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Study of Mechanical Properties of as Drown and artificially aged Brass (Cu-39Zn-3.2Pb) alloy.

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Abstract: The mechanical properties of as rolled brass alloy (Cu-39Zn-3.2Pb-0.86Fe-0.55Sn) was investigated in as rolled and cast-aged at 1hr, 3hr and 5hr condition such as, tensile strength, hardness and impact test was performed. The alloy was solutionized and then heat treated at 215ºc. It was noticed from the study, the ultimate tensile strength and the percentage of elongation of the alloy was improved with the heat treatment, where as the hardness and the impact strength of the alloy will not show the much change with the artificial aging.

Key words: alloy, artificial aging, solutionizing, ultimate strength.

1. Introduction.

Brass is the alloy formed with the major contribution of copper and zinc, other impurities such as Pb, Fe, Sn, Ni. The desired mechanical, electrical and chemical properties of the alloy are achieved by varying the proportion of the alloy. Brass alloys are having verity of applications.

The presence of copper which enables the alloy with wider range of applications buy artificial aging[1]. In most of the non ferrous metal application the brass will also be used such as civil engineering, aircraft industry, electric industry, chemical industry, musical instruments and many more due to its considerable ductility and corrosion resistance with good costing characteristics the presence of zinc more than 45% by weight in the alloy will leads to the highly brittle metal so the solely the mechanical properties are depends upon the zinc percentage in the alloy, at high temperature the ductility of the alloy drops due to the sliding of grain boundaries and precipitation[2]. Around 50% decrease in ultimate tensile strength of Cu-Zn alloy was observed with increasing the test temperature at around 250ºC to 450°C[2]. The microscopic cavities are formed around the inclusions with the precipitation on the grain boundaries are also the other reason for the ductility drop[3,4]. The tensile strength of brass alloy usually in the range of 250 to 500Mpa with the modulus of elasticity of 82 to 117 Gpa, the brass alloy are having a lower melting point around 940ºC which vary with its composition the density of this alloy is 8.4 gm/cm^3[5] with non magnetism[6] due to properties like this the alloy is having applications in low pressure valves, architectural frames, gear, plumbing pictures, bearings and decorative hardware[7].

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2. Experimentation:

As rolled brass alloy bars are machined into a tensile test specimen according to a ASTM 8E standard and are subjected to heat treatment at 215ºC for 1hr, 3hr and 5 hr. followed by solutionizing at 450°C then these specimens are subjected to a tensile test on universal tensile testing machine UTE- 40. The solutionizing and artificial aging are achieved by using a muffle furnace having a temperature accuracy of 3ºC.

2.1 Hardness test:

The hardness test was carried out as for rolled and treated(1hr,3hr and 5hr) brass alloy. A Brinell hardness test accessory of mensanto house field Tensometer experimental setup was used to perform the hardness test the corresponding BHN value was calculated by using the following formula with the applied load of 250 kg and ball diameter of 5 mm.

$$BHN = \frac{2P}{\pi D[D - \sqrt{D^2 - d^2}\,]}$$

Figure 1: hardness testing device

Where p – load applied

D – Diameter of the indenter.

d – Diameter of impression.

2.2. Impact test

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The impact test is performed to inorder to evaluate the toughness, notch sensitivity and the impact strength of the engineering materials. charpy and izod test was performed for 1 hour, 3 hour and 5 hour aged samples with v-notch test on impact test setup of AIT-300EN, Charpy and Izode test specimen dimensions ar shown in figure 1and the position of specimen held during the test is shown in fig 2.

