International Journal of Materials Science
ISSN 0973-4589 Volume 12, Number 4 (2017), pp. 627-633

http://www.ripublication.com

The Effect of Nickel on Mechanical Properties of Aluminium Alloy Al - 7075

Ch. Shiva Krishna[1], J. Manoj Kumar[2]

M. Tech student[1], Assistant professor[2].
Department of Mechanical Engineering, S R Engineering College, Ananthasagar, Warangal T.S, India

Abstract

The effect of nickel on the structure and mechanical properties of a high strength casting Zn-5.1% Mg-2.1% Cu-1.2% Cr-0.18% Al-Balanced alloy was studied. The most favorable combination of properties is shown to be attained at 0.4% of Ni; it is consistent with the results of analysis of the phase diagram of the Al-Zn-Mg-Cu-Ni system, some fragments of which are constructed in the present work. An alloy with 0.4% Ni is greatly superior to a high-strength alloy of Al-7075 type in technological efficiency for mechanical properties.

Keywords: Aluminium alloy of 7075 type, Mechanical properties, Impact, Hardness and Tensile.

INTRODUCTION

Aluminium is one of the important engineering application materials available in earth and of the earth's solid surface it occupies around 9% by weight. The one of the important source is bauxite ore. The special properties of Al are low density and corrosion resistance. Due to this reason it finds applications in aerospace industry and automotive industry [1]. The AA (Aluminium Association) alloys finds its application extensively in the following fields: aerospace, automobile parts, railway machine parts and other equipments due to its better mechanical, electrical, thermal and physical properties along with high strength to weight ratio and more importantly it has good corrosion resistance. Because of these properties Aluminium alloys are more useful in the transportation and construction equipment. Use of these alloys reduce the weight of the equipment to a greater extent and hence in turn improve efficiency [2].

This paper will focus on the mechanical properties of the AA7075aluminium alloy after addition of Nickel.

EXPERIMENTAL PROCEDURE

Initially a base metal (BM) sheet of 5mm thick 7075 Aluminium alloy pieces are taken for casting. These base metals of Aluminium alloy have good weld ability, very good corrosion resistance and have the highest strength of the non-heat treatable. In general 0.35% (weight %) of Nickel is added to AA 7075 Aluminium alloy. Then there is a positive change in its Hardness, Impact energy and tensile test reports [4]. And then we added 2.3% (weight %) of Nickel, but this time Hardness, Impact energy and tensile test reports are rapidly decreased [5].

Table 1:AA7075 material chemical composition (weight %)

	Si	Fe	Cu	Mn	Cr	Mg	Zn	Ti	Al
Min.	0	0	1.20	0	0.18	2.10	5.10	0	Balance
Max.	0.40	0.50	2.00	0.30	0.28	2.90	6.10	0.20	Balance

RESULTS AND DISCUSSIONS

Hardness

The hardness value of AA7075 is increased after addition of 0.35% of nickel. The hardness value is shown in Table2. The base metal 7075 hardness, after addition of 0.35% of nickel is 162(HBW), it was more than of base metal. The Hardness test specimen is showed in figure1.

The hardness value of AA7075 is decreased after addition of 2.3% of nickel [5]. The hardness value is shown in Figure2. The base metal 7075 hardness, after addition of 2.3% of nickel is 84(HBW), it was too low when compared to base metal. Sample reference and used equipment are given in table2.

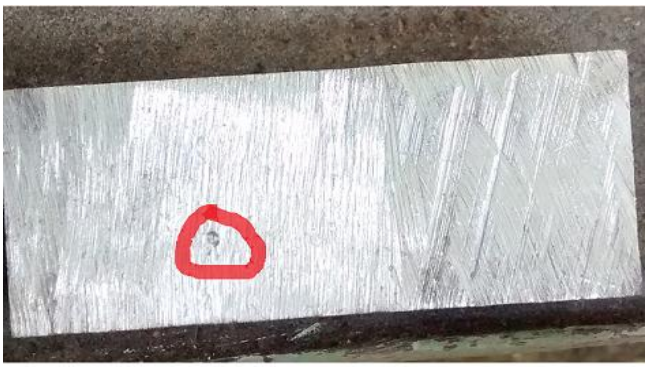


Figure1: Hardness test specimen

Table 2: Sample ref., used equipment and Hardness reports

Nature of test	HARDNESS (BRINELL)
Sample ref.	150*150*25 mm
Equipment used	VICKERS CUM BRINELL HARDNESS TESTER
Results	Ball Diameter : 5 mm Test Load : 250 kg **HARDNESS : 162 HBW (AA7075 + 0.35% of NICKEL)** **HARDNESS : 84 HBW (AA7075 + 2.3% of NICKEL)**

Impact

In mechanics, an impact is a high force or shock applied over a short period of time when two or more bodies collide [6]. Such a force or acceleration usually has a greater effect than application of lower force over a proportionally longer period of time. This effect depends critically on the relative velocity of bodies with one another. Charpy test is also known as the V-notch test, is a standardized high strain-rate test which determines the amount of energy absorbed by a material during fracture [7]. The change in work piece before impact test and after impact test is shown in figure2 and 3. The nature of test, type of notch, notch depth and results are given in table3.

