Gmail

Irza Sukmana <irza.sukmana@gmail.com>

[jit] Submission Acknowledgement

1 message

Irza Sukmana <bksptnbaratteknik@gmail.com> Mon, Oct 28, 2019 at 10:05 AM
To: Irza Sukmana <irza.sukmana@gmail.com>

Irza Sukmana:

Thank you for submitting the manuscript, "Rancang Bangun Awal Alat Ukur Tekanan (Forging) Untuk Aplikasi Pengelasan Gesek" to Jurnal Inovasi Teknologi. With the online journal management system that we are using, you will be able to track its progress through the editorial process by logging in to the journal web site:

Submission URL: https://ojs.umrah.ac.id/index.php/jit/authorDashboard/submission/1574
Username: irza_sukmana

If you have any questions, please contact me. Thank you for considering this journal as a venue for your work.

Irza Sukmana

Jurnal Inovasi Teknologi

Jurnal Inovasi Teknologi
Vol. 01, No. 01, hal. 1- 6, Oktober 2019
JURNAL INOVASI TEKNOLOGI
ISSN xxxx-xxxx (Online)
ISSN xxxx-xxxx (Print)
DOI: xxxx.xxxx.xvz

Commented [U1]: Please use our net template and write your manuscript in english

Commented [U2]: You may ask jit for a translation service for your manuscript if needed

Rancang Bangun Awal Alat Ukur Tekanan (*Forging*) Untuk Aplikasi Pengelasan Gesek

Bagus Muhammad Fauzi, Irza Sukmana*, Yanuar Burhanuddin
Jurusan Teknik Mesin, Fakultas Teknik, Universitas Lampung
Jl. Prof. Dr. Sumantri Brojonegoro No. 1, Bandar Lampung
*Corresponding Author: irza.sukmana@gmail.com

Abstract— Friction welding is a metal joining which is done without melting beforehand where the process is to combine using the rotation rate in one of the work materials. In previous studies the forging pressure parameters used for friction welding did not have a definite reference to the strength of the joint in friction welding. This last project is to design the initial design and fabrication forging measuring instrument for application of friction welding. The steps include conceptual of design, embodiment process, and performance analysis. The conceptual design result include hollow iron U shape, telescopic iron, and telescopic iron with screw. The measuring system uses a 500kg load cell, Arduino Leonardo, HX711 amplifier, and datalogger. Furthermore, after all components are assembled, then the load cell calibration is performed to determne the calibration factor. The next stage is to do a pressure test to see the performance of the performance of forging measuring instrument of friction welding.
Keywords— *Friction Welding, Load Cell, HX711 Amplifier, Arduino*

Commented [U3]: The abstract has been written use an IMRAD, good

Commented [U4]: Keynote should be not in capital unless the brand name

Intisari— Pengelasan gesek adalah teknik penyambungan logam yang dilakukan tanpa pencairan terlebih dahulu dimana prosesnya adalah penggabungan menggunakan laju putaran di salah satu material kerja. Dalam penelitian sebelumnya parameter *forging pressure* yang digunakan untuk pengelasan gesek ini tidak memiliki referensi yang pasti terhadap kekuatan sambungan pada pengelasan gesek. Tugas akhir ini adalah untuk rancang bangun awal alat ukur tekanan (*forging*) untuk aplikasi pengelsan gesek. Tahapannya meliputi konseptual desain, proses embodiment dan analisis kinerja. Hasil konseptual desain meliputi besi *hollow* U, besi *telescopic* dan besi *telescopic* ulir. Sistem pengukur menggunakan load cell 500kg, Arduino Leonardo, *amplifier* HX711, dan *datalogger*. Selanjutnya setelah semua komponen dirakit, kemudian dilakukan kalibrasi load cell untuk mengetahui faktor kalibrasi. Tahapan selanjutnya adalah melakukan uji tekanan untuk melihat unjuk kerja dari alat ukur tekanan (*forging*) pengelasan gesek ini.
Kata kunci— *Pengelasan gesek, load cell, amplifier HX711, Arduino*

Commented [U5]: Abstrak Bahasa Indonesia dihilangkan

I. PENDAHULUAN

Las gesek (*friction welding*) merupakan salah satu teknik penyambungan logam yang sulit dilakukan dengan metode pengelasan cair. Pada pengelasan gesek (*friction welding*) proses penyambungan logam dilakukan tanpa pencairan terlebih dahulu. Dimana proses pengelasan tersebut terjadi akibat penggabungan antara laju putaran salah satu benda kerja yang berputar. Gesekan putaran dari salah satu benda kerja tersebut akan menghasilkan panas yang dapat meluluhkan kedua ujung benda kerja yang bergesekan dan akhirnya terjadi proses penyambungan (Ardianto, 2015).

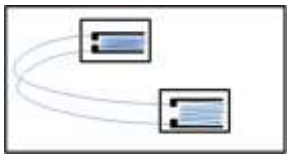
Dalam penelitian sebelumnya yang telah dilakukan oleh Nasution (Nasution, 2014),

pengelasan gesek dengan material besi – *stainless steel* dimana menggunakan parameter *forging pressure*. Namun *forging pressure* yang digunakan belum mempunyai referensi yang akurat tentang pengaruh kekuatan sambungan pada pengelasan gesek. Lalu melalui penelitan yang dilakukan oleh Solihin (Solihin, 2016) proses pengelasan gesek yang dilakukan tidak menggunakan parameter tekanan (*forging*) melainkan dengan parameter waktu kontak dan kecepatan putar, sehingga besar kemungkinan kualitas sambungan dari pengelasan gesek dipengaruhi oleh tekanan selama proses pengelasan.

II. TINJAUAN PUSTAKA

2.1 *Strain Gage*

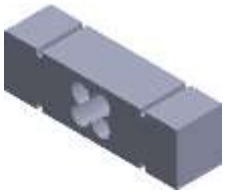
Strain Gage adalah sebuah transduser pasif yang merubah suatu pergeseran mekanis menjadi perubahan tahanan. Karena tekanan dari beban yang ditimbang, menyebabkan tahanan dari foil kawat (timah atau perak yang berukuran tipis) berubah terhadap panjang. Dan apabila bahan pada salah satu gage disatukan dan akan mengalami tarikan atau tekanan. Perubahan yang teerjadi pada tahanannya sebanding dengan perubahan regangan. Perubahan inilah yang diukur dengan jembatan *Wheatstone* dan tegangan keluaran yang dihasilkan dijadikan referensi beban yang diterima *Load Cell* (Handinata, 2012 : 3).



Gambar 1. *Strain Gage*

2.2 *Load Cell*

Load cell merupakan transduser gaya yang mengukur gaya dengan cara mengukur defleksi yang diakibatkan oleh gaya tersebut. *Load Cell* merupakan komponen inti yang terdapat pada timbangan digital. Komponen sensor dalam load cell yang digunakan untuk mengukur besarnya defleksi adalah *strain gauge*. (Nuryanto, 2015).



Gambar 2. *Load Cell*

2.3 *Mikro Kontroler*

Mikro kontroler adalah sistem mikro prosesor lengkap yang terkandung di dalam sebuah chip. Mikro kontroler berbeda dari mikro prosesor serbaguna yang digunakan dalam sebuah PC, karena sebuah mikro kontroler umumnya telah berisi komponen pendukung sistem minimal mikro prosesor, yakni memori dan pemrograman *Input-Output*. Mikro kontroler dapat diprogram untuk melakukan penghitungan, menerima *input* dan menghasilkan *output*. Mikro kontroler mengandung sebuah inti prosessor, memori dan pemrograman *Input-Output***.** (Oktariawan, 2013).

III. METODOLOGI PENELITIAN

Dalam rancang bangun awal alat ukur tekanan untuk aplikasi pengelasan gesek dibagi menjadi beberapa tahapan yakni konseptual desain, proses *embodiment*, dan analisis kinerja. Dalam tahap konseptual desain terdapat beberapa proses yang dilakukan. Proses tersebut dijelaskan berikut:

1) Pembuatan Konsep Desain

Pada fase ini beberapa konsep dibentuk, konsep ini dibentuk berdasarkan pada daftar persyaratan yang telah didapati dari fase perencanaan dan penjelasan tugas. Konsep tersebut merupakan solusi merupakan masalah perancangan yang harus dipecahkan.

