Effect of holding Time

by Jurnal Austenit Jurusan Teknik Mesin

Submission date: 08-Sep-2021 02:12PM (UTC+0900)
Submission ID: 1564300589
File name: AMR.576.146_Dicky,_fatahul.pdf (303.18K)
Word count: 1695
Character count: 8424

Advanced Materials Research
ISSN: 1662-8985, Vol. 576, pp 146-149
doi:10.4028/www.scientific.net/AMR.576.146

Online: 2012-10-08

Effect of Holding Time, Grain Size and Compacting Pressure Parameters Against Compressive Strength of Aluminum - 5%Fly Ash

Dicky Seprianto[1,a], Firdaus[1,b], Fatahul Arifin[1,c]

[1]Mechanical Engineering Department, Politeknik Negeri Sriwijaya, Palembang-Indonesia

[a]dq_abiel@yahoo.co.id, [b]ffirdauss04@yahoo.com, [c]farifinus@yahoo.com

Key words: aluminum powder, compressive, fly ash

Abstract. This research is aimed to analysis the effect of holding time, grain size and compacting pressure parameter against compressive strength of Aluminum-5% fly ash using powder metallurgy method. The irregular form and homogeneous particles of aluminum powder used in this research is produced by Merck German, while fly ash is taken from residual combustion coal in forging process in mechanical engineering workshop of Politeknik Negeri Sriwijaya (Polsri) which is mashed up to grains size 140 and 270 mesh, pressed with holding time 60 and 120 seconds, with compacting pressure 139 N/mm^2 and 275 N/mm^2 by cold iso-static pressing. The green body resulted from these processes then sintered up to 550^{0}C. Taguchi Method is used to determine factors which affect optimum condition of compressive strength of Aluminum-5% fly ash. The research result using ANOVA show that the holding time, grains size, , and compacting pressure parameters has significantly affect the compressive strength of Aluminum-5% fly ash.

Introduction

Aluminum has such a good properties like light-weight, anti-corrosion and good thermal conductivity. That is why mostly used in automotive industry.

Fly ash is solid waste of power plant coal-fired steam that contains of heavy metals. The Ministry of Environment of Republic of Indonesia has set it as hazardous and toxic materials (B3). Fly ash contains elements of the combined materials and some metals that have high value, so fly ash likely to be exploited [8].At this time the fly ash is waste material of resulted from combustion coal which has low economic value, so the utilization of materials which are made with aluminum alloy-fly ash (ALFA) is very advantageous in terms of the economy compared with other alloys.

The main factors in producing of ALFA using the powder metallurgy method are the process of compacting and its large grains. For that reason, this research will be limited to the alloys from a mixture of aluminum powder as a matrix with a reinforcement of 5% fly ash, fly ash which is taken from the combustion of coal in subdivision of forging in workshop of Mechanical Engineering Politeknik Negeri Sriwijaya. This research takes sintering temperature of 550 ^{0}C, variations in pressure compaction are 139 and 275 N/mm^2, the anchoring process of compacting 60 and 120 seconds, and the fly ash grains are 140 and 270 mesh.

This research aims to determine the compressive strength of ALFA. In addition to the effect of holding time and the percentage of contribution, alloy solidification pressure (compacting) and large grain size fraction of fly ash by weight 5% at 550 ^{o}C sinter temperature compressive strength of the alloy with the approach using the Taguchi method, and validation data with analysis of variance, so that it can be seen that the optimal composition of each of these factors. While for compressive strength testing used standard ASTM C 773-88.

Theoretical Background

The use of aluminum as the metal each year is on the order of a second after the iron and steel, non ferrous metals among the highest. Until now the production of aluminum ingot aluminum Indonesia types reached 256 thousand tons per year [8].

Aluminum weighs about one-third of steel, easily bent, be treated with the machine, cast, drawn (drawing), and extruded. Aluminum is also the conductor of both heat and electricity. While, it is compared to its mass, aluminum has advantages over copper, which is now a metal conductor of heat and electricity is pretty good, but heavy enough.

