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STRENGTH DETERMINATION OF ALUMINIUM AT DIFFERENT TEMPRATURES

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Abstract

The necking of specimen is specifically related to the decrease in cross section when specimen is subjected to tensile strength greater than ultimate tensile strength (UTS). The strain distribution no longer hold uniform along the gauge length. As the tensile load is applied, due to which length of specimen increases but there is decrease in cross section.

The present work laid stress on determining the tensile properties from stress strain curve by tensile testing of aluminium (specimen) at different range of high temperature The tensile testing is carried out on INSTRON static series 600 KN. The specimens were tested at different range of high temperature (Room Temperature - 325 degree Celsius). True Stress and strain is calculated using the engineering equation. Using the values of true stress and true strain the true stress strain curve was plotted. The polynomial equation is obtained from each specimen curve. The graph is plotted between temperature and ultimate tensile strength (UTS) which indicates that the ultimate tensile strength decreases with the increase in temperature.

Keywords: *Tensile test, KN model, Polynomial Equation and its interpretation with temperature.*

Introduction

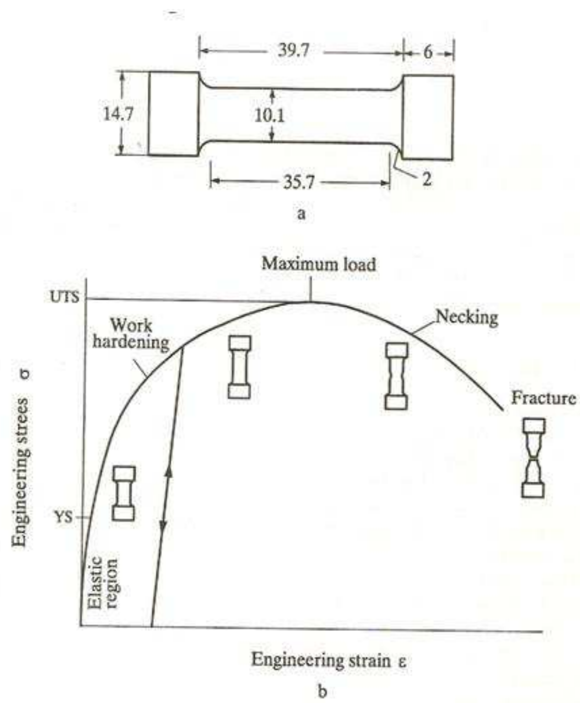
The tensile properties of Al, Cu, stainless steel and its alloy examined in the high temperature the need for materials with useful strength above 1600k has stimulates the interest in refractory alloys .Cast aluminium alloys have found wide application to manufacture lighted-weight components of complex shape in automotive and aerospace industries. To improve the strength and ductility of cast aluminium alloys, it is necessary to study their fracture properties by conducting a series of tests.

The tensile properties of Al are strength ductility creep. the temperature range of 37ºC to 350ºC That temperature is maintain inside furnace . tensile testing of aluminium with high temperature in INSTRON static series. The aluminium is tested with different temperature range we have taken the range 37ºC(room temp.),90,130,170,210, 250,290,325ºC

The Tensile Test

The engineering stress-strain curve Specimens used in a tensile test are prepared according to standard specifications. The test pieces can be cylindrical or flat. Figure S.la shows the standard dimension of a typical cylindrical specimen. It is gripped at the two ends and pulled apart in a machine by the application of a load. The stress-strain curve obtained from the tensile test of a typical ductile metal is shown in Fig. On the y-axis, the engineering stress, defined as the load P divided by the original cross-sectional area Ao of the test piece, is plotted. The engineering strain E, defined as the change in length 1L divided by the initial gauge length La is plotted on the x-axis. The % elongation is obtained by multiplying the engineering strain by 100.

The stress-strain curve starts with elastic deformation. The stress is proportional to strain in this region, as given by Hooke's law. At the end of the elastic region, plastic deformation starts. The engineering stress corresponding to this transition is known as the yield strength (YS), an important design parameter.