Fig : 1. Charpy and Izode test specimen

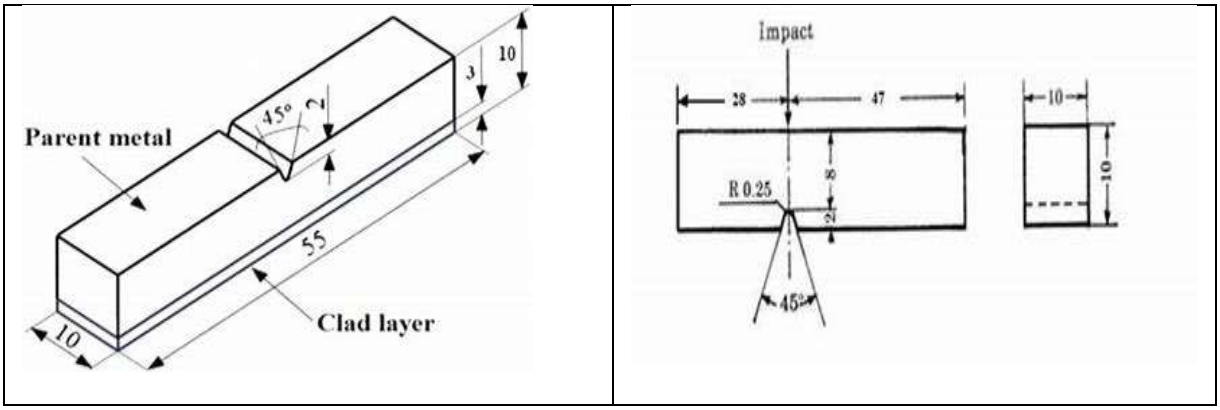
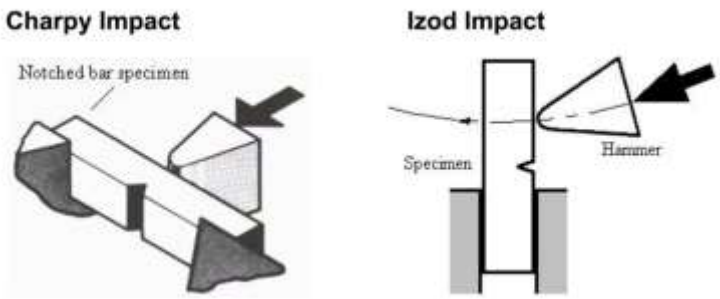


Fig : 2 Position of test specimens held during the impact test.



2.3 Tensile test: Tensile test was performed for the Brass alloy as rolled and heat treated of 1hr, 3hr and 5hr aged conditions. Universal testing machine of capacity of 400N UTE-40 was used to conduct the test, the as rolled bars of brass alloy are turned in to tensile test specimens according to ASTM E8 standard and are solutionized and then heat treated at different ageing time.

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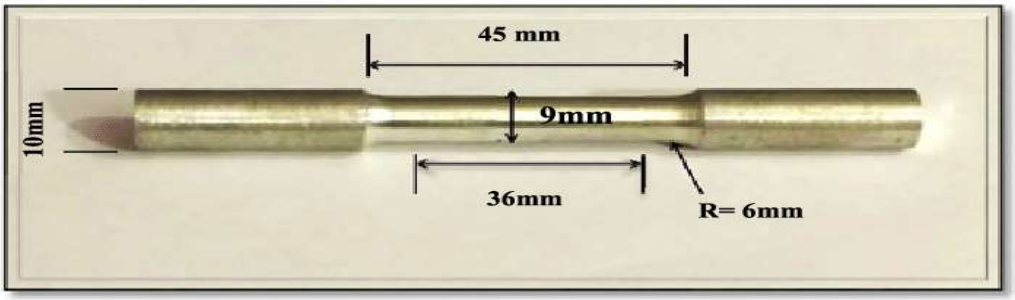

Figure 3: Tensile test specimen.

3. Results and discussion:

Tensile strength of brass alloy usually in the range of 250 to 500 MP from the experimental observation the ultimate tensile strength find the percentage of elongation of the brass alloy for specimens at 1 hour 3 hour and 5 hour aged are listed as below. From the above table the heat treatment process will yield a better results at 5 hour condition then the 1 hour and 3 hour aged condition.

3.1: Hardness test.

Table : 3.1 Hardness test results	
Condition	BHN
As rolled	129
1 hour Heat treated	131
3 hour Heat treated	130.7
5 hour Heat treated	129.8

The hardness test was carried out for all the samples of brass alloy for 1 hr, 3 hr, 5hr and as rolled conditions, the observed values are tabulated in table 3.1. From the hardness test result table we noticed that the heat treatment of Cu-39 Zn alloy was not much affected by the artificial aging up to 5 hours.

3.2: Impact test.

The izod and charpy test was conducted for the brass alloy with the specimens of dimensions as shown below and the results are tabulated in table 3.2. It is observed from the impact test the heat treatment of the Bros Ally was not shown a large change in its value during the impact test for artificial aged conditions of 1hr to 5hr. but as compared to the as rolled slight improvement was noticed.