Al-Fly Ash Utilization to manufacture of automotive components and other applications can reduce the huge expenditure in terms of energy consumption [6]. Al-Si alloys (hypo-eutectoid) / Al2O3 casting method and the addition of 3 wt% Al_2O_3 causes increased hardness of 27 BHN to 37 BHN and UTS from 75 MPa to 93 MPa [5].

A similar study of aluminum due to the influence of compaction pressure and sintering temperature. The results show a maximum thermal conductivity of 2.306 gr/cm3 after sintering, the maximum hardness of 44 BHN and the maximum transverse fracture strength of 20.7 MPa occurs at a temperature of 5000C and a pressure of 435 MPa [7].

Fly ash has color grey. The density of fly ash is 2.1-2.9 gr/cm^3, it is mainly effect by Fe_2O_3. The properties of fly ash are depending on the origin of the type of coal being burned. Most of the fly ash are contain $SiO_2 + Al_2O_3 + Fe_2O_3$ more than 70% and oxides of Mg, Ca, Na, K, in a relatively small amount.Mechanical testing intended to simulate the loading pattern that will be experienced by the material at the operating conditions of the material one is a test press (compressive strength). Axial stress (σ) in the specimen is calculated by dividing the load F to the cross-sectional area (A) [4].

$$\sigma = \frac{F}{A}$$

Where: F = Force (N) ; A = Surface area (mm^2)

Result and Discussion

Compressive strength of the specimens was measured in mechanical laboratory using Hydraulic Material Tester Machine GUNT 310 Germany based on ASTM C 773-88 standard, each specimen were tested 5 times, same condition and randomly. The result can be seen in table 1.

Table 1: Compressive Test Result Of Specimen

Std	Run	Factor 1	Factor 2	Factor 3	Number of Sample	Response
		Size of Grains (mesh)	Holding Time (Sec)	Compacting Pressure (N/mm^2)		Compressive Strength (N/mm^2)
3	1	270	60	275	1	198.43
					2	197.96
					3	198.04
					4	198.27
					5	197.86
2	2	140	120	275	1	156.69
					2	157.21
					3	156.86
					4	157.11
					5	157.44
1	3	140	60	139	1	112.33
					2	111.87
					3	112.42
					4	112.04
					5	111.98
4	4	270	120	139	1	183.09
					2	182.87
					3	183.13
					4	182.98
					5	182.77

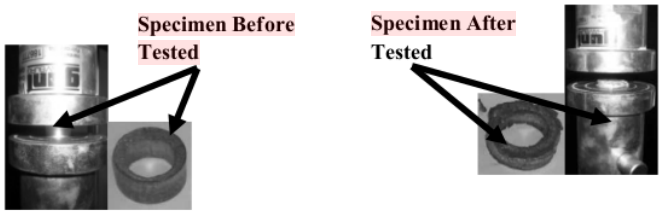

Fig 1: Specimen Before and After Tested

Table 2: Combination Factor and Level Compressive Strength Result

Eks	Factor A	B	C	Replication 1	2	3	4	5	Total	Mean
1	1	1	1	112.33	111.87	112.42	112.04	111.98	560.64	112.13
2	1	2	2	156.69	157.21	156.86	157.11	157.44	785.31	157.06
3	2	1	2	198.43	197.96	198.04	198.27	197.86	990.56	198.11
4	2	2	1	183.09	182.87	183.13	182.98	182.77	914.84	182.97
					Average				**812.84**	**162.57**
					Total				**3251.35**	**650.27**

Tabel 3: ANOVA Average Compressive Strength Specimen

Source	Sum of Squares	Degrees of Freedom	Mean Square	F_0	F_{Tabel}	Percentage
A	15649.22	1	15649.22	285660.8	4.49	74%
B	1109.31	1	1109.31	20249.26	4.49	5%
C	4511.71	1	4511.71	82356.73	4.49	21%
Error	0.88	16	0.055			
Total	21271.1	19				

