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STUDIES ON ULTIMATE TENSILE STRENGTH AND HARDNESS OF 7075 (Al-Zn-Mg) ALLOY SUBJECTED TO RETROGRESSION AND REAGING HEAT TREATMENT

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ABSTRACT

Aluminium alloys are the lighter metals compared to the other types. It has the high strength to weight ratio relatively to low density. Therefore this alloys are extensively used in the aircraft industries and now a days in the automobile industries. The Aluminium Alloy (AA) 7××× series of alloys developed in recent years are high strength alloys. The properties of these alloys can be further improved by subjecting them to Retrogression and Reaging (RRA) treatment.

Key Words: Retrogression and Reaging (RRA), Aluminium Alloy (AA) 7×××

I. INTRODUCTION

The Aluminium Alloy (AA) 7××× series available in wrought condition is first homogenized to obtain uniform phase composition in the alloy. Then the alloy is subjected to convectional solutionizing and resistance furnace to a temperature of 4600 C and held at this temperature for 3 hours followed by slow cooling back to the room temperature. This results in relieving residual stresses in material and achieving uniform phase composition through the material.

age hardening treatment. Subsequently, retrogression i.e., resolutionizing the alloy at selected temperatures and times followed by reaging is done to complete the heat treatment. The specimens are then subjected to mechanical testing namely tensile test and hardness test.

II. METHOD AND MATERIAL

The material selected is composition of Al-Zn-Mg (7075) alloy . From the investigation of raw material by the method of chemical analysis the composition found are Cu 1.53%, Mg 2.36%, Si 0.04%, Fe 0.10%, Zn 5.88%.

III. THE METHODS FOLLOWED

Homogenization

The Wrought raw material obtained in the form of semi circular block of radius 97.5 mm and thickness of 78 mm , these blocks has to be subjected to homogenization by slow heating in a electric

Specimen Details

The tensile specimens of gauge length 16mm and gauge diameter of 4 mm is of 20 numbers been machined from the semi circular block as shown in fig. 1 . The hardness specimen of 100 mm diameter disc of thickness 8 mm has been machined from the raw material semicircular block as shown in fig .2.



Fig .1 Sample of tensile test specimen



Fig .2 Sample of hardness Specimen

Solution Heat Treatment

All the specimens homogenized were heated in air circulating furnace at 460°C for a period of 2 hours. Before this the furnace has been stabilized at 460°C and specimens are kept in the furnace for a free time of 20 mins. Then the specimens are then cooled by water quenching to room temperature.

Age Hardening

The specimens which are subjected to solution heat treatment have undergone precipitation heat treatment.

Partial Resolutionisation

The process in which the specimens are reheated at a temperatures of 140°C , 160°C , 180°C , 200°C , 220°C for a period of 3 minutes, 7 minutes, 11 minutes and 15 minutes and then cooled by quenching it in water to room temperature.

Reaging

The partial resolutionized specimens are then aged at 120°C for the period of 24 hours in an air circulating furnace.

IV. RESULTS AND DISCUSSIONS

Ultimate Tensile Strength

The ultimate tensile strength for retrogression specimen at different temperatures such as 140°C , 160°C , 180°C , 200°C and 220°C for different RRA time at 3 mins, 7 mins, 11 mins, 15 mins as shown in fig .3. This test has been carried out on PC 2000 machine The ultimate tensile strength is highest at 140°C for 3 mins. Where as the least value of UTS is at 220°C for 11 mins. Further, it is observed that the least value for all UTS is for 220°C at 7 mins and 11 mins . At 15 mins the least value of UTS is for 160°C .

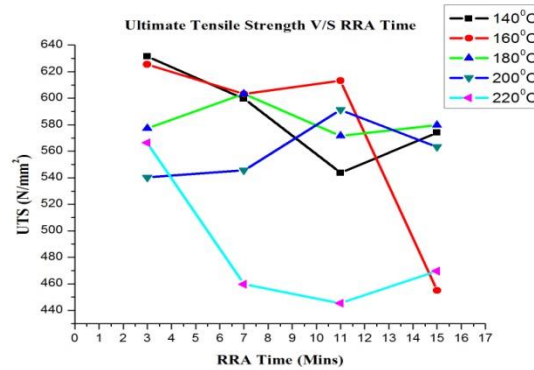


Fig .3 Graph of RRA Time (3mins, 7 mins, 11 mins, 15 mins) v/s Ultimate Tensile Strength of Al-7075 alloy

Proof Stress

The proof stress for retrogression specimen at different temperatures such as 140⁰ C, 160⁰ C, 180⁰ C, 200⁰ C and 220⁰ C for different RRA time at 3 mins, 7 mins, 11 mins, 15 mins as shown in fig .4. The proof stress V/s RRA time graph is as shown in fig .3. It can be seen that the highest value of proof stress remains at 140⁰ C for 7 mins and lowest value is at 220⁰ C for 7 mins. It has been noticed that the lowest value of proof stress remains at 220⁰ C. Other values remains in clusters.

