Analysis of Physical and Mechanical Properties of Backhoe’s Bucket Repairment with Cladding Methode

Abstract:

Buckets are the most important component in backhoe construction, the bucket functions as a digger and carrier component in an excavator. Due to the heavy working media of the excavator so that this component is the most easily damaged part, damage that often occurs is wear caused by friction arising so that the thickness of the bucket is reduced which can eventually cause cracks in the bucket and in continuous use can cause the bucket to crack and broken. Cladding method is done to shorten the time or simplify the repair process is to directly patch the damaged part with a welding layer and then do the grading using a grinding. This study aims to determine the physical and mechanical properties of the material from the cladding process when compared with the raw material, the variations used are raw material, cladding with filler welding, and cladding with plates. The welding process is carried out with GMAW (Gas Metal Arc Welding) and low carbon steel. Welding results will be tested tensile strength, bending strength , impact test, hardness test, chemical composition, and corrosion rate. From the hardness test results showed that the weld metal from plate variation has the highest hardness value of 443 VHN. From the results of tensile testing the basic material has the highest value with 359.08 MPa. From the bending test results the highest value obtained from filler verification with 494.01 Mpa and the highest impact price obtained from the plate variation cladding method with a value of 1.49 J / mm2

Info:

Periodical:	Key Engineering Materials (Volume 841)
Edited by:	Prof. Mosbeh Kaloop
Pages:	254-258
DOI:	https://doi.org/10.4028/www.scientific.net/KEM.841.254
Citation:	Cite this paper
Online since:	May 2020
Authors:	Yustiasih Purwaningrum*, Muhammad Hafiz, Risky Suparyanto
Keywords:	Cladding, Corrosion Rate, Hardness, Tensile Strength
Export:	RIS, BibTeX
Price:	39,00 €
Permissions:	Request Permissions
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* - Corresponding Author

References

Cited by

Related Articles

Engineering Research

Materials Science

Key Engineering Materials - Editorial Board

ISSN: 1662-9795

Details

Volumes

Editorial Board

ISBN(softcover): 978-3-0357-1514-9 ISBN(eBook): 978-3-0357-3514-7

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Key Engineering Materials
ISSN: 1662-9795, Vol. 841, pp 254-258

Submitted: 2019-12-04
Accepted: 2019-12-04
Online: 2020-05-05

Analysis of Physical and Mechanical Properties of Backhoe's Bucket Repairment with Cladding Methode

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Keywords: Cladding, Tensile strength, Corrosion rate, Hardness

Abstract. Buckets are the most important component in backhoe construction, the bucket functions as a digger and carrier component in an excavator. Due to the heavy working media of the excavator so that this component is the most easily damaged part, damage that often occurs is wear caused by friction arising so that the thickness of the bucket is reduced which can eventually cause cracks in the bucket and in continuous use can cause the bucket to crack and broken. Cladding method is done to shorten the time or simplify the repair process is to directly patch the damaged part with a welding layer and then do the grading using a grinding. This study aims to determine the physical and mechanical properties of the material from the cladding process when compared with the raw material, the variations used are raw material, cladding with filler welding, and cladding with plates. The welding process is carried out with GMAW (Gas Metal Arc Welding) and low carbon steel. Welding results will be tested tensile strength, bending strength, impact test, hardness test, chemical composition, and corrosion rate. From the hardness test results showed that the weld metal from plate variation has the highest hardness value of 443 VHN. From the results of tensile testing the basic material has the highest value with 359.08 MPa. From the bending test results the highest value obtained from filler verification with 494.01 Mpa and the highest impact price obtained from the plate variation cladding method with a value of 1.49 J / mm2.

Introduction

Heavy equipment is equipment that are widely used in building construction or mining. Increasing infrastructure development and mining has led to higher demand for heavy equipment. The type of heavy equipment that is most often used is a digger or also known as an excavator. Excavators are used to dig soil or rocks, including types of excavators are front shovels, backhoes, draglines and clamshells. The construction of a backhoe excavator is divided into several parts, including: buckets that are used as digging containers, arms of the backhoe, the wheelhouse of the operator, the engine as a motor, and the shoe track frame that functions as a wheel on the excavator.