Figure 2: Work piece before testing

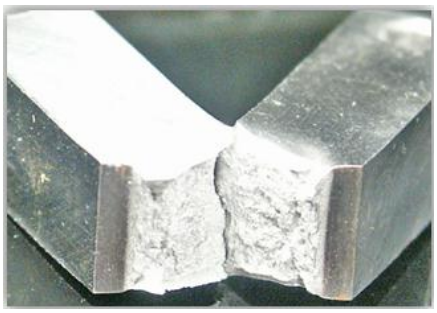


Figure3: Work piece after testing

Table 3: The nature of impact test, type of notch, notch dept, size and results

Nature of test	CHARPY IMPACT
Type of notch	"v"
Notch depth	2mm
Size	10*10*55mm
Results	**Impact : 12 Joules (AA7075 + 0.35% of NICKEL)** **Impact : 2 Joules (AA7075 + 2.3% of NICKEL)**

TENSILE

A tensile test, also known as tension test is a mechanical test that can be performed on materials. Tensile test is relatively simple, inexpensive and fully standardized. In this test, a sample is subjected to a tension till breaking point or failure of a material [8]. This result from the test which were conducted are commonly used to select a material for an application, for quality control, and to predict how a material will react under other types of forces

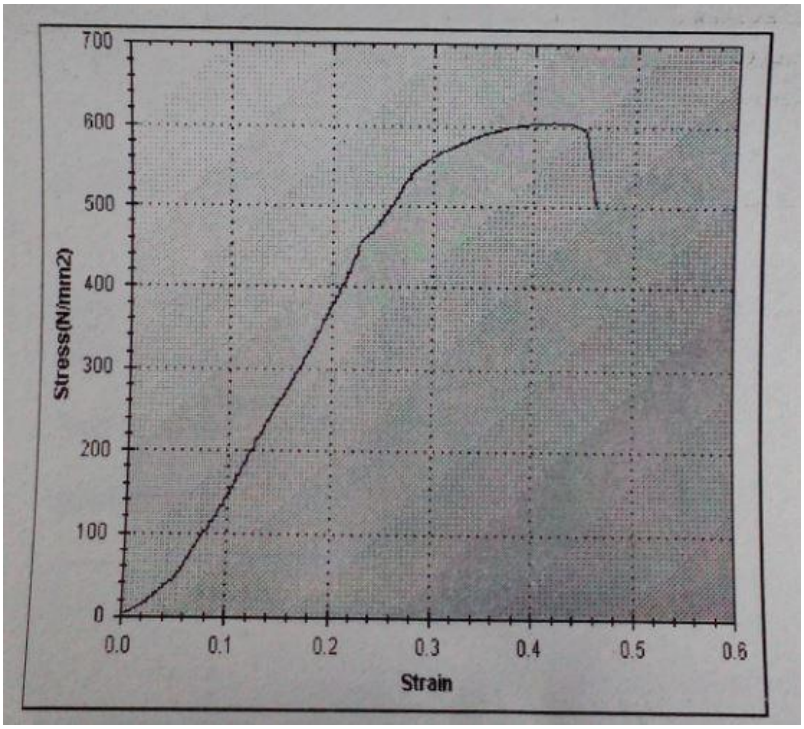
A tensile specimen is a standardized sample cross-section. It has two shoulders and a section in between figure3. The shoulders are large so they can be readily gripped, whereas the section has a smaller cross-section so that the deformation and failure can occur in this area [9] figure4. The tensile test results are shown in table4. The stress vs strain graphs are given in figure5 and figure6.

