# STUDIES ON WEAR PROPERTIES OF 7075 (Al-Zn-Mg) ALLOY SUBJECTED TO RETROGRESSION AND REAGING HEAT TREATMENT

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## Introduction

Precipitation is one of the well-known method to improve the hardness, proof strength and ultimate tensile strength of various alloys, Retrogression and reaging (RRA) is a relatively new type of heat treatment applicable to certain precipitation hardenable aluminium alloys. It can be applied to high strength 7xxx series, i.e. Aluminium-zinc-magnesium alloys to improve the combination of strength and resistance to stress corrosion cracking. The problem with 7xxx series alloys is that they are very much susceptible to stress corrosion cracking when aged to maximum strength temper T6. The alloy has to be over aged to T7 to produce acceptable stress corrosion cracking resistance. Unfortunately, it lowers the strength. The RRA treatment consists of solution heat treatment, quench to room temperature, age hardening, retrogression and reaging.

## Experimental

In the present investigation, Aluminium-zinc-magnesium alloy (7075) was selected. This alloy contains 6.131% Zn, 2.135% Mg, 1.895 % Cu, 0.214% Mn.

## Heat Treatment

**Various steps in heat treatment are as follows :**

- Homogenization
- Solution heat treatment.
- Age hardening / Precipitation hardening
- Partial resolution treatment
- Reaging.

## Homogenization

Firstly the material is in as rolled form is subjected to homogenization treatment. Here the material is heated to 450°C for 3 hours and the material is allowed to cool in the furnace. This treatment is done so as to relive all residual internal stresses caused due to rolling and also to obtain a fine microstructure.

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**Solution heat treatment :** Here the specimens were heated to 465°C in a muffle type heat treatment furnace and soaked at this temperature for the duration of 2 hours. The specimens were then quenched into water at room temperature to retain the solid solution.

**Age hardening/Precipitation hardening:** In this process, specimens that were solutionised were subjected to precipitation heat treatment. the specimens were aged at 120°C for durations of 24 hours.

**Partial resolutionisation** : Here the specimens were reheated to selected temperatures of 200°C, 220°C, 260°C and 280°C for time duration 5 minutes and 10 minutes and were quenched in water at room temperature to achieve partial resolutionizing.

**Reaging** : The partial resolutionised specimens were aged at 120°C for 24 hours.

## Testing :

Hardness of the specimens were determined by Vicker's hardness test, wear tests were conducted on pin on disc type of wear resistance tester for a test duration of 20 min in order to evaluate wear resistance of the specimens.

## Results & Discussion :

Fig.1 shows the variation of Vickers' hardness for retrogresion (at 200°C, 180°C and 160°C) and reaged specimens at various retrigression times. The hardness initially increases from 205 VHN for T6 treated specimens (zero retrogression time) upto a retrogression time of about 15 min and decreases later on upto a retrogression time of 40min, where the hardness value is somewhat closer to that at T6 condition.

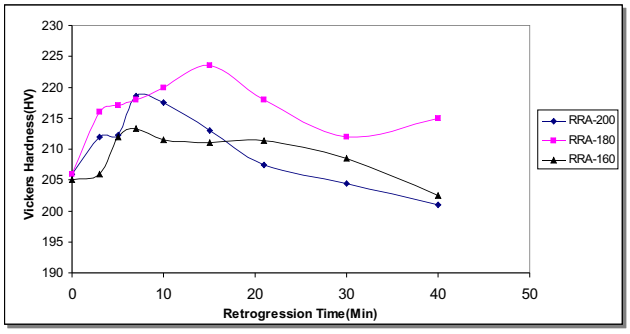


**Fig.1 Vickers hardness profile for Retrogression (at 200°C, 180°C & 160°C) and re-aged specimen at various Retrogression times**

Thus the hardness of age hardened specimens decreases marginally after subjecting them to retrogression and reaging treatment. Decrease in hardness can be attributed to the coarsening of grain boundary precipitates

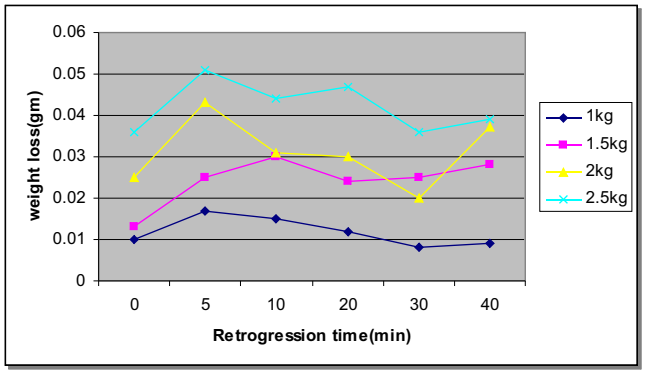


**Figure: 2 Variation of Weight loss Vs retrogression time of the Al-7075 when subjected to RRA at200$^0$C, by varying weight.**