2) Pemilihan Konsep Desain

Pemilihan konsep ini bertujuan untuk melanjutkan ke tahap *embodiment design*

ISSN xxxx-xxxx (Online)
ISSN xxxx-xxxx (Print)

yang dipilih adalah konsep yang paling baik dari konsep yang lainnya, dari segi kemudahan masuk dan keluarnya material, fabrikasi, biaya pembuatan komponen,kemampuan diasembly/dirakit, pengoperasian, dan perawatan.

3) Pewujudan (*embodiment*) Konsep Desain

Setelah melalui beberapa tahap perencanaan diatas, maka tahap selanjutnya adalah mengembangkan konsep yang telah dipilih berdasarkan persyaratan awal yang telah ditentukan, kemudian dibuat menjadi model desain 3 dimensi menggunakan aplikasi CAD (*Computer Aided Design*) Solidworks 2016.

Gambar 3 Konsep Alat Ukur Tekanan Pengelasan Gesek

4) Perencanaan Komponen Utama

Dalam proses perancangan perangkat alat ukur tekanan (*forging*) pengelasan gesek ini terdiri dari empat komponen utama yang perlu dianalisis kemampuannya ketika pengoperasian yang sesungguhnya dilakukan. Yakni pada bagian besi *hollow* U, *telescopic* , *telescopic* ulir, dan sistem arduino . Untuk komponen sistem arduino merupakan komponen yang mengoperasikan *load cell* sebagai alat ukur tekanan (*forging*) pengelasan gesek.

Gambar 4 Skema Diagram Antar Muka Sistem Arduino

Tahap selanjutnya adalah proses *embodiment* , yang merupakan fase lanjutan dari fase konseptual desain, tujuan dari fase ini adalah mengetahui kemampuan dari konsep desain yang telah terpilih pada tahap sebelumnya. Keluaran dari tahap ini berupa rangka alat yang telah dirakit dan pengujian alat ukur tekanan yang dilakukan.

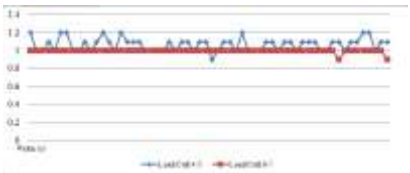
Dan dalam tahap analisis kinerja diberikan analisis hasil kinerja alat dengan parameter hasil pengujian dan penggunaan dari alat ukur tekanan (forging) pengelasan gesek dengan menambahkan poin positif dan poin negatif.

IV. HASIL DAN PEMBAHASAN

4.1 Proses *Embodiment*

Tahap ini merupakan fase lanjutan dari fase konsep desain, tujuannya adalah untuk menilai apakah alat ukur tekanan (forging) pengelasan gesek ini mampu mengolah data dari uji coba dengan kalibrasi beban menggunakan pemberat berskala dan pengujian dengan kayu dan magnesium AZ31B. Sebelumnya telah dilakukan pemilihan konsep dimana dipilih konsep ketiga sebagai konsep yang akan dikembangkan. Konsep ini mempunyai keunggulan yakni adanya mekanisme lepas load cell sehingga terjadi tarik dan tekan, dengan demikian dapat diperoleh hasil yang maksimal. Konsep ketiga memiliki beberapa komponen seperti, besi hollow U, telescopic, telescopic ulir, baut – baut, dan load cell.

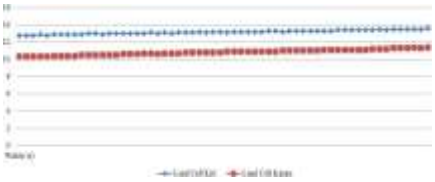
Berikut adalah hasil nilai kalibrasi dan uji coba alat ukur.



Gambar 5. Grafik Nilai Kalibrasi Alat Ukur Tekanan Pegelasan Gesek

Dari hasil uji coba ini dapat kita lihat bahwa pada *load cell* sebelah kiri nilai kalibrasi yang diperoleh sebesar 430,00 dengan rata-rata nilai keluaran 1,07 kg. Apabila nilai kalibrasi dinaikkan menjadi 440,00 maka hasil yang diperoleh kurang memuaskan karena nilai rata-rata yang diperoleh kurang dari 1kg dari skala pemberat. Nilai ini diambil dalam 1 menit uji coba *load cell*. Sebaliknya pada *load cell* kanan nilai kalibrasi yang diperoleh sebesar 970,00 dengan nilai keluaran rata-rata sebesar 0,997 kg. Nilai kalibrasi ini lebih besar dari perolehan nilai kalibrasi *load cell* sisi kiri karena bentuk dari *load cell* kiri dan *load cell* kanan yang berbeda tetapi memiliki nilai beban maksimum yang sama yakni 500 kg. Di *load cell* sisi kanan nilai yang diperoleh lebih memuaskan karena nilai yang dihasilkan dari uji coba lebih stabil di 1kg.

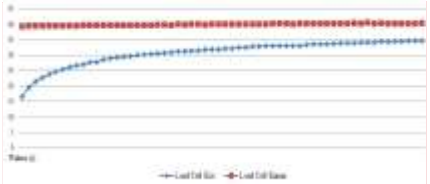
Setelah dilakukan kalibrasi untuk mengetahui nilai kalibrasi dari tiap *load cell* maka dilakukan pengujian nyata dengan kayu dan magnesium AZ31B. Terlebih dahulu dilakukan pengujian dengan menggunakan kayu untuk mengetahui kemampuan ukur terhadap benda dengan sifat elastis yang tinggi. Untuk membuat kondisi yang nyata maka dilakukan pengujian dengan meletakkan spesimen pada mesin bubut untuk mengetahui kemampuan dari alat ukur tekanan (*forging*) pengelasan gesek. Adapun hasil pengujian tekanan dengan menggunakan kayu adalah sebagai berikut.



Gambar 6 Pengujian Tekanan Dengan Menggunakan Kayu

Dari hasil pengujian *load cell* dengan menggunakan kayu sebagai objek pengujian diperoleh bahwa nilai keluaran *load cell* kiri menunjukkan nilai tekanan sebesar 128.3717 kg dengan nilai kalibrasi 430.00. Nilai ini lebih besar dari nilai keluaran *load cell* kanan dimana diperoleh nilai tekanan sebesar 53.33833 kg dengan nilai kalibrasi 970.00.

Kemudian pengujian dilakukan dengan menggunakan magnesium AZ31B sebagai bahan pengujian yang mana diketahui bahwa magnesium merupakan salah satu bahan yang digunakan dalam proses pengelasan gesek. Pada proses pengujiannya objek magnesium yang digunakan berukuran 141mm × 132mm × 56mm. Objek pengujian juga diletakkan dengan menempel pada *chuck* sehingga dapat diperoleh nilai tekan yang maksimal. Berikut adalah grafik dan tabel hasil percobaan pengujian tekanan dengan menggunakan Magnesium AZ31.



Gambar 7. Grafik Pengujian Tekanan Menggunakan Magnesium

Commented [U6]: Please explain the meaning of this fugue related to your aim of study

Dari hasil pengujian tekanan dengan magneium dapat diketahui bahwa nilai keluaran *load cell* kiri menghasilkan nilai keluaran rata-rata sebesar 211.935 kg dengan nilai kalibrasi 430.00. Sedangkan nilai keluaran rata-rata dari *load cell* kanan sebesar 155.1867 kg dengan nilai kalibrasi 970.00 yang artinya nilai keluaran *load cell* kanan lebih tinggi pada pengujian tekanan dengan magnesium AZ31B.

4.2 Analisis Kinerja

Jurnal Inovasi Teknologi
Vol. 01, No. 01, hal. 1- 4, Oktober 2019

ISSN xxxx-xxxx (Online)
ISSN xxxx-xxxx (Print)

Tahap ini merupakan lanjutan dari proses *embodiment* untuk analisa kerja dan kinerja dari alat ukur tekanan (*forging*) pengelasan gesek. Pada tahap ini ada beberapa poin penting yang terbagi menjadi dua yakni sisi positif dan sisi negatif dari alat ukur tekanan (*forging*) pengelasan gesek.

Berikut ini adalah tabel analisis kinerja dari alat ukur tekanan (*forging*) pengelasan gesek sebagai berikut.

