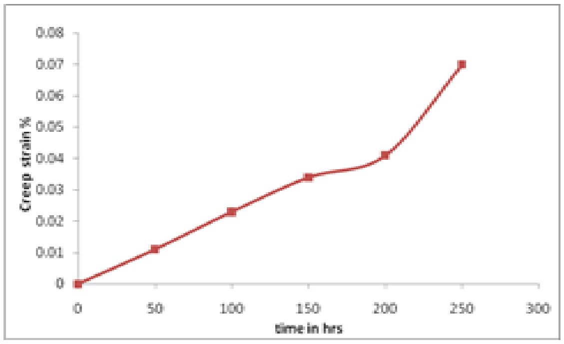
Stress (MPa)	Temperature(C^0)	Time (hrs)	Creep strain(%)
58	253	143	0.980
74	201	311	0.089
197	150	211	0.059
227	125	199	0.030
244	176	299	1.99

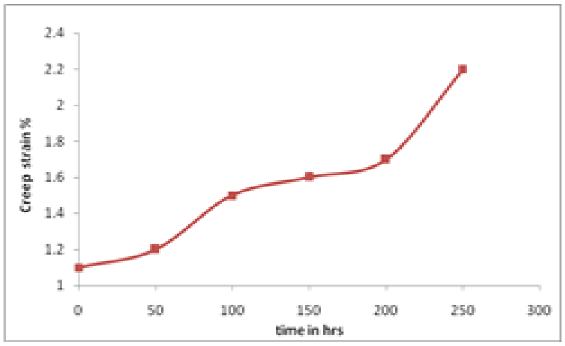
Table 1.0 . Creep data for Aluminium and Silicon Carbide Composite

3. EXPERIMENTAL RESULTS









4. FINITE ELEMENT ANALYSIS RESULTS

For analysis of creep in Ansys solid 185 element is selected and properties of Aluminum and silicon carbide composite has been established. Three dimensional model of rectangular specimen was developed and has been meshed using mesh tool.

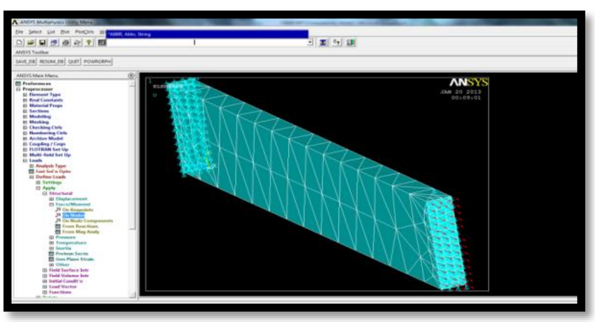
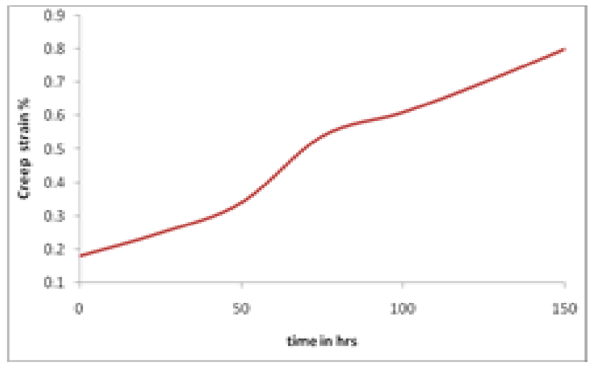


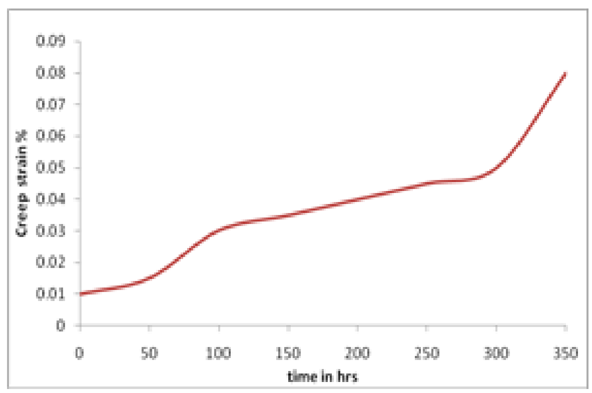
Fig 4.6 Constraints and loading of the specimen

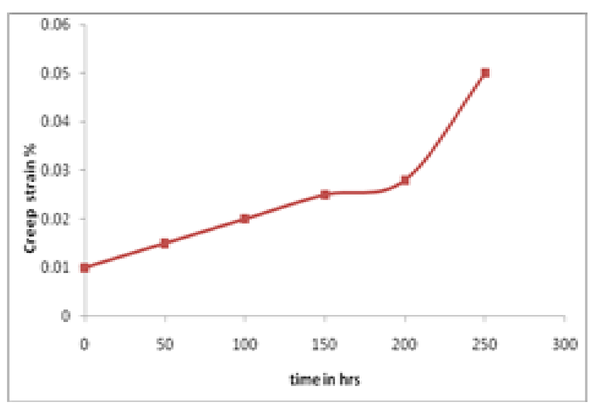
The numbers of elements generated are 1908and the numbers of nodes are 7375

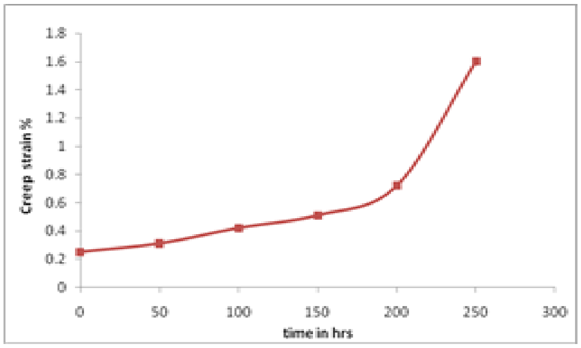
5. RESULTS AND DISCUSSION

The creep analysis of the particle reinforced composite (Aluminium and silicon carbide whiskers) specimen at various stress levels and temperatures has been carried out using FEM. Analyzing the results it is observed that maximum creep strain percentage is found to be 1.56 at stress level of 244Mpa and temperature of 176 °C and time of 219hrs. The creep strain percentage induced in the material at stress level of 74Mpa and temperature 201°C and time 311 hrs is 0.06 which is shown in figure 5.5 and creep strain percentage of 0.76 has been observed in the material when subjected to stress level of 58Mpa and temperature of 253°C at time 143 hr which is shown in the figure 5.6. FEM and Experimental results of creep strain percentage of the material at stress levels of 58Mpa, 74Mpa, 197Mpa, 244Mpa and temperatures of 253°C, 201°C, 182°C, 125°C, 176°C is shown through the figures 5.1-5.4 and 5.7-5.10 respectively.









CONCLUSION

Experimental and Computational methods for the creep life assessment of particle reinforced composite (Aluminium and silicon carbide whiskers) and the following conclusions are drawn

- It can be concluded that for the particle reinforced composite material as the temperature increases creep strain also increases.
- It can be concluded that for particle reinforced composite materials with the increase in the temperature creep resistance decreases and vice versa.
- It can be concluded that creep analysis of particle reinforced composite material (Aluminium and silicon carbide whiskers) exhibits primary creep stage significantly over longer times.

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