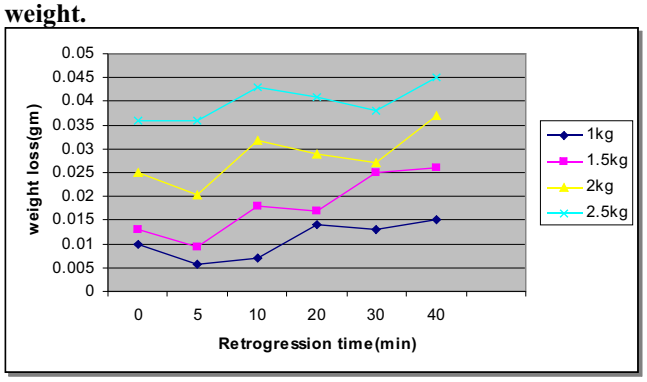


**Figure: 3 Variation of Weight Loss Vs Retrogression Time of the Al-7075 when subjected to RRA at 180$^0$C, by varying weight.**

Fig.2 & 3 shows the variation of weight loss (after a test duration of 20 min) with retrogression time for various loads, for specimens subjected to RRA at 200$^o$C and 180$^o$C respectively. At all loads with weight loss in retrogressed specimens are comparable to that obtained for T-6 condition (zero retrogression time).

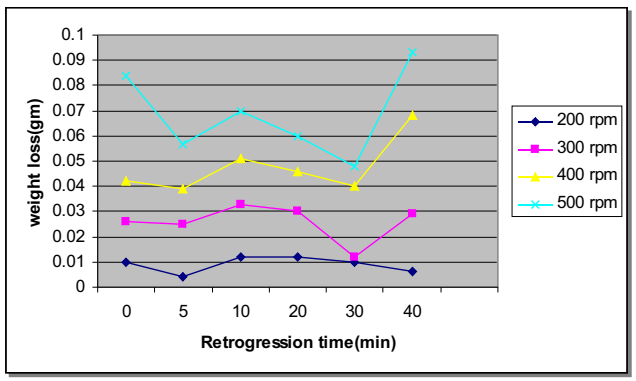


**Figure: 4 Variation of Weight loss Vs Retrogression Time of the Al-7075 when subjected to RRA at200$^0$C, by varying RPM**

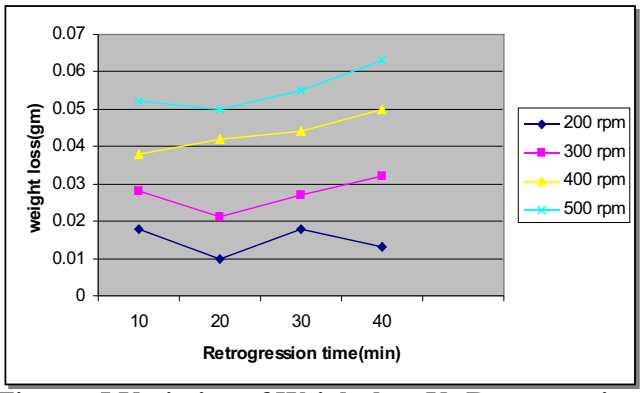


**Figure: 5 Variation of Weight loss Vs Retrogression Time of the Al-7075 when subjected to RRA at 180 $^0$C, by varying RPM**

Fig.4 & 5 shows that the variation of weight less (after a test duration of 20 min) with retrogression time for various speeds, for specimens subjected to RRA at 200$^o$C and 180$^o$C respectively. Here again the weight loss in retrogressed specimens are comparable to that obtained for T6 condition (zero retrogression time).

## Conclusions

It is reported in the literature that after retrogression and reaging treatment, UTS & hardness reduces slightly. However the resistence to stress corrosion cracking improves. The wear resistance of specimens is comparable to that obtained in specimens after T-6 treatment, indicating that eventhough retrogression treatment brings down UTS and hardness of the specimens compared to T-6 treated specimens, the wear resistance of the specimens is retained after retrogression treatment.

## References :


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