Tabel 1. Analisis Kinerja Alat Pegukur Tekanan Pengelasan Gesek

Analisis Kinerja	Skor				
	1	2	3	4	5
Kemampuan dirakit/ disembly				■	
Kepraktisan dalam penggunaan alat				■	
multifungsi, dapat digunakan untuk mengukur tekanan				■	
sistem mikrokontroler			■		
Berat rangka alat		■			
Masalah Mekanisme Gerak			■		
Keakurasian					■
Fabrikasi dan biaya pembuatan		■			
Pengoperasian alat				■	
Perawatan Alat					■

Keterangan :
1 = Sangat Kurang 4 = Baik
2 = Kurang 5 = Sangat Baik
3 = Cukup

Hasil penilaian analisis kinerja alat pengukur tekanan (*forging*) pengelasan gesek dapat disimpulkan bahwa alat memiliki kemampuan untuk ditingkatkan kembali pada sistem akuisisi data arduino dengan melakukan penggantian pada komponen *datalogger*. Terkait masalah mekanisme gerak, bisa dilakukan pemberian *grease* untuk memudahkan gerak maju atau mundur. Sehingga untuk pengambilan data dapat lebih optimal dengan perangkat *datalogger* yang bekerja mengakuisisi data proses tekanan (*forging*). Untuk keakuratan alat dalam pengujian tekanan diberikan nilai sangat baik karna mampu menghasilkan nilai tekanan. Namun untuk masalah berat rangka alat belum ditemukan solusi untuk mengurangi berat rangka alat.

V. KESIMPULAN

Konsep desain alat ukur tekanan (*forging*) pengelasan gesek yang menggunakan mekanisme besi *telescopic* dengan metode penguncian baut pada bagian atas dan mekanisme lepas pada bagian bawah. Konsep ini merupakan yang terbaik dari segi kemampuan, keakuratan, pengoperasian, dan perawatan. Pengujian tekan dengan menggunakan kayu pada *load cell* kiri menghasilkan nilai 128.3717 kg dengan nilai kalibrasi 430.00 dan *load cell* kanan menghasilkan nilai 53.33833 kg dengan nilai kalibrasi 970.00. Pengujian tekan dengan menggunakan Magnesium AZ31 pada *load cell* kiri menghasilkan nilai 211.935 kg dengan nilai kalibrasi 430.00 dan pada *load cell* kanan menghasilkan nilai 155.1867 kg dengan nilai kalibrasi 970.00. Adanya perbedaan bentuk desain antara *load cell* sebelah kiri dan *load cell* sebelah kanan sehingga nilai kalibrasi yang dihasilkan berbeda satu sama lain meskipun kedua *load cell* sama-sama memiliki nilai beban maksimum sebesar 500kg.

UCAPAN TERIMA KASIH

Penulis mengucapkan terima kasih atas dukungan finansial melalui penelitian Hibah Kompetensi Kemenristekdikti TA 2016.

REFERENSI

[1] Ardianto , A.F, 2015. *Kekuatan puntir sambungan las gesek Al-Mg-Si dengan variasi sudut chamfer dua sisi dan kekasaran.* Universitas Brawijaya. Malang.

[2] Handinata, O, 2012, *Pengembangan Rancang Bangun Alat Pengukur Indeks Massa Tubuh Berbasis Atmega8535 Dan Databasenya Berbasis PC*, Jurnal Fisika, Fakultas MIPA, Universitas Sumatera Utara.

[3] J.K.Gupta, R.S.Khurmi. (2005) *A Text Book Of machine Design*, Ram Nagar, New Delhi.

[4] Magga, R, 2011.*Penggunaan Strain Gage (Load Cell) Untuk Analisa Tegangan Pada Pembebanan Statik Batang Aluminium*. Jurusan Teknik Mesin, Fakultas Teknik, Universitas Tadulako.

[5] *Nasution.A.K, 2014. Partially degradable friction-welded pure iron-stainless steel 316L bone pin. Faculty of Biosciences and Medical Engineering, Universiti*

Commented [U8]: Please translate and prrof read your conclusion in English

Commented [U7]: Explain how you make sure that this table was am appropriate tools for evaluating your product

Teknologi Malaysia, Johor Bahru 81310, Malaysia.

[6] Nurcahyono, D, 2017.*Analisis Kalibrasi Load Cell Tarik Tipe Pancake Dengan Metode Kalibrasi Tekan*. Pusat Penelitian Metrologi-LIPI. Banten.

[7] Nuryanto, R. (2015). *Pengukur Berat dan Tinggi Badan Ideal Berbasis Arduino*. Karya Ilmiah Program Sarjana. Surakarta: Universitas Muhammadiyah Surakarta.

[8] Oktariawan, I. 2013. *Pembuatan Sistem Otomasi Dispenser Menggunakan M[1]ikrokontroller Arduino Mega 2560.* Jurusan Teknik Mesin, Fakultas Teknik, Universitas Lampung.

[9] Solihin, 2016. *Pengaruh Kecepatan Putar Dan Waktu Kontak Pada Friction Welding Magnesium AZ31 Terhadap Kualitas Sambungan Las*, Jurusan Teknik Mesin, Fakultas Teknik, Universitas Lampung.

Commented [U9]: Should be written in English and we asked a resources max 10 years beorer

Gmail

Irza Sukmana <irza.sukmana@gmail.com>

Artikel Vol1 Ed1, mohon dicek dan direvisi (if any)

1 message

Journal Innovation and Technology <jit.bksptn@gmail.com> Sun, Mar 15, 2020 at 4:38 AM
To: irza.sukmana@gmail.com
Cc: Sapta Nugraha <saptanugraha@umrah.ac.id>

Dear Author(s),

Bersama ini kami lampirkan file artikel Bapak/Ibu yang sudah direview dan ditulis ulang sesuai template final JIT BKS PTN Barat. Perlu kami informasikan bahwa sesuai dengan rencana pengembangan JIT ke depan akan secara penuh diterbitkan dalam Bahasa Inggris. Untuk itu pada Volume 1 Edisi 1, April 2020 ini akan berisi 8 artikel ilmiah dimana 5 diantaranya berbahasa Inggris dan 3 lainnya dalam Bahasa Indonesia.

Kita harapkan mulai Edisi 2, Oktober 2020 dan seterusnya seluruh artikel berbahasa Inggris.

Untuk memastikan standar kualitas artikel tersebut, kami mohon agar Bapak Ibu contributor dapat mendownload artikelnya dan melakukan perbaikan yang diminta (bila ada komentar tinta merah) dan mengirimkan ulang perbaikan artikel versi finalnya melalui email ini paling lambat Jum'at 20/3/2020.

Atas perhatian dan kerjasamanya kami ucapkan terima kasih.

Regards,

Editorial Board
Journal of Innovation and Technology
Engineering Forum to BKS PTN Barat - Indonesia
Direct phone/WA : +62 811-7747-774

Article3_V1Ed1_April2020_Irza_EdRev1.doc
398K

Jurnal Inovasi Teknologi
Vol. 01, No. 01, hal. 1- 6, Oktober 2019
JURNAL INOVASI TEKNOLOGI
ISSN xxxx-xxxx(Online)
ISSN xxxx-xxxx (Print)
DOI: xxxx.xxxx.xyz

Initial Design of Forging Measuring Instrument For Application of Friction Welding

Bagus Muhammad Fauzi, Irza Sukmana*, Yanuar Burhanuddin
Department of Mechanical Engineering, Faculty of Engineering, Universitas Lampung
Jl. Prof. Dr. Sumantri Brojonegoro No. 1, Bandar Lampung
*Corresponding Author: irza.sukmana@gmail.com

Abstract - Friction welding is a metal joining technique without melting beforehand in which the process is to combine the rotation rate in one of the work materials. In the previous studies, the forging pressure parameters used for friction welding did not have a definite reference to the strength of the joint in friction welding. This project is to make initial design of forging measuring instrument for application of friction welding. The steps include conceptual design,embodiment process, and performance analysis. The conceptual design result includes hollow iron Ushape, telescopiciron, and telescopic iron with screw. The measuring system uses a 500 kg load cell, Arduino Leonardo, HX711amplifier, and data logger. Then, after all components are assembled, the load cell calibration is performed to determine the calibration factor. The next stage is to do pressure test to see the performance of forging measuring instrument of friction welding.

Keywords - *Friction Welding, Load Cell, HX711 Amplifier, Arduino*

I. INTRODUCTION

Friction welding is one of the metal joining techniques that is hard to do with liquid welding method. In friction welding, metal joining process is without melting the metal beforehand, in which the process is to combine the rotation rate in one of the work materials. The rotation of friction in one of the working materials will heat and melt both joints thus causing joining process (Ardianto, 2015).

In the previous study conducted by Nasution (Nasution, 2014), friction welding used iron material - *stainless steel*, with *forging pressure* parameter. However, *forging pressure* used still did not have an accurate reference to the strength of the joint yet. Another study conducted by Solihin (Solihin, 2016) shows that friction welding did not use forging parameter but time-contact and rotation speed parameter, thus making the connection quality of this friction welding is most probably affected by pressure during welding process.