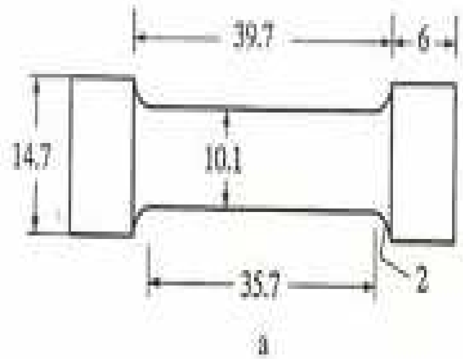
The tensile test: (a) a standard cylindrical test specimen (dimensions in mm), and (b) the engineering stress-strain curve.

Many metals exhibit a continuous transition from the elastic region to the plastic region. In such cases, the precise determination of the yield strength is difficult. A parameter called proof strength (or offset yield strength!
that corresponds to a specified permanent set is used. After loading up to the proof stress level and unloading, the specimen shows a permanent elongation of 0.1 or 0.2%. The stress-strain curve has a positive slope in the plastic region, indicating that the stress required to cause further deformation increases with increasing strain, a phenomenon known as work hardening or strain hardening. If the load is removed when the specimen is in the plastic region, it retraces a straight line path parallel to the initial line and reaches zero stress at a finite value of permanent elongation, see Above fig. Thus, the elastic part of the deformation is recovered. On reloading, plastic deformation starts only on reaching the stress level prior to unloading.
The engineering stress reaches a maximum and then decreases. The maximum value is known as the ultimate tensile strength (UTS) or simply the tensile strength Up to the UTS, the strain is uniformly distributed along the gauge length .Beyond UTS, somewhere near the middle of the specimen, a localized cease in cross-section known as necking develops. Once the neck forms, further deformation is concentrated in the neck. The strain is no longer uniform along the gauge length. The cross-sectional area of the neck continuously decreases, as the % elongation increases. Voids nucleate in the necked region at the interface of hard second-phase particles in the material. These voids grow and coalesce, as the strain increases. The true cross-section bearing the a C becomes very small, as compared to the apparent cross-section, due to the growth of these internal voids. At this stage, the specimen may fractural shows that ductility measured in terms of the true strain at fracture ec below for definition of true strain) decreases with increasing concentration

EXPERIMENTAL PROCEDURE

Specimen Preparation

Before performing the test Specimen of standard size and shape must be produced from the material to be tested for the result to be comparable. It is strongly advised to manufacture .the specimen size and shape according to standard. We are using the round test bar .Round test bar are used for sheet/plate with thickness. We are show the standard size specimen



Experiment

SATEC Series KN Model Universal Testing Machines

This machine is designed for the high capacity tension test compression bending test and shear testing .the main design of the KN Model provides the ultimate in versatility. We are using for tensile test with high temperature

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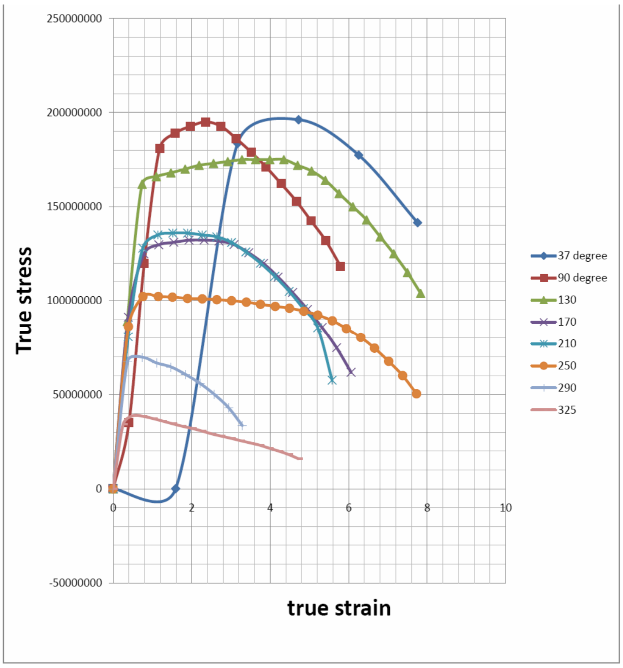
Specimen Used

All aluminium specimen

Result and Discussion

After the graph is plotted between the true stress strain for each specimen, now we are plotting the combined graph for all 8 specimens. This graph is between true stress and strain . this graph is shown for different temperature of each specimen. The temperature is 37,90,130,170,210,250,290,325ºC.

