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Review Article

A REVIEW OF THE PROPERTIES OF ALUMINUM ALLOY AL 5052

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ABSTRACT

With modernization and development of new technologies in the field of manufacturing, there is a strong need of new and advance materials to be analyzed and studied so as to get the most of the benefits of new technologies. In lieu to this if we talk about non ferrous materials which have some unique properties as compared to ferrous materials. In non ferrous materials a very promising material is aluminum alloy Al 5052 which have good corrosion resistance especially in marine atmosphere. This paper will help you to understand the aluminum alloy and also we will talk about its properties under different condition.

KEYWORDS: Aluminum Alloy, Al 5052, Hardness, Strength.

INTRODUCTION

With new technologies and advancement in the field of production or manufacturing, new and advance products have been developed. These products need material with unique properties so that it can be better suited in the actual environment and can work properly as required. Non Ferrous materials have some unique features and if we talk about aluminum alloys which are light weight, strong and corrosion resistance are most preferred material. In this, aluminum alloy Al 5052 which is in the series of 5xxx has many unique properties as corrosion resistance in marine atmosphere. Also with alloys we can see that the properties of various the component materials are added up and in aluminum alloy Al 5052 which has magnesium are the major alloying element helps to improve the relevant properties of the alloy. So it's very necessary to study the properties at various conditions. This paper will

present you the fundamentals of the material aluminum alloy Al 5052 and will discuss about its properties.

WROUGHT ALUMINUM ALLOYS

Wrought alloys and cast alloys are two different types of alloys. In cast alloys, forming or shaping by appreciable deformation is not possible as they are brittle. But in case of wrought alloys, they are amenable to mechanical deformation, which means they can be formed or shaped as desired and they do not need to be casted [5]. The wrought aluminum alloys can be milled into various shapes by any manufacturing techniques which are commonly available as per the requirement of the product.

There are two types of wrought aluminum alloy they are commonly [8],

a) Alloys that can be hardened by cold working and are non heat treatable.
b) Alloys that can be heat treated.

Aluminum alloys which are hardened by heat treatment are done by precipitate hardening. Precipitate hardening and the treating of steel to form tempered martensite are totally different phenomena, even though the heat treatment producer are similar, therefore the processes should not be confused. The principle difference lies in the mechanisms which by hardening and strengthening are achieved [5]. Also it should be mentioned that the major limitation of these is that of its low melting temperature which restricts its use in high temperatures. The mechanical strength can be increased by cold work and alloying but its decreases its corrosion resistance properties, etc. These all makes it very necessary and important to analyze and study the properties of the alloys so that to understand the mechanism behind them.

Wrought Aluminum alloys are designated by four digits and by a temper designation with single letter which shows the condition of the material as annealed, fabricated cold worked and heat treated. The major alloying element is identified by the first digit. For example if the number is 5xxx then the major alloying element is magnesium and which have good corrosion resistance and weld ability and are non heat treatable. The second digit indicates modifications of the alloy. The third and fourth digits identify the different alloys in the group and have no numerical significance except for 1xxx series which shows the amount of aluminum in the alloy [8].

Aluminum alloys in this context and material of interest in our discussion is aluminum alloy Al 5052 falls in the category of wrought alloys. Aluminum alloy 5052 mainly contains nearly 2.5% magnesium which retards formability and 0.25% chromium increases corrosion

resistance [13], [17]. It shows better fatigue strength and workability in addition to corrosion resistance in marine condition. It has the general properties which are common to all alloys of aluminum such as low density and thermal conductivity. It finds its application in general sheet metal work and in marine application. The alloy composition of 5052 by weight as per the ASTM standard [2] is

- Magnesium - 2.2%-2.8%
- Chromium - 0.15%-0.35%
- Copper - 0.1%
- Iron - 0.4%
- Manganese - 0.1%
- Silicon - 0.25%
- Zinc - 0.1%
- Others each 0.05%
- Others total 0.15%
- Remainder Aluminum

II.1. Annealing

Standard temperature for annealing of Al 5052 is 350 ºC .The process consists of heating the sample to the re-crystallization temperature. It is followed by holding it at this temperature for some time but it's not necessary and then cooling it down to the room temperature at a rapid rate but rate is not important [4].