Bucket is the most easily damaged component. Damage that often occurs is wear caused by friction that arises so that the bucket thickness is reduced which can eventually cause bucket cracks and in continuous use can cause the bucket to crack and break. Bucket replacement costs and takes a long time so if there is damage to the bucket, repairs that can be done is to cut the damaged part and replace with a new steel plate using welding. However, what is generally done by the company to shorten the time or simplify the repair process is to directly patch the damaged part with the weld layer. After all the damaged parts are covered with welds, then grading is done using a grinding. Repairing buckets with this methode can minimize the unit in a breakdown condition. This repaired methode is called cladding.

Cladding is a process where material covers or coats another either internally or externally [1]. Cladding can be done by forming processes such as rolling and casting, and joining processes such as welding [2]. Different types of arc welding like Shielded Metal Arc Welding (SMAW), Gas Tungsten Arc Welding (GTAW), Gas Metal Arc Welding (GMAW), Flux Cored Arc Welding (FCAW) can sucessfullly produce cladding. GMAW is widely accepted by industry to produce weld cladding [3 4].

The advantages of Gas Metal Arc Welding (GMAW) are high productivity, low cost and high reliability [5 6]. The shape of cladding influences mechanical properties of cladding steel welded [7].

Experimentals

Welding System. This experimental used SWRM 1008 Low Carbon Steel as a raw material. The spectrometric analysis of the specimen was done by using Spectromax and the chemical compositions of base metal and welding metal were reported in Table 1. The welding processes was carried out by GMAW (Gas Metal Arc Welding) with electrode ER 70S-6 as a filler metals. The welding parameter is shown in Table 2.

Table 1 Chemical Composition of SWRM 1008 Low Carbon Steel

Element	Fe	C	Mn	P	Si	Cu	S	Ni	Cr	Mo
Raw Material	99.5318	0.0666	0.2537	0.0308	0.0117	0.1400	0.0156	0.0063	0.0229	0.0052
Filler	97.7337	0.0647	1.0909	0.1640	0.6826	0.2642	0.0163	0.0392	0.0467	0.0014

Table 2 Welding Parameter

Material	Low Carbon Steel (SWRM 1008)
Dimension	250 mm x 250 mm x 1.36 mm
Type	GMAW
Electrode	AWS A5.18 ER 70S-6 , diameter 1.2 mm
Current	80 A
Welding rate	2.7 mm/s
Voltage	16 Volt
Wire feed rate	1 m/min
Welding gas	Argon

The variation buttering of welding that used were filler and plate. The schematic of cladding is shown in Fig. 1. In variations of cladding with filler, the surface of the raw material with dimensions of 250x250 mm welded on its surface is then flattened with a grinding. The other variation, cladding with plate, a plate measuring 250 mm x 10 mm was added to the top of the base plate in a row with a gap of about 1 mm. In the plate variation the welding process is carried out only on gaps that have been prepared in advance. This welding is carried out in a continuous direction (sequence) to avoid large deformations.

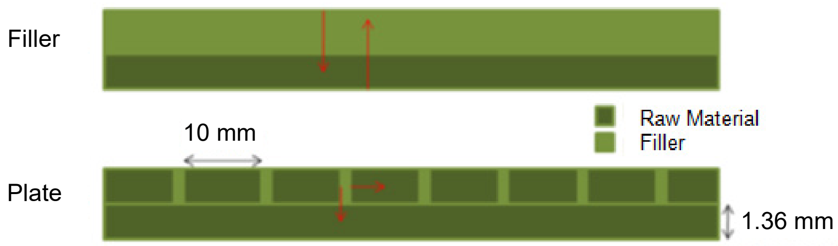

Fig. 1 Variation Cladding Steel Welded

Joints Characterizations. Mechanical properties of cladding weld steels obtained from tensile strength and bending strength testing. The tensile strength of cladding steel welded were tested by Universal Testing Machine. The specimens tested were according to the standar ASTM E - 8M. Three point bending method used to measure the bending strength of buttering weld steels. This test is carried out using standards JIS Z2204.