Figure 3: before tensile test

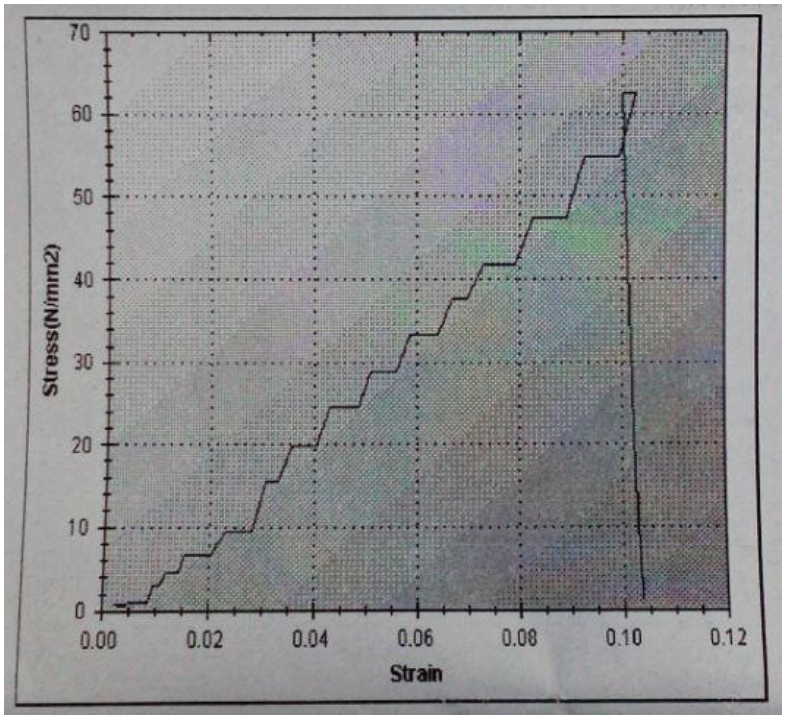
Figure4: After tensile test

Table 4: Tensile test report

Nature of test	TENSILE	
Specimen shape	Solid Round	
Specimen Description	150*150*25 mm	
Results	Load At Yield : 66.27 kN Yield Stress : 534.019 N/mm^2 Load At Peak : 74.940 kN **Tensile Strength : 603.884 N/mm^2** % Elongation : 13.26 %	AA7075 + 0.35% of NICKEL
	Load At Yield : 6.72 kN Yield Stress : 54.585 N/mm^2 Load At Peak : 7.680 kN **Tensile Strength : 62.383 N/mm^2** % Elongation : 1.42 %	AA7075 + 2.3% of NICKEL



Graph for tensile test of AA7075 + 0.35% Nickel



Graph for tensile test of AA7075 + 2.3% Nickel

CONCLUSION

We studied the properties of AA7075 by adding Nickel in weight%.

MATERIAL/ PROPERTY	AA 7075	AA7075 with 0.35% of nickel	AA7075 with 2.3% of nickel
TENSILE YIELD STRENGTH	540 MPa	603.88 MPa	62.383 MPa
HARDNESS (BRINELL) (Ball diameter 5mm, Test load 250kg)	150 BHW	162 BHW	84 BHW
ELONGATION	9%	13.26%	1.42%
IMPACT ENERGY	10JOULES	12JOULES	2 JOULES

As the percentage of Ni increases to 0.35wt% the properties like Strength, Hardness, Tensile and Impact energy are increases compared to base AA7075. If further we increase the Ni content to 2.3wt% there is a drastic reduction in the properties compared to base AA7075 and 0.35wt%.as shown in above reports.

By this we know that addition of Ni to AA7075 up to certain amount (0.35%) increases the properties beyond that there is a drastic reduction in the properties like Strength, Hardness, Tensile and Impact energy.

REFERENCES

[1] Gu¨rel Cam and Selcuk Mistikoglu, JMEPEG (2014) 23:1936–1953 _ASM International DOI: 10.1007/s11665-014-0968-x.

[2] J. Adamowski a,*, C. Gambaro b, E. Lertora b, M. Ponte b, M. Szkodo c, Volume 28 Issue 8 August 2007.

[3] P. Z. Zhao and T. Tsuchida, "Effect of fabrication conditionsand Cr, Zr contents on the grain structure of 7075 and 6061aluminium alloys,"*Materials Science and Engineering A*, vol. 499,no. 1-2, pp. 78–82, 2009.

[4] H.J. Zhang, H.J. Liu ⇑, L. Yu, Materials and Design 32 (2011) 4402–4407.

[5] M.A. Sutton *, B. Yang, A.P. Reynolds, R. Taylor, Materials Science and Engineering A323 (2002) 160–166.

[6] Mohammad Hasan Shojaeefard a, Reza Abdi Behnagh b, Mostafa Akbari c, Mohammad Kazem Besharati Givi d, Foad Farhani e, Materials and Design 44 (2013) 190–198.

[7] K.V. Jata and S.L. Semiatin Air Force Research Laboratory, Materials and Manufacturing Directorate, AFRL/MLLM, 2230 Tenth Street, Wright-Patterson AFB, OH 45433-7817 USA, Scripta mater. 43 (2000) 743-749.

[8] Xiaocong He a,⇑, Fengshou Gu b, Andrew Ball b, Progress in Materials Science 65 (2014) 1–66.

[9] W H Jiang and R Kovacevic* The Research Centre of Advanced Manufacturing Systems, Southern Methodist University, Richardson Texas, USA.