II. LIBRARY RESEARCH

2.1 *Strain Gage*

Strain Gage is a passive transducer that converts mechanical friction into resistance one. As pressure and tension are measured, resistance of wire foil (thin tin or silver) changes its length. If one of materials at the gage is attached, it will cause strain or pressure. It is this conversion that is measured with *Wheatstone* bridge and the output pressure resulted is made as force reference accepted by *Load Cell* (Handinata, 2012 :3).

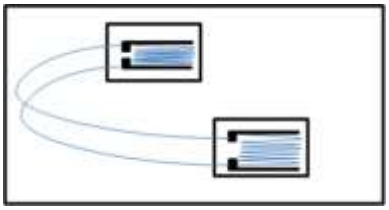
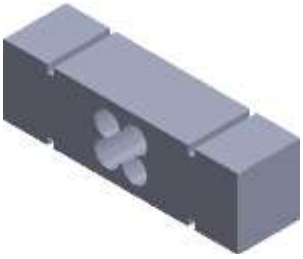


Figure 1. *Strain Gage*

2.2 *Load Cell*

Load cell is a transducer to measure force by measuring deflection caused by that force. *Load Cell* is the core component in digital scale. The sensory component in the load cell used to measure deflection is *strain gauge*. (Nuryanto, 2015).



Gambar 2. *Load Cell*

2.3 *Micro Controller*

Micro controller is a complete microprocessor system in a chip. Micro controller is different from multi-function one in a PC because a typical micro controller contains with supporting components of a minimal microprocessor system, that is, memory and programming of *Input-Output*. Micro controller is capable for programming to operate a calculation, accepting *input* and generating *output*. Micro controller contains with core processor, memory, and programming of *Input-Output***.** (Oktariawan, 2013).

III. RESEARCH METHODOLOGY

Initial Design of Forging Measuring Instrument For Application of Friction Welding is divided into some phases, namely: conceptual design, *embodiment* process, and analysis of performance. In conceptual design, there are processes to follow, namely:

1) Making conceptual design.

This phase is how the concept is made based on the planning list and its duties. The concept is the solution of the planning that must be solved.

2) Selecting conceptual design.

Selecting concept is aimed at continuing to the phase of *embodiment design*, in which the best concept is selected on the basis of the availability of the materials, fabrication, the cost of making components, capability of assembling, operating, and maintaining.

3) *Embodiment of* conceptual design

After passing some planning phases above, the next phase is developing the selected concept one based on early requirement, changing into 3-dimension design using CAD application (*Computer Aided Design*) Solidworks2016.

Figure 3 Concept of Forging Measurement Tool for Friction Welding

4) Planning of Main Component

In the planning process of forging measurement tool, friction welding consists of four main components. It is necessary to analyze their force before the actual operation starts. These components include *hollow* U iron, *telescopic*, *telescopic* iron with screw, and Arduino system. Arduino system is component that operates *load cell* as forging measurement tool for friction welding.

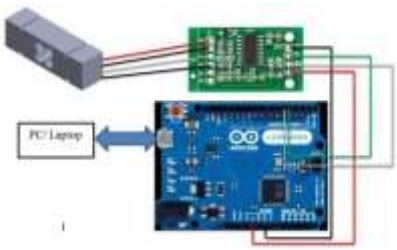


Figure 4 Scheme of Face Tracking Diagram of Arduino System

ISSN xxxx-xxxx (Online)
ISSN xxxx-xxxx (Print)

The next phase is *embodiment* process, as the continuation of conceptual design phase. This phase is aimed at identifying the force of selected concept in the previous phase. The output of this phase is the form of tool frame that has been assembled and tested by forging measurement tool.

Analysis of performance phase will show the test result of forging measurement tool of friction welding. It will add positive and negative points of friction welding.

IV. RESULT AND DISCUSSION

4.1 Process of *Embodiment*

This is continual phase of conceptual design. It aims at assessing whether or not forging measurement tool of friction welding capable of processing trial data by calibrating height using height scale and testing with wood and magnesium AZ31B. Prior to this phase, the third concept to develop has been chosen. This concept is superior as it has unattached load cell mechanism so as to pull and press the force optimally. This third concept has some components, namely: hollow iron U, telescopic, telescopic iron with screw, and load cell. The following is the result of calibration value and forging measurement tool testing.

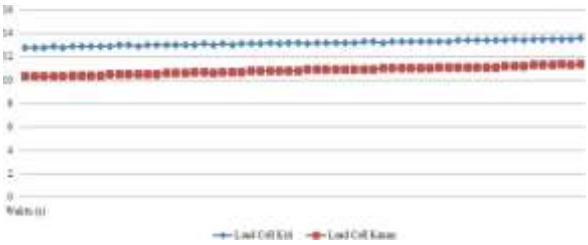


Figure 5. Calibrated Value Graphic of Forging Measument Tool of friction welding

This trial test shows that the calibrated value of *load cell* on the left is 430,00 with approximate output value of 1,07 kg. If calibrated value is elevated to 440,00, the result will be less satisfactory as its approximate value is less than 1 kg of the height scale. This value is derived from 1 minute trial test of *load cell*. While, the calibrated value of *load cell* on the right is 970,00 with approximate value of 0,997 kg. This calibrated value is bigger than on the left one due to their difference in shape. However, their maximal height value is the same, that is, 500 kg. The *load cell* on the right has more satisfactory value as it generates a more stable trial testing, that is, 1kg.

After calibrated value was performed to find out each calibration in each *load cell*, then the actual testing on wood and magnesium AZ31B was performed. Firstly, testing on wood was performed to find out the measurement force on highly elastic materials. To make it as an actual condition, a specimen was tried on lathe to find out the force of forging measurement tool of friction welding. The result showing forging testing on wood as on Figure 6.

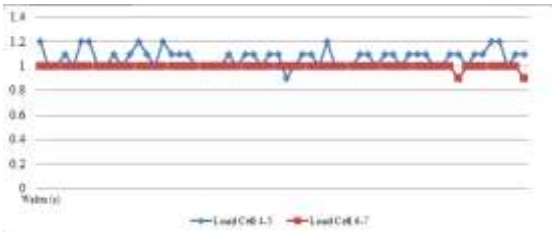


Figure 6 Forging Testing on Wood

Forging testing on wood shows that the output value of *load cell* on the left is 128.3717 kg with calibrated value of 430.00. It is bigger than the output value of load *cell* on the right, that is 53.33833 kg with calibrated value of 970.00.

Next, the testing using magnesium AZ31B was performed. It is already known that magnesium is one of the materials used in friction welding process. The size of magnesium used in this testing is 141mm × 132mm × 56mm. The tested object is attached to the *chuck* so as to generate optimal force. The following is

graphic and table of forging measurement tool using Magnesium AZ31.

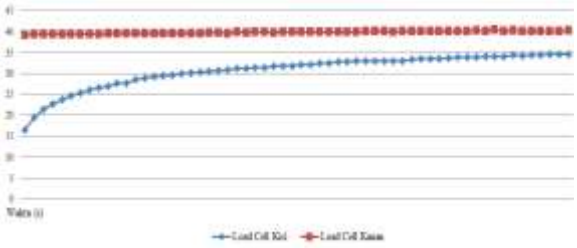


Figure 7. Graphic of Forging measurement using Magnesium

Forging testing shows that the output value of *load cell* on the left is approximately 211.935 kg with calibrated value of 430.00. While, the output value of *load cell* on the right is approximately 155.1867 kg with calibrated value of 970.00. It tells us that the output value of *load cell* on the right is higher than the forging testing using magnesiumAZ31B.

4.2 Analysis of Performance

This phase is the continuation of *embodiment* process which aims at analyzing working and performance of forging measurement tool of friction welding. There are two important points of positive and negative ones for this forging measurement tool of friction welding.

The following is the Table for analysis of performance of forging measurement tool of friction welding.

Table 1. Analysis of Performance of forging measurement tool of friction welding

Analisis Kinerja	Skor				
	1	2	3	4	5
Kemampuan dirakit/ diasembly				■	
Kepraktisan dalam penggunaan alat				■	
multifungsi, dapat digunakan untuk mengukur tekanan				■	
sistem mikrokontroler			■		
Berat rangka alat		■			
Masalah Mekanisme Gerak			■		
Keakuratan					■
Fabrikasi dan biaya pembuatan		■			
Pengoperasian alat				■	
Perawatan Alat					■

Description:
1 =The worst
2 =Worse
3 =Fair
4 =Good
5 = Excellent

It can be concluded from this analysis that the tool is capable for improvement on acquisition of Arduino data system by conversion on *datalogger* component. Related to moving mechanism, greasing can be added to ease forward and backward movement. By doing so, a more optimal data collection using *datalogger* software will work well in doing acquisition of forging data process. For the accuracy of tool when performing forging, the testing indicates an excellent description as it is capable of generating force. However, there is still problem with the weight of tool that needs solution to decrease its weight.