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Table:3.2 impact test results		
Condition	Charpy test	Izode test
As rolled	210	96
1 hour Heat treated	248	100
3 hour Heat treated	252	104
5 hour Heat treated	250	108

3.3: Tensile Test

Table 3.3: Tensile test results		
Condition	Ultimate tensile strength	% of elongation
As rolled	400	24.20
1 hour Heat treated	427	31.89
3 hour Heat treated	396	23.50
5 hour Heat treated	451	44.52

Fig: 4.1 Tesnsile Strength

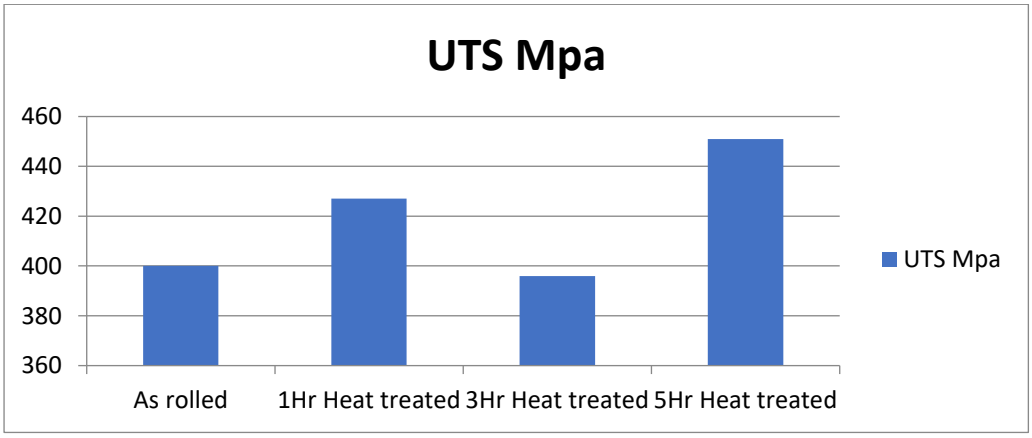

Figure 4 Ultimate tensile strength of Brass ally

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Tensile strength of Brass alloy was enhanced greatly after the heat treatment. The ultimate tensile strength of the ally improved by 6.75 % for 1hr het treated and by 13% for 5hr heat treated samples but at 3hr heat treated condition the UTS was not shown any change in its value as compared to the as rolled condition.

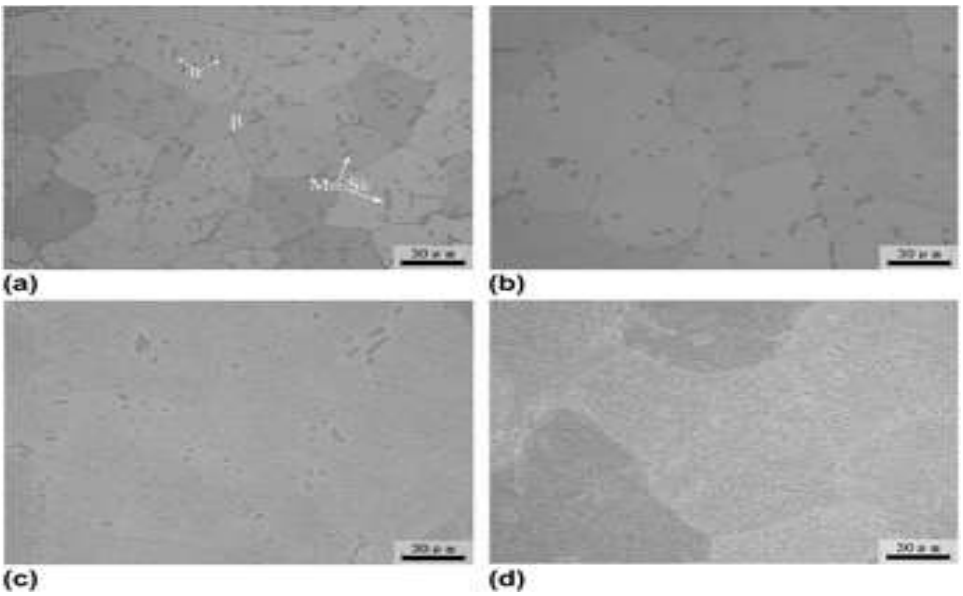

Figure 4: Microstructure of Brass alloy ; a) As rolled b) 1Hour heat treated c) 3 hour heat treated 4) 5 Hour heat treated [9]

The percentage of elongation was also improved with the heat treatment up to 45%, except for 3hr condition of the alloy.

4. Conclusions

1. Heat treatment results the formation of the of α, and γ Sn-rich phases, hence the micro structural change will take place. The grain boundaries and the orientations are changed.

2. The ultimate tensile strength and the %of elongation was considerably improved after heat treatment for 1hr and 5hr heat treated samples.

3. Impact strength and the hardness test results are not affected by the heat treatment process for thought the experiments .

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