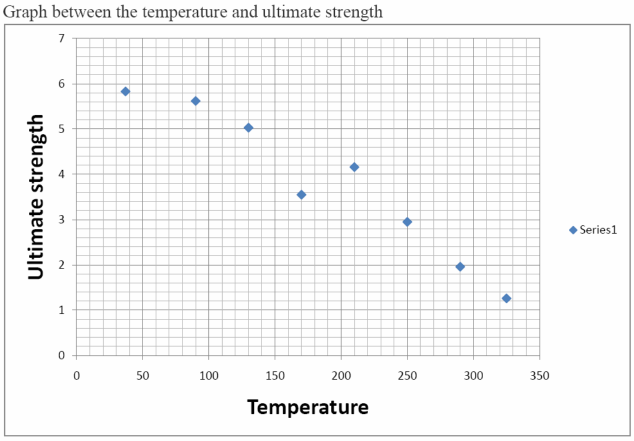


Ultimate Strength

Now we are find out the ultimate tensile strength (UTS) for each specimen . then we are plotted the graph between the different range of temperature and ultimate tensile strength. The value of ultimate strength is given below

Temperature	Ultimate Strength
37	5.83
90	5.62
130	5.03
170	3.55
210	4.16
250	2.95
290	1.96
325	1.26

Graph between the temperature and ultimate strength



Polynomial Equation

The polynomial equation is found out off each specimen of different temperature. When the polynomial equation find out then we are representing these equation in standard form (Y=Ax2+Bx+c). Then we have determine the value of A, B and C .

After find out the value of A, B and C we can plotted the graph between the temperature and A, B and C.

Standard form of polynomial equation Y=Ax2+Bx+C .

1.) $\sigma=- 8E+06\epsilon2+8E+07\epsilon+2E+06$

2.) $\sigma=-2E+07\epsilon2+1E+08\epsilon+3E+07$

3.) $\sigma=-6E+06\epsilon2+5E+07\epsilon+8E+07$

4.) $\sigma= -9E+06\epsilon2+6E+07\epsilon+6E+07$

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5.) σ= -1E+07ϵ2+7E+07ϵ+5E+07

6.) σ= -4E+06ϵ2+3E+07ϵ+6E+07

7.) σ= -2E+07ϵ2+5E+07ϵ+3E+07

8.) σ= -3E+06ϵ2+1E+07ϵ+2E+07

The graph is plotted between the temperature and A, B and C

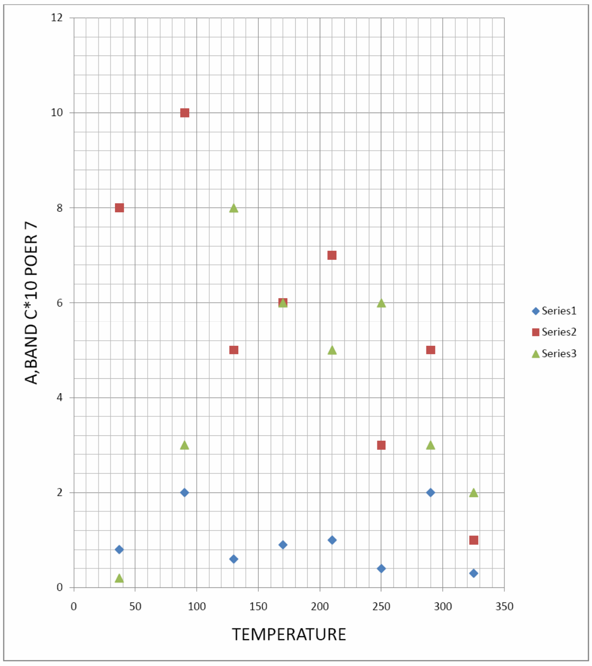
temperature	A	B	C
37	- 0.8E+07	8E+07	0.2E+07
90	-2E+07	10E+07	3E+07
130	-0.6E+07	5E+07	8E+07
170	-0.9E+07	6E+07	6E+07
210	-1E+07	7E+07	5E+07
250	- 0.4E+07	3E+07	6E+07
290	-2E+07	5E+07	3E+07
325	-0.3E+07	1E+07	2E+07

Tabulatin of A,B and C

The value off A is given belo and multiply of 10^7 such that B value is following . and also value of C .

temp.	A	B	C
37	0.8	8	0.2
90	2	10	3
130	0.6	5	8
170	0.9	6	6
210	1	7	5
250	0.4	3	6
290	2	5	3
325	0.3	1	2

The graph is plotted between the A,B,C and the temperature . the series 1 is coefficient of x^2 and B is coefficient of x and C is coefficient of x^0.