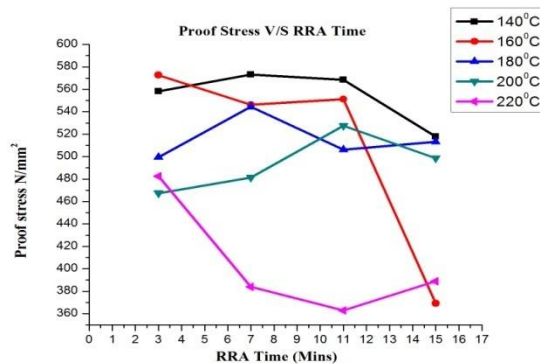


Fig.4 Graph of RRA Time (3mins, 7 mins, 11 mins, 15 mins) v/s Proof Stress of Al-7075 alloy

Hardness Value

The hardness value for retrogression specimen at different temperatures such as 140⁰ C, 160⁰ C, 180⁰ C, 200⁰ C and 220⁰ C for different RRA time of 3 mins, 7 mins, 11 mins, 15 mins as shown in fig .5. The hardness test has been carried out on Rockwell hardness machine of B- type The hardness value remains highest for 220⁰ C at 15 mins. For 220⁰ C at 3mins the hardness value remains the least, for other temperatures hardness value remains in clusters . The hardness value is somewhat comparably closer to zero retrogression time or T-6 condition.

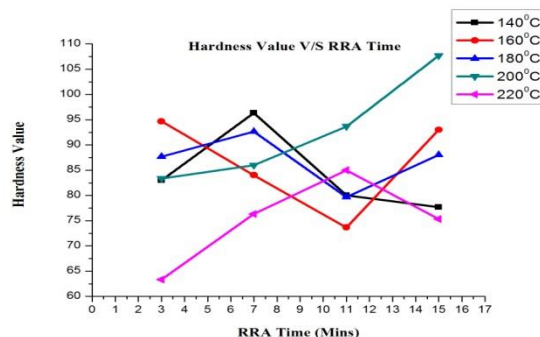


Fig. 5 Graph of RRA Time (3mins, 7 mins, 11 mins, 15 mins) v/s Hardness Value of Al-7075 alloy

Percentage Of Elongation

The variation of percentage of elongation with RRA time for different temperatures such as 140⁰ C, 160⁰ C, 180⁰ C, 200⁰ C and 220⁰ C are as shown in the fig 6. The percentage of elongation of specimen is highest for 180⁰ C at 7 mins and lowest percentage of elongation is for 220⁰ C at 11 mins, the remaining values of percentage of elongation are in the cluster and are nearer to that of the T-6 condition specimens.

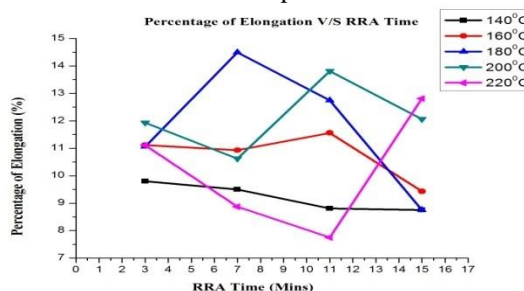


Fig.6 Graph of RRA Time (3mins, 7 mins, 11 mins, 15 mins) v/s Percentage of Elongation of Al-7075 alloy

V. CONCLUSION

It has been noted that after retrogression and reaging heat treatment the ultimate tensile strength , hardness value and proof stress slightly reduces at 220⁰ C. The highest value of ultimate tensile strength remains at 140⁰ C and hardness value remains at 220⁰ C . The percentage of elongation highest value remains at 180⁰ C for 7 mins and lowest value at 220⁰ C for 11 mins. There is not much changes in the ultimate tensile strength compared to T-6 treated specimens except for some two cases and hardness value has been retained to some extent compared to T-6 conditioned specimens.

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