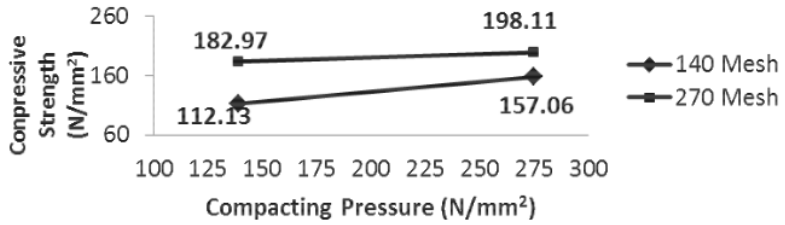

Fig.2: Effect Grain Size and Compacting Pressure to Compressive Strength Value Specimen

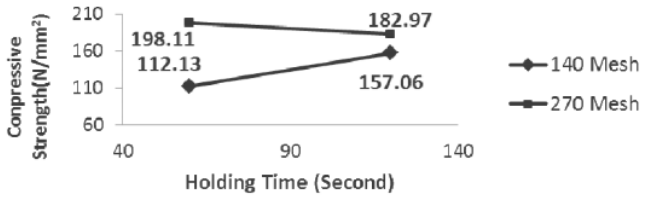

Fig. 3: Effect Grain Size and Holding Time to Compressive Strength Value Specimen

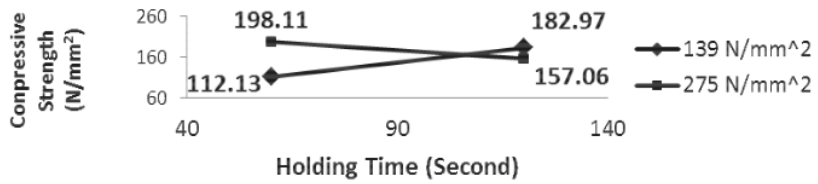

Fig.4: Effect of Holding Time and Compacting Pressure to Compressive Strength Specimen

It can be seen on Fig. 2, the highest compressive strength obtained in the large size 270 mesh with 120 seconds of holding time. This is consistent with the analysis of variance; the greatest significant influence is grains size factor, with 74% the percent contribution. The compressive strength will be increase that is caused by increase of compacting pressure and large grain size. This is due to a given load on the compressive strength test will be converted into energy that will be absorbed by the specimen.

Conculsions

Based on the results of research and data analysis of Aluminum-5% fly ash using powder metallurgy process can be concluded as follows:

1. Using Taguchi Method Approach L4 Array and ANOVA, F counting > F table, so grain size, holding time and Compacting pressure has effected the compressive strength with convenience level 95 % ($\alpha = 0.05$).
2. The main factor which influences compressive strength is the grain size. The smaller the grain size, the higher compressive strength of ALFA.
3. The response value of compressive strength is 198.43 N/mm^2 that is obtained factor combination and level of grain size 270 meshes, holding time 60 second and compacting pressure 275 N/mm^2.

References

[1] Arik H., and Chengiz B., 2001,"Investigation of Influences of Pressing and Sintering Temperature on the Mechanical Properties of Al-AlC_4O_3 Composite Materials", Turkish J.Eng.Env.S, 53-58.

[2] Dicky S, 2010,"Multi Response Optimization on Manufacturing Aluminum/Fly Ash Processes Powder Metallurgy Using Design-Expert, Thesis S2, UP Eng.German R.M., 1994, "Powder Mettalurgy Science", 2nd edition, Metal Powder Industries Federation, Princenton, New Jersey.Mahendra K.V, 2005, "Castable Composites and Their Application in Automobiles", BMS College Of Engineering, Bangalore, India

[3] R. Ganesh Narayanan, "Powder Metallurgy – Basic & Aplication", http://www.iitg.ernet.in/engfac/ganu/public_html/Part2-09.pdf retrieved date 21-02-2011

[4] Rohatgi P.K., Weiss D., and Gupta Nikhil, "Applications of fly ash in synthesizing low-cost mmcs for automotive and other applications", JOM (2006): pp71-76

[5] Zhang, H., Ramesh, K.I., Chin E.S.C., 2004, "High Strain Rate Response of Aluminum 6092/B4C Composites", Materials Science and Engineering A384, 26-34.