Polynomial Equation with Temperature

We have find out eight polynomial equation for each specimen.Now we assume the basic polynomial equation is room temperature (40ºC) specimen. We can drive that equation form of temperature,and find out the each specimen equation for different temperature. The temperature is first one is Room temperature 37,90,130,170,210,250,290,325ºC.

The basic equation:

$$\sigma = -8*10^6\epsilon^2*p^{(T-40)}+8*10^7\epsilon*q^{(T-40)}+2*10^6*r^{(T-40)}$$

equation no. 1

$$\sigma = - 8E+06\epsilon^2 *p^{(T-40)} +8E+07\epsilon*q^{(T-40)} +2E+06*r^{(T-40)}$$

equation no. 2.

The above both equation are same

Now find out the value of p , q and r for each specimen.The temperature range of 37, 90, 130, 170, 210, 250, 290, 325ºC . We have put the value of temperature in the equation and find out the next specimen polynomial equation. The value of p , q and r we are assume the value of these parameter p, q and r.The value of like 1.1, 1.4, 1.35, 1.25, 1.5, 1.45, 1.3 etc. and

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	Specim.2	Specim.3	Spec.4	Spec.5	Spec.6	Spec.7	Spec.8
Temper. Degree Celsius	90	130	170	210	250	290	325
p	1.1	1.4	1.35	1.25	1.5	1.45	1.3
q	1.02	1.05	1.25	1.3	1.4	1.09	1.08
r	1.5	1.6	1.8	1.5	1.9	1.7	1.9

After put the value of different temperature we found the polynomial equation. This equation like the original equation but not the same. The difference is not so much brtween the original equation value A,B and C and this equation value A1,B1 andC1.

Conclusion:-

1) The characteristic commercially available aluminium at different high temperature is tested to determine its suitability to be used at elevated temperature.
2) It is seen that as the temperature increases the ultimate tensile strength decreases but the ductility increases.
3) A polynomial equations in the form a
$\sigma=A\epsilon 2*p(T-40)+B\epsilon*q(T-40)+C*r(T-40)$
Is prepared to predict the behaviour of aluminium at different
high temperature (room temperature to 325ºC) .

References :-

[1]Dr.(Proff.)AbdulMubeen,Material Science.Strength of Materials
[2].M. Radovic M. W. BarsoumT. El-Raghy J. Seidensticker and S.Wiederhorn Tensile properties of Ti3SiC2 in the 25–1300°C temperature range. Department of Materials Engineering, Drexel University, Philadelphia, PA 19104-2875, USA National Institute of Standards and Technology, Gaithersburg, MD 20899, USA (2000)
[3].J.O˜noro M.D. Salvador, L.E.G. Cambronero High-temperature mechanical properties of aluminium alloys reinforced with boron carbide particles Dept. Ingeniería y Ciencia de los Materiales, ETSI Industriales, Universidad Politécnica de Madrid, c/José Gutiérrez Abascal 2, 28006 Madrid, Spain
[4] H. Lianxi, L. Shoujing, H. Wencan, Z.R. Wang, J. Mater. Proc. Technol. 49 (3– (1995) 287–294.
[5] A.K. Ghosh, Fundamentals of Metal-Matrix Composites, Butterworth, London, 1993.
[6] S.V. Kamat, J.P. Hirth, R. Mehrabian, Acta Metall. 37 (9) (1989) 2395–2402.
[7] C.H.J. Davies, N. Raghunathan, T. Sheppard, J. Mater. Sci. Technol. 8 (1992) 977–984
[8] Y. Kun, V. Dollhopf, R. Kochendörfer, Compos. Sci. Technol. 46(1993) 1–6.