Corrosion and Vickers microhardness testing is carried out to obtain physical properties of buttering weld steels. Vickers indentor under 200 gr force for 10 seconds was used to investigate the hardness of buttering weld steels.

$$corrosion\ rate = \frac{W}{TSA\ x \frac{T}{365}}$$

W = weight loss (gram)
TSA = total surface area (mm^2)
T = time of exposure (days)

Results and Discussion

Tensile Strength. Fig. 2 shown the tensile strength and elongation of cladding steel. The experimental results showed that the method of cladding steel welded to repair bucket decreased tensile strength and elongation of material. The decline of tensile strength in a row as follows: cladding with filler = 273.89 MPa and cladding with plate = 318.89 MPa.

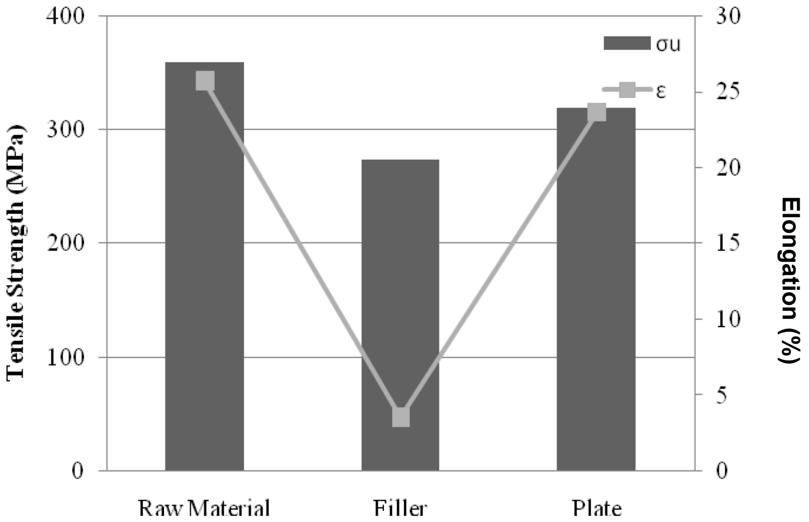

Fig. 2 Tensile Strength of Cladding Steel Welded

Bending Strength. As we can see from Fig. 3 the weld metals with filler cladding has a highest bending strength. The values of bending strength of this variation is 494.01 Mpa, this value is 31.06 % more than raw material.

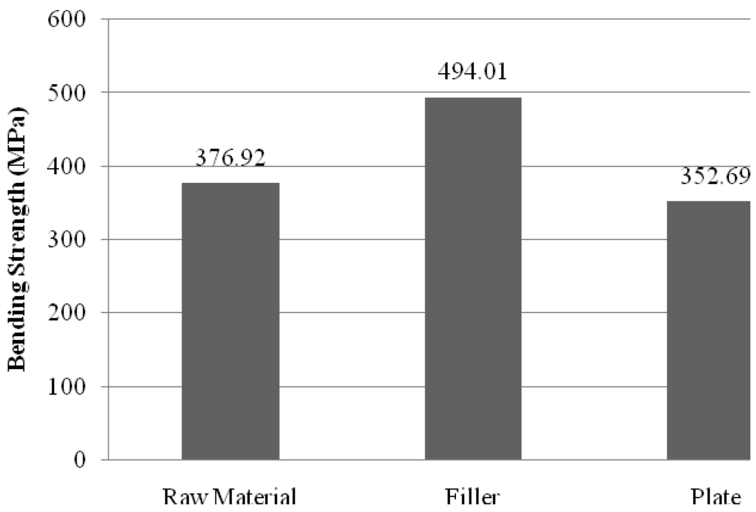

Fig. 3 Bending Strength of Cladding Steel Welded

Corrosion. The value of corrosion rate can we seen at Fig. 4. From this diagram, it was found that filler specimens had the best resistance to corrosian with a value of 1.43 mmpy slightly different from raw material specimens which had an average value of 1.54 mmpy. whereas specimens with plate cladding variations have the lowest resistance of corrosion with a value of 4.24 mmpy.