[6] Toshihiro Takami, 2000, "MMC All Aluminum Cylinder Block For High Power SI Engines", Toyota Motor Corp, http://hosting.dynamis.net/littlerocket retrieved date 21-02-2011

Effect of holding Time

ORIGINALITY REPORT

82%	19%	82%	3%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

MATCHED SOURCE

1	Dicky Seprianto, Firdaus Firdaus, Fatahul Arifin. "Effect of Holding Time, Grain Size and Compacting Pressure Parameters against Compressive Strength of Aluminum - 5%Fly Ash", Advanced Materials Research, 2012 Publication	82%

82%

★ Dicky Seprianto, Firdaus Firdaus, Fatahul Arifin. "Effect of Holding Time, Grain Size and Compacting Pressure Parameters against Compressive Strength of Aluminum - 5%Fly Ash", Advanced Materials Research, 2012

Publication

Exclude quotes	On	Exclude matches	< 1%
Exclude bibliography	On		

Effect of holding Time

Sp. This word is misspelled. Use a dictionary or spellchecker when you proofread your work.

Article Error You may need to use an article before this word. Consider using the article **the**.

Article Error You may need to use an article before this word.

Article Error You may need to use an article before this word.

Article Error You may need to use an article before this word.

Missing "," You may need to place a comma after this word.

Proofread This part of the sentence contains a grammatical error or misspelled word that makes your meaning unclear.

P/V You have used the passive voice in this sentence. Depending upon what you wish to emphasize in the sentence, you may want to revise it using the active voice.

Article Error You may need to use an article before this word. Consider using the article **the**.

Wrong Article You may have used the wrong article or pronoun. Proofread the sentence to make sure that the article or pronoun agrees with the word it describes.

Article Error You may need to use an article before this word. Consider using the article **a**.

Article Error You may need to use an article before this word. Consider using the article **the**.

Proofread This part of the sentence contains a grammatical error or misspelled word that makes your meaning unclear.

Article Error You may need to remove this article.

Article Error You may need to use an article before this word.

Article Error You may need to use an article before this word.

Article Error You may need to use an article before this word.

Article Error You may need to use an article before this word. Consider using the article **a**.

Article Error You may need to remove this article.

Missing "," You may need to place a comma after this word.

Article Error You may need to use an article before this word. Consider using the article **the**.

Missing "," You may need to place a comma after this word.

Wrong Article You may have used the wrong article or pronoun. Proofread the sentence to make sure that the article or pronoun agrees with the word it describes.

Sp. This word is misspelled. Use a dictionary or spellchecker when you proofread your work.

Frag. This sentence may be a fragment or may have incorrect punctuation. Proofread the sentence to be sure that it has correct punctuation and that it has an independent clause with a complete subject and predicate.

S/V This subject and verb may not agree. Proofread the sentence to make sure the subject agrees with the verb.

Verb This verb may be incorrect. Proofread the sentence to make sure you have used the correct form of the verb.

P/V You have used the passive voice in this sentence. Depending upon what you wish to emphasize in the sentence, you may want to revise it using the active voice.

Article Error You may need to use an article before this word. Consider using the article **the**.

Prep. You may be using the wrong preposition.

Dup. You have typed two **identical words** in a row. You may need to delete one of them.

Confused You have used **Effect** in this sentence. You may need to use **affect** instead.

Missing "," You may need to place a comma after this word.

Article Error You may need to use an article before this word.

Article Error You may need to use an article before this word.

Article Error You may need to use an article before this word.

Article Error You may need to use an article before this word.

P/V You have used the passive voice in this sentence. Depending upon what you wish to emphasize in the sentence, you may want to revise it using the active voice.

Sp. This word is misspelled. Use a dictionary or spellchecker when you proofread your work.

Article Error You may need to use an article before this word. Consider using the article **the**.

Article Error You may need to use an article before this word.

Frag. This sentence may be a fragment or may have incorrect punctuation. Proofread the sentence to be sure that it has correct punctuation and that it has an independent clause with a complete subject and predicate.