V. CONCLUSION

Conceptual design of forging measurement tool of friction welding uses mechanism of *telescopic* iron, screw locking method at the top part, and loose mechanism at down part. This concept is the best to the extent of its capacity, accuracy, operation, and maintenance. Forging testing on wood at *load cell* on the left generates 128.3717 kg with calibrated value of 430.00 and *load cell* at the right generates 53.33833 kg with calibrated value of 970.00. Forging testing on Magnesium AZ31 at *load cell* on the left generates 211.935 kg with calibrated value of 430.00 and at *load cell* on the right generates 155.1867 kg with calibrated value of 970.00. The differences of model design between *load cell* on the left and *load cell* on the right also cause differences of calibrated value, yet both *load cells* have the same maximum forces, that is, 500kg.

ACKNOWLEDGEMENT

The writer wishes to thank for the financial grant for this research to Hibah Kompetensi Kemenristekdikti TA 2016.

REFERENSI

ISSN xxxx-xxxx (Online)
ISSN xxxx-xxxx (Print)

[1] Ardianto , A.F, 2015. *Kekuatan puntir sambungan las gesek Al-Mg-Si dengan variasi sudut chamfer dua sisi dan kekasaran.* Universitas Brawijaya. Malang.

[2] Handinata, O, 2012, *Pengembangan Rancang Bangun Alat Pengukur Indeks Massa Tubuh Berbasis Atmega8535 Dan Databasenya Berbasis PC*, Jurnal Fisika, Fakultas MIPA, Universitas Sumatera Utara.

[3] J.K.Gupta, R.S.Khurmi. (2005) *A Text Book Of machine Design*, Ram Nagar, New Delhi.

[4] Magga, R, 2011.*Penggunaan Strain Gage (Load Cell) Untuk Analisa Tegangan Pada Pembebanan Statik Batang Aluminium*. Jurusan Teknik Mesin, Fakultas Teknik, Universitas Tadulako.

[5] *Nasution.A.K, 2014. Partially degradable friction-welded pure iron-stainless steel 316L bone pin. Faculty of Biosciences and Medical Engineering, Universiti Teknologi Malaysia, Johor Bahru 81310, Malaysia.*

[6] Nurcahyono, D, 2017.*Analisis Kalibrasi Load Cell Tarik Tipe Pancake Dengan Metode Kalibrasi Tekan*. Pusat Penelitian Metrologi-LIPI. Banten.

[7] Nuryanto, R. (2015). *Pengukur Berat dan Tinggi Badan Ideal Berbasis Arduino*. Karya Ilmiah Program Sarjana. Surakarta: Universitas Muhammadiyah Surakarta.

[8] Oktariawan, I. 2013. *Pembuatan Sistem Otomasi Dispenser Menggunakan M[1]ikrokontroller Arduino Mega 2560.* Jurusan Teknik Mesin, Fakultas Teknik, Universitas Lampung.

[9] Solihin, 2016. *Pengaruh Kecepatan Putar Dan Waktu Kontak Pada Friction Welding Magnesium AZ31 Terhadap Kualitas Sambungan Las*, Jurusan Teknik Mesin, Fakultas Teknik, Universitas Lampung.

Jurnal Inovasi Teknologi
Vol. 01, No. 01, hal. 1- 6, Oktober 2019
JURNAL INOVASI TEKNOLOGI
ISSN xxxx-xxxx(Online)
ISSN xxxx-xxxx (Print)
DOI: xxxx.xxxx.xyz

Initial Design of Forging Measuring Instrument For Application of Friction Welding

Bagus Muhammad Fauzi, Irza Sukmana*, Yanuar Burhanuddin
Department of Mechanical Engineering, Faculty of Engineering, Universitas Lampung
Jl. Prof. Dr. Sumantri Brojonegoro No. 1, Bandar Lampung
*Corresponding Author: irza.sukmana@gmail.com

Commented [U1]: PLEASE RE-WRITE YOUR MANUSCRIPT ACCORDING TO OUR NEW TEMPLATE FOR PUBLICATION

Abstract - Friction welding is a metal joining technique without melting beforehand in which the process is to combine the rotation rate in one of the work materials. In the previous studies, the forging pressure parameters used for friction welding did not have a definite reference to the strength of the joint in friction welding. This project is to make initial design of forging measuring instrument for application of friction welding. The steps include conceptual design,embodiment process, and performance analysis. The conceptual design result includes hollow iron Ushape, telescopiciron, and telescopic iron with screw. The measuring system uses a 500 kg load cell, Arduino Leonardo, HX711amplifier, and data logger. Then, after all components are assembled, the load cell calibration is performed to determine the calibration factor. The next stage is to do pressure test to see the performance of forging measuring instrument of friction welding.

Keywords - *Friction Welding, Load Cell, HX711 Amplifier, Arduino*

I. INTRODUCTION

Friction welding is one of the metal joining techniques that is hard to do with liquid welding method. In friction welding, metal joining process is without melting the metal beforehand, in which the process is to combine the rotation rate in one of the work materials. The rotation of friction in one of the working materials will heat and melt both joints thus causing joining process (Ardianto, 2015).

In the previous study conducted by Nasution (Nasution, 2014), friction welding used iron material - *stainless steel,* with *forging pressure* parameter. However, *forging pressure* used still did not have an accurate reference to the strength of the joint yet. Another study conducted by Solihin (Solihin, 2016) shows that friction welding did not use forging parameter but time-contact and rotation speed parameter, thus making the connection quality of this friction welding is most probably affected by pressure during welding process.

II. LIBRARY RESEARCH

2.1 *Strain Gage*

Strain Gage is a passive transducer that converts mechanical friction into resistance one. As pressure and tension are measured, resistance of wire foil (thin tin or silver) changes its length. If one of materials at the gage is attached, it will cause strain or pressure. It is this conversion that is measured with *Wheatstone* bridge and the output pressure resulted is made as force reference accepted by *Load Cell* (Handinata, 2012 :3).

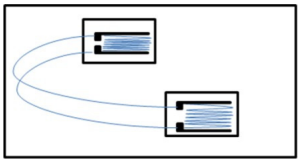
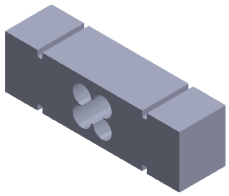


Figure 1. *Strain Gage*

2.2 *Load Cell*

Load cell is a transducer to measure force by measuring deflection caused by that force. *Load Cell* is the core component in digital scale. The sensory component in the load cell used to measure deflection is *strain gauge*. (Nuryanto, 2015).



Gambar 2. *Load Cell*

2.3 *Micro Controller*

Micro controller is a complete microprocessor system in a chip. Micro controller is different from multi-function one in a PC because a typical micro controller contains with supporting components of a minimal microprocessor system, that is, memory and programming of *Input-Output*. Micro controller is capable for programming to operate a calculation, accepting *input* and generating *output*. Micro controller contains with core processor, memory, and programming of *Input-Output***.** (Oktariawan, 2013).

III. RESEARCH METHODOLOGY

Initial Design of Forging Measuring Instrument For Application of Friction Welding is divided into some phases, namely: conceptual design, *embodiment* process, and analysis of performance. In conceptual design, there are processes to follow, namely:

1) Making conceptual design.

This phase is how the concept is made based on the planning list and its duties. The concept is the solution of the planning that must be solved.

2) Selecting conceptual design.

Selecting concept is aimed at continuing to the phase of *embodiment design,* in which the best concept is selected on the basis of the availability of the materials, fabrication, the cost of making components, capability of assembling, operating, and maintaining.

3) *Embodiment of* conceptual design

After passing some planning phases above, the next phase is developing the selected concept one based on early requirement, changing into 3-dimension design using CAD application (*Computer Aided Design*) Solidworks2016.