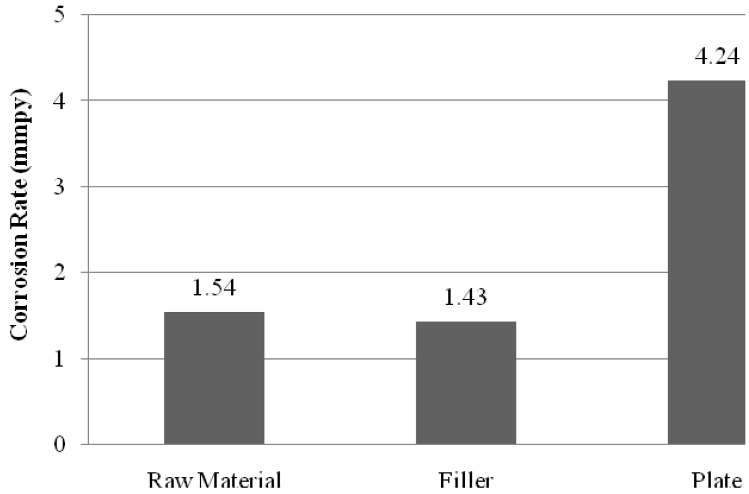

Fig. 4 Corrosion rate of Cladding Steel Welded

Hardness. Variation of hardness from buttering steel is shown in Fig. 5. The Fig.1 shows that hardness of welding metal has highest values. The hardness number of weld metals are 443 VHN for plate cladding and 423 VHN for filler cladding.

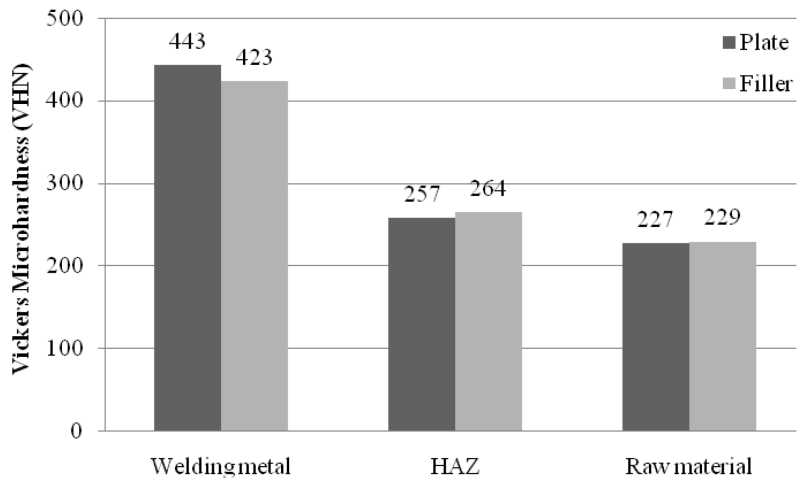

Fig. 5 Hardness Number of Cladding Steel Welded

Summary

Based on the results of tests that have been carried out in research into the repaired of the backhoe bucket with cladding method with variations in the welding process with variations of filler and plate, the following conclusions can be drawn:

- The chemical composition of cladding steel welded such as S, Ni, Si, Cr, Mn, N, Cu and Ti has increased, but the element C has decreased. The reduction of element C causes the mechanical properties of the filler variation to increase, this is seen in bending testing
- Cladding with plate variations have better mechanical properties because have better hardness, tensile strength and strain values than filler variations.

- The corrosion rate on cladding steel weled with plate variations has very poor corrosion resistance with a value of 4.2429 mmpy compared to raw material specimens and filler variation with a value of 1.4358 mmpy.

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