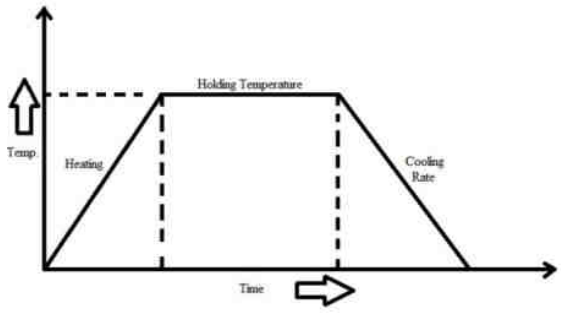

Figure: Annealing Curve [1]

CASE STUDY

Let's the case of Tensile strength and hardness of Al 5052 with cold worked and Al 5052 annealed at 350 ºC and will see what happens to the tensile strength and hardness after annealed. The following is the experimented data from ASM Hand Book [9] which is as follows:

Table 1: Tensile Properties and Hardness of Al 5052 H32 according to ASM Hand Book [9]

Material	Annealed Temperature	Ultimate Tensile Strength	Hardness (Brinell)
Al 5052	0 ºC	228MPa	60
Al 5052	350 ºC	193MPa	47

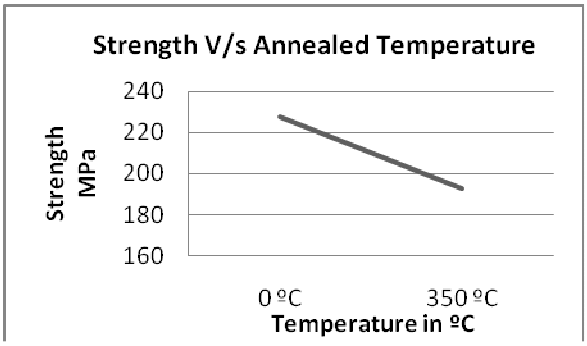

Figure 2a: Strength V/s Annealed Temperature

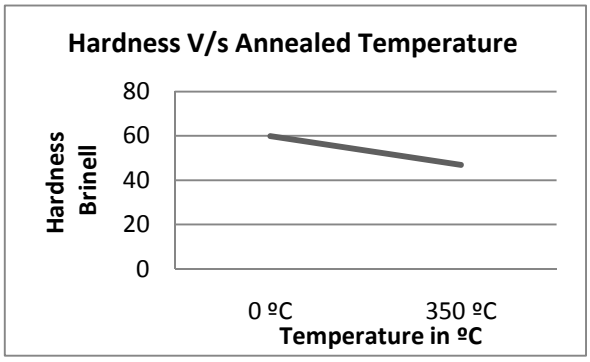

Figure 2b: Hardness V/s Annealed Temperature

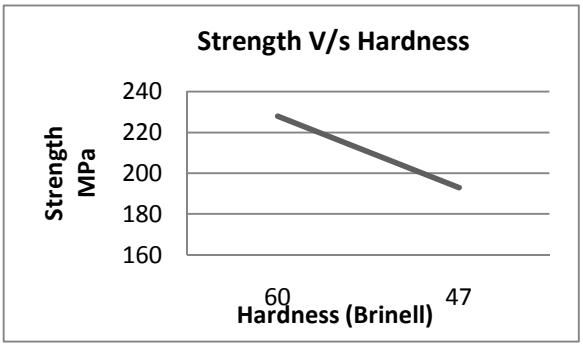

Figure 2c: Strength V/s Hardness

From the data we prepare the following above graphs which shows how the strength and hardness behaves with annealing and also depicts how strength and hardness are related.