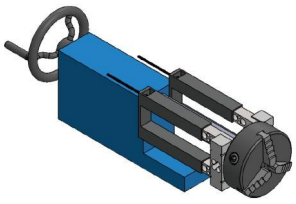


Figure 3 Concept of Forging Measurement Tool for Friction Welding

4) Planning of Main Component

In the planning process of forging measurement tool, friction welding consists of four main components. It is necessary to analyze their force before the actual operation starts. These components include *hollow* U iron, *telescopic*, *telescopic* iron with screw, and Arduino system. Arduino system is component that operates *load cell* as forging measurement tool for friction welding.

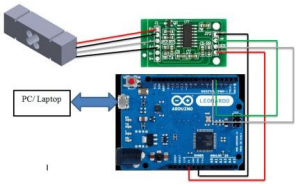


Figure 4 Scheme of Face Tracking Diagram of Arduino System

ISSN xxxx-xxxx (Online)
ISSN xxxx-xxxx (Print)

The next phase is *embodiment* process, as the continuation of conceptual design phase. This phase is aimed at identifying the force of selected concept in the previous phase. The output of this phase is the form of tool frame that has been assembled and tested by forging measurement tool.

Analysis of performance phase will show the test result of forging measurement tool of friction welding. It will add positive and negative points of friction welding.

IV. RESULT AND DISCUSSION

4.1 Process of *Embodiment*

This is continual phase of conceptual design. It aims at assessing whether or not forging measurement tool of friction welding capable of processing trial data by calibrating height using height scale and testing with wood and magnesium AZ31B. Prior to this phase, the third concept to develop has been chosen. This concept is superior as it has unattached load cell mechanism so as to pull and press the force optimally. This third concept has some components, namely: hollow iron U, telescopic, telescopic iron with screw, and load cell. The following is the result of calibration value and forging measurement tool testing.

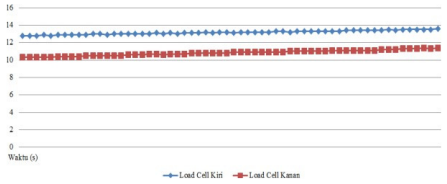


Figure 5. Calibrated Value Graphic of Forging Measument Tool of friction welding

This trial test shows that the calibrated value of *load cell* on the left is 430,00 with approximate output value of 1,07 kg. If calibrated value is elevated to 440,00, the result will be less satisfactory as its approximate value is less than 1 kg of the height scale. This value is derived from 1 minute trial test of *load cell*. While, the calibrated value of *load cell* on the right is 970,00 with approximate value of 0,997 kg. This calibrated value is bigger than on the left one due to their difference in shape. However, their maximal height value is the same, that is, 500 kg. The *load cell* on the right has more satisfactory value as it generates a more stable trial testing, that is, 1kg.

After calibrated value was performed to find out each calibration in each *load cell*, then the actual testing on wood and magnesium AZ31B was performed. Firstly, testing on wood was performed to find out the measurement force on highly elastic materials. To make it as an actual condition, a specimen was tried on lathe to find out the force of forging measurement tool of friction welding. The result showing forging testing on wood as on Figure 6.

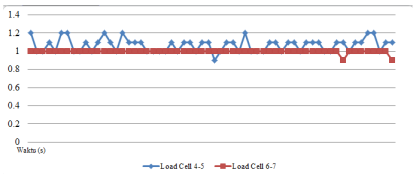


Figure 6 Forging Testing on Wood

Forging testing on wood shows that the output value of *load cell* on the left is 128.3717 kg with calibrated value of 430.00. It is bigger than the output value of load *cell* on the right, that is 53.33833 kg with calibrated value of 970.00.

Next, the testing using magnesium AZ31B was performed. It is already known that magnesium is one of the materials used in friction welding process. The size of magnesium used in this testing is 141mm × 132mm × 56mm. The tested object is attached to the *chuck* so as to generate optimal force. The following is

graphic and table of forging measurement tool using Magnesium AZ31.

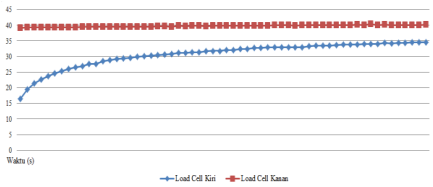


Figure 7. Graphic of Forging measurement using Magnesium

Forging testing shows that the output value of *load cell* on the left is approximately 211.935 kg with calibrated value of 430.00. While, the output value of *load cell* on the right is approximately 155.1867 kg with calibrated value of 970.00. It tells us that the output value of *load cell* on the right is higher than the forging testing using magnesiumAZ31B.

4.2 Analysis of Performance

This phase is the continuation of *embodiment* process which aims at analyzing working and performance of forging measurement tool of friction welding. There are two important points of positive and negative ones for this forging measurement tool of friction welding.

The following is the Table for analysis of performance of forging measurement tool of friction welding.

Table 1. Analysis of Performance of forging measurement tool of friction welding

Analisis Kinerja	Skor				
	1	2	3	4	5
Kemammpuan dirakit/ diasembly				■	
Kepraktrisan dalam penggunaan alat				■	
multifungsi, dapat digunakan untuk mengukur tekanan				■	
sistem mikrokontroler			■		
Berat rangka alat		■			
Masalah Mekanisme Gerak			■		
Keakuratan					■
Fabrikasi dan biaya pembuatan		■			
Pengoperasian alat				■	
Perawatan Alat					■

Description:
1 =The worst
2 =Worse
3 =Fair
4 =Good
5 = Excellent

It can be concluded from this analysis that the tool is capable for improvement on acquisition of Arduino data system by conversion on *datalogger* component. Related to moving mechanism, greasing can be added to ease forward and backward movement. By doing so, a more optimal data collection using *datalogger* software will work well in doing acquisition of forging data process. For the accuracy of tool when performing forging, the testing indicates an excellent description as it is capable of generating force. However, there is still problem with the weight of tool that needs solution to decrease its weight.

V. CONCLUSION

Conceptual design of forging measurement tool of friction welding uses mechanism of *telescopic* iron, screw locking method at the top part, and loose mechanism at down part. This concept is the best to the extent of its capacity, accuracy, operation, and maintenance. Forging testing on wood at *load cell* on the left generates 128.3717 kg with calibrated value of 430.00 and *load cell* at the right generates 53.33833 kg with calibrated value of 970.00. Forging testing on Magnesium AZ31 at *load cell* on the left generates 211.935 kg with calibrated value of 430.00 and at *load cell* on the right generates 155.1867 kg with calibrated value of 970.00. The differences of model design between *load cell* on the left and *load cell* on the right also cause differences of calibrated value, yet both *load cells* have the same maximum forces, that is, 500kg.

ACKNOWLEDGEMENT

The writer wishes to thank for the financial grant for this research to Hibah Kompetensi Kemenristekdikti TA 2016.

REFERENSI

ISSN xxxx-xxxx (Online)
ISSN xxxx-xxxx (Print)

[1] Ardianto , A.F, 2015. *Kekuatan puntir sambungan las gesek Al-Mg-Si dengan variasi sudut chamfer dua sisi dan kekasaran.* Universitas Brawijaya. Malang.

[2] Handinata, O, 2012, *Pengembangan Rancang Bangun Alat Pengukur Indeks Massa Tubuh Berbasis Atmega8535 Dan Databasenya Berbasis PC*, Jurnal Fisika, Fakultas MIPA, Universitas Sumatera Utara.

[3] J.K.Gupta, R.S.Khurmi. (2005) *A Text Book Of machine Design*, Ram Nagar, New Delhi.

[4] Magga, R, 2011.*Penggunaan Strain Gage (Load Cell) Untuk Analisa Tegangan Pada Pembebanan Statik Batang Aluminium*. Jurusan Teknik Mesin, Fakultas Teknik, Universitas Tadulako.

[5] *Nasution.A.K, 2014. Partially degradable friction-welded pure iron-stainless steel 316L bone pin. Faculty of Biosciences and Medical Engineering, Universiti Teknologi Malaysia, Johor Bahru 81310, Malaysia.*

[6] Nurcahyono, D, 2017.*Analisis Kalibrasi Load Cell Tarik Tipe Pancake Dengan Metode Kalibrasi Tekan*. Pusat Penelitian Metrologi-LIPI. Banten.

[7] Nuryanto, R. (2015). *Pengukur Berat dan Tinggi Badan Ideal Berbasis Arduino*. Karya Ilmiah Program Sarjana. Surakarta: Universitas Muhammadiyah Surakarta.

[8] Oktariawan, I. 2013. *Pembuatan Sistem Otomasi Dispenser Menggunakan M[1]ikrokontroller Arduino Mega 2560.* Jurusan Teknik Mesin, Fakultas Teknik, Universitas Lampung.

[9] Solihin, 2016. *Pengaruh Kecepatan Putar Dan Waktu Kontak Pada Friction Welding Magnesium AZ31 Terhadap Kualitas Sambungan Las*, Jurusan Teknik Mesin, Fakultas Teknik, Universitas Lampung.

JIT Journal of Innovation and Technology
e-ISSN: 2721-8562; p-ISSN: 2721-8570
Vol. 1, No. 1, April 2020. Page: XX – XX

Initial Design of Forging Measuring Instrument for Application of Friction Welding

Bagus Muhammad Fauzi[1], Irza Sukmana[1,*], Yanuar Burhanuddin[1]

[1] *Department of Mechanical Engineering, Faculty of Engineering, Universitas Lampung Jl. Prof. Dr. Sumantri Brojonegoro No. 1, Bandar Lampung, Indoneisa*

*Corresponding Author: irza.sukmana@gmail.com

Article history
Received:
Revised:
Accepted:

DOI: 10.31629/jit.vXXXXX

Abstract
Friction welding is a metal joining technique without melting beforehand in which the process is to combine the rotation rate in one of the work materials. In the previous studies, the forging pressure parameters used for friction welding did not have a definite reference to the strength of the joint in friction welding. This project is to make initial design of forging measuring instrument for application of friction welding. The steps include conceptual design, embodiment process, and performance analysis. The conceptual design result includes hollow iron U-shape, telescopic iron, and telescopic iron with screw. The measuring system uses a 500 kg load cell, Arduino Leonardo, HX711amplifier, and data logger. Then, after all components are assembled, the load cell calibration is performed to determine the calibration factor. The next stage is to do pressure test to see the performance of forging measuring instrument of friction welding.

Keywords: friction welding, load cell, HX711 amplifier, Arduino

1. Introduction

Friction welding is one of the metals joining techniques that is hard to do with liquid welding method. In friction welding, metal joining process is without melting the metal beforehand, in which the process is to combine the rotation rate in one of the work materials. The rotation of friction in one of the working materials will heat and melt both joints thus causing joining process as highlighted by others [1,2].

In the previous study, friction welding used for joining iron and stainless steel, with additional forging pressure parameter [2]. However, forging pressure used still did not have an accurate reference to the strength of the joint yet. Another study also shows that friction welding did not use forging parameter but time-contact and rotation speed parameter, thus making the connection quality of this friction welding is most probably affected by pressure during welding process [3].

2. Literature Review

2.1 Strain Gage

Strain Gage is a passive transducer that converts mechanical friction into resistance one. As pressure and tension are measured, resistance of wire foil (thin tin or silver) changes its length. If one of materials at the gage is attached, it will cause strain or pressure. It is this conversion that is measured with Wheatstone bridge and the output pressure resulted is made as force reference received by load-cells.

© 2020 by the authors. This open access article is distributed under a Creative Commons Attribution (CC-BY) license.

DOI: 10.31629/jit.v1i1.2129

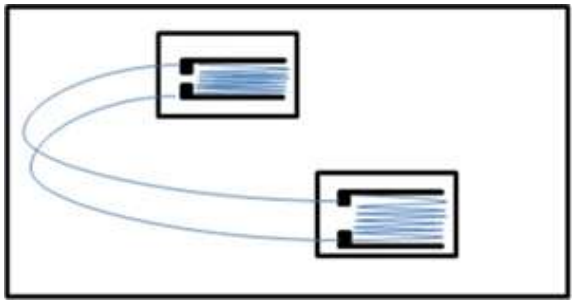


Figure 1. Strain Gage

2.2 Load Cell

Load cell is a transducer to measure force by measuring deflection caused by that force. Load Cell is the core component in digital scale. The sensory component in the load cell used to measure deflection is strain gauge.

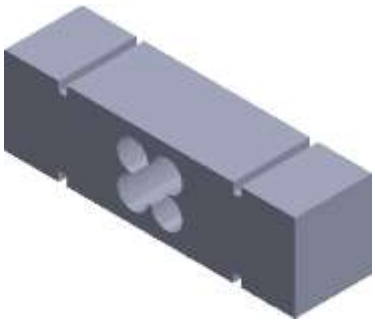


Figure 2. Load Cell

2.3 Micro Controller

Micro controller is a complete microprocessor system in a chip. Micro controller is different from multi-function one in a PC because a typical micro controller contains with supporting components of a minimal microprocessor system, that is, memory and programming of Input-Output. Micro controller is capable for programming to operate a calculation, accepting input and generating output. Micro controller contains with core processor, memory, and programming of Input-Output.

3. Research Methodology

Initial Design of Forging Measuring Instrument for Application of Friction Welding is divided into some phases, namely: conceptual design, embodiment process, and analysis of performance. In conceptual design, there are processes to follow, namely:

3.1Making Conceptual Design

This phase is how the concept is made based on the planning list and its duties. The concept is the solution of the planning that must be solved.

3.2 Selecting Conceptual Design

Selecting concept is aimed at continuing to the phase of embodiment design, in which the best concept is selected on the basis of the availability of the materials, fabrication, the cost of making components, capability of assembling, operating, and maintaining.

3.3 Embodiment of conceptual design

After passing some planning phases above, the next phase is developing the selected concept one based on early requirement, changing into 3-dimension design using CAD application (Computer Aided Design) Solidwork 2016.

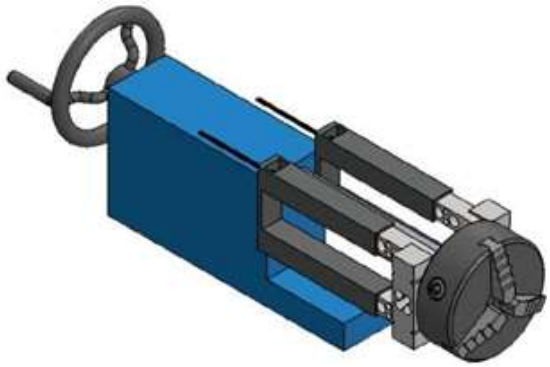


Figure 3. Concept of Forging Measurement Tool for Friction Welding

3.4 Planning of Main Component

In the planning process of forging measurement tool, friction welding consists of four main components. It is necessary to analyze their force before the actual operation starts. These components include hollow U iron, telescopic, telescopic iron with screw, and Arduino system. Arduino system is component that operates load cell as forging measurement tool for friction welding [4,5].

DOI: 10.31629/jit.v1i1.2129

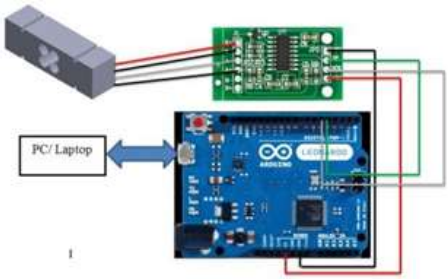


Figure 4. Scheme of Face Tracking Diagram using Arduino System

The next phase is embodiment process, as the continuation of conceptual design phase. This phase is aimed at identifying the force of selected concept in the previous phase. The output of this phase is the form of tool frame that has been assembled and tested by forging measurement tool.

Analysis of performance phase will show the test result of forging measurement tool of friction welding. It will add positive and negative points of friction welding.

4. Results and Discussion

4.1 Process of Embodiment

This is continual phase of conceptual design. It aims at assessing whether or not forging measurement tool of friction welding capable of processing trial data by calibrating height using height scale and testing with wood and magnesium AZ31B. Prior to this phase, the third concept to develop has been chosen. This concept is superior as it has unattached load cell mechanism so as to pull and press the force optimally. This third concept has some components, namely: hollow iron U, telescopic, telescopic iron with screw, and load cell.

The following is the result of calibration value and forging measurement tool testing [6].

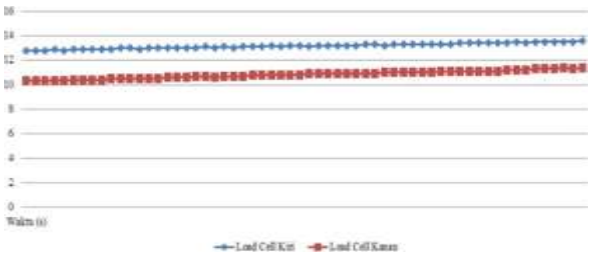


Figure 5. Calibrated Value Graphic of Forging Measument Tool of friction welding

This trial test shows that the calibrated value of load cell on the left is 430,00 with approximate output value of 1,07 kg. If calibrated value is elevated to 440,00, the result will be less satisfactory as its approximate value is less than 1 kg of the height scale. This value is derived from 1 minute trial test of load cell. While, the calibrated value of load cell on the right is 970,00 with approximate value of 0,997 kg. This calibrated value is bigger than on the left one due to their difference in shape. However, their maximal height value is the same, that is, 500 kg. The load cell on the right has more satisfactory value as it generates a more stable trial testing, that is, 1kg.