- When annealing is done at 350 ºC correspondingly, the ultimate tensile strength shows decrement.
- Also there is a decrement in the hardness when annealed.
- With annealing there is reduction in both strength and hardness.

CONCLUSION

From the above discussion and the various graphs plotted between strength versus annealing temperature, hardness versus annealing temperature and strength versus hardness, we can conclude that:

- The strength and hardness of Al 5052 decreases with annealing.
- The material have good corrosion resistance significantly in marine atmosphere
- The material restricts the use in higher temperature as the melting point is low.
- The material is suited for general sheet metal work.

In general sheet metal work, the material should be ductile and we have seen that annealing decreases both the strength and hardness in aluminum alloy Al 5052. With all these we can properly explore the use and scope of application of the aluminum alloy and will able to make sure the benefits of its usage well accounted.

REFERENCES

[1] Bhowmik, A. (2016). A Comprehensive Study of an Aluminum Alloy AL-5052. *Advance Physics Letter* , 2349-1108.

[2] ASTM B209. (1996). *Standards Specification for Aluminum and Aluminum - Alloy Sheet and Plate.*

[3] ASTM B557. (1984). *Standard Methods of Tension Testing Wrought and Cast Aluminum- and Magnesium-alloy Products.*

[4] ASTM B918. (2009). *Standard Practice for Heat Treatment of Wrought Aluminum Alloys.*

[5] Callister, W. (2007). *Materials Science and Engineering An Introduction* . New York: John Wiley and Sons. Inc.

[6] G.E.Dieter. (1988). *Mechanical Metallurgy.* McGraw-Hill Book Company (UK) Limited.

[7] Gang, U. G. (2007). Microstructural Evolution during Annealing of 5052 Al Alloy deformed at Cryogenic Temperature. *Solid State Phenomena* , 1393-1396.

[8] Kalpakjian, S. (2013). *Manufacturing Engineering and Technology.* New Delhi: Pearson.

[9] *Metals Handbook Vol.2 - Properties and Selection: Nonferrous*

Alloys and Special-Purpose Materials. ASM International.

[10] Michael, A. (2007). *Material Engineering, Science, Processing and Design.* Chennai: Butterworth-Heinemann.

[11] Min, J. (2012). Comparison of tensile properties and crystallographic textures of three magnesium alloy sheets . *The Minerals, Metals & Materials Society* , 355-360.

[12] Mugendiran, V. (2013). Tensile Behaviour of Al 5052 Alloy Sheets annealed at different temperatures. *Advance Materials Research* , 431-435.

[13] Narayanaswamy, R. (2009). A Crystallographic texture perspective formability investigation of aluminium 5052 alloy sheets at various annealling temperatures. *Materials and Design* , 1804-1817.

[14] Ozturk, F. (2008). Evaluation of tensile properties of 5052 type aluminum-magnesium alloy at warm temperatures. *World Academy of Materials and Manufacturing Engineering* , 95-98.

[15] P.C.Sharma. (2012). *A Textbook of Production Technology.* New Delhi: S.Chand and Co.

[16] Raghuwanshi, B. (2012). *A course in Workshop Technology Vol 1.* Delhi: Dhanpat Rai and Co.

[17] Ravindran, R. (2009). An analysis of void coalescence in AL 5052 alloy sheets annealed at different temperatures formed under different stress conditions. *Materials Science and Engineering* , 252–267.

[18] Tokisue, H. (2006). Structures and Mechanical Properties of Multilayer Friction Surfaced Aluminum Alloys. *The Japan Institute of Light Metals* , 874 - 882.

[19] Ui Gu Gang, S. H. (2009). The Evaluation of Microstructure and Mechanical Properties of a 5052 Aluminium alloy by the application of cryogenic rolling and warm rolling. *Material Transactions* , 82-86.