After calibrated value was performed to find out each calibration in each load cell, then the actual testing on wood and magnesium AZ31B was performed. Firstly, testing on wood was performed to find out the measurement force on highly elastic materials. To make it as an actual condition, a specimen was tried on lathe to find out the force of forging measurement tool of friction welding. The result showing forging testing on wood as on Figure 6.

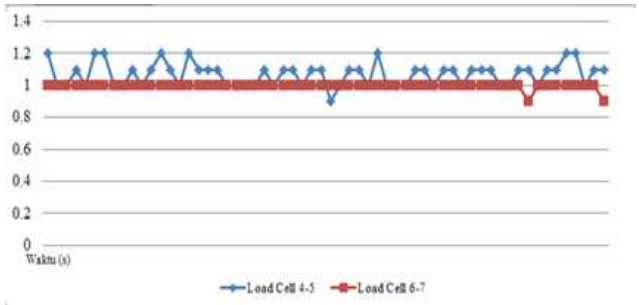


Figure 6. Forging Testing on Wood

Forging testing on wood shows that the output value of load cell on the left is 128.3717 kg with calibrated value of 430.00. It is bigger than the output value of load cell on the right, that is 53.33833 kg with calibrated value of 970.00.

Further testing on Magnesium AZ31B was performed. It is already known that magnesium is one of the materials used in friction welding process. The size of magnesium used in this testing is 141mm × 132mm × 56mm. The tested object is attached to the chuck so as to generate optimal force. The following is graphic and table of forging measurement tool using Magnesium AZ31. The result is presented on Figure 7.

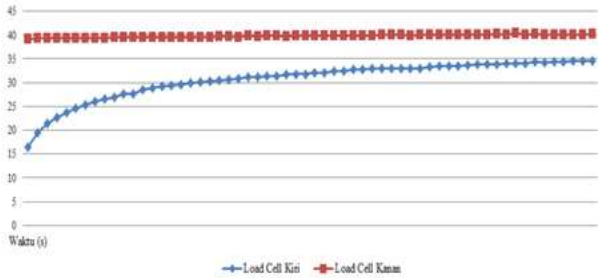


Figure 7. Graphic of Forging measurement using Magnesium

Forging testing shows that the output value of load cell on the left is approximately 211.935 kg with calibrated value of 430.00. While, the output value of load cell on the right is approximately 155.1867 kg with calibrated value of 970.00. It tells us that the output value of load cell on the right is higher than the forging testing using magnesium AZ31B [7,8].

4.2 Analysis of Performance

This phase is the continuation of embodiment process which aims at analyzing working and performance of forging measurement tool of friction welding. There are two important points of positive and negative ones for this forging measurement tool of friction welding [9].

It can be resume that the tool is capable for improvement on acquisition of Arduino data system by conversion on datalogger component. Related to moving mechanism, greasing can be added to ease forward and backward movement. By doing so, a more optimal data collection using datalogger software will work well in doing acquisition of forging data process. For the accuracy of tool when performing forging, the testing indicates an excellent description as it is capable of generating force. However, there is still problem with the weight of tool that needs solution to decrease its weight [8,9].

5. Conclusion

Conceptual design of forging measurement tool of friction welding uses mechanism of telescopic iron, screw locking method at the top part, and loose mechanism at down part. This concept is the best to the extent of its capacity, accuracy, operation, and maintenance. Forging testing on wood at load cell on the left generates 128.3717 kg with calibrated value of 430.00 and load cell at the right generates 53.33833 kg with calibrated value of 970.00. Forging testing on Magnesium AZ31 at load cell on the left generates 211.935 kg with calibrated value of 430.00 and at load cell on the right generates 155.1867 kg with calibrated value of 970.00. The differences of model design between load cell on the left and load cell on the right also cause differences of calibrated value, yet both load cells have the same maximum forces of 500kg.

Acknowledgement

Authors would like to express gratitude for the financial support from BLU Universitas Lampung Hibah Kerjasama Luar Negeri (KLN) TA2019 as well as Hibah DIPA FT Unila 2019.

References

[1] A. F. Ardianto. 2015. Kekuatan puntir sambungan las gesek Al-Mg-Si dengan variasi sudut chamfer dua sisi dan kekasaran. Universitas Brawijaya. Malang.

[2] A. K. Nasution *et al.* 2014. Partially degradable friction-welded pure iron-stainless steel 316L bone pin. Faculty of Biosciences and Medical Engineering, Universiti Teknologi Malaysia, Johor Bahru 81310, Malaysia.

[3] Solihin. 2016. Pengaruh Kecepatan Putar Dan Waktu Kontak Pada Friction Welding Magnesium AZ31 Terhadap Kualitas Sambungan Las, Jurusan Teknik Mesin, Fakultas Teknik, Universitas Lampung.

[4] R. Magga. 2011. Penggunaan Strain Gage (Load Cell) Untuk Analisa Tegangan Pada Pembebanan Statik Batang Aluminium. Jurusan Teknik Mesin, Fakultas Teknik, Universitas Tadulako.

[5] O. Handinata. 2012. Pengembangan Rancang Bangun Alat Pengukur Indeks Massa Tubuh Berbasis Atmega8535 Dan Databasenya Berbasis PC, Jurnal Fisika, Fakultas MIPA, Universitas Sumatera Utara.

[6] D. Nurcahyono. 2017.Analisis Kalibrasi Load Cell Tarik Tipe Pancake Dengan Metode Kalibrasi Tekan. Pusat Penelitian Metrologi-LIPI. Banten.

[7] R. Nuryanto. 2015. Pengukur Berat dan Tinggi Badan Ideal Berbasis Arduino. Karya Ilmiah Program Sarjana. Surakarta: Universitas Muhammadiyah Surakarta.

DOI: 10.31629/jit.v1i1.2129

[8] I. Oktariawan. 2013. Pembuatan Sistem Otomasi Dispenser Menggunakan M ikrokontroller Arduino Mega 2560. Jurusan Teknik Mesin, Fakultas Teknik, Universitas Lampung.

[9] J. K. Gupta and R. S. Khurmi. 2005. A Text Book of Machine Design, Ram Nagar, New Delhi.

JIT Journal of Innovation and Technology
e-ISSN: xxx-xxx-xxxxx ; p-ISSN: xxx-xxx-xxxx
Vol. 1, No. 1, April 2020. Page: 1 – 4

Initial Design of Forging Measuring Instrument for Application of Friction Welding

Bagus Muhammad Fauzi[1], Irza Sukmana[1,*], Yanuar Burhanuddin[1]

[1] *Department of Mechanical Engineering, Faculty of Engineering, Universitas Lampung Jl. Prof. Dr. Sumantri Brojonegoro No. 1, Bandar Lampung, Indoneisa*

*Corresponding Author: irza.sukmana@gmail.com

Article history
Received: xxxx
Revised: xxxx
Accepted: xxxx

DOI: 10.xxxx/jit.0000.00.000

Abstract
Friction welding is a metal joining technique without melting beforehand in which the process is to combine the rotation rate in one of the work materials. In the previous studies, the forging pressure parameters used for friction welding did not have a definite reference to the strength of the joint in friction welding. This project is to make initial design of forging measuring instrument for application of friction welding. The steps include conceptual design, embodiment process, and performance analysis. The conceptual design result includes hollow iron U-shape, telescopic iron, and telescopic iron with screw. The measuring system uses a 500 kg load cell, Arduino Leonardo, HX711amplifier, and data logger. Then, after all components are assembled, the load cell calibration is performed to determine the calibration factor. The next stage is to do pressure test to see the performance of forging measuring instrument of friction welding.

Keywords: friction welding, load cell, HX711 amplifier, Arduino

Online First

1. Introduction

Friction welding is one of the metal joining techniques that is hard to do with liquid welding method. In friction welding, metal joining process is without melting the metal beforehand, in which the process is to combine the rotation rate in one of the work materials. The rotation of friction in one of the working materials will heat and melt both joints thus causing joining process [1].

In the previous study conducted by Nasution [2] friction welding used iron material - stainless steel, with forging pressure parameter. However, forging pressure used still did not have an accurate reference to the strength of the joint yet. Another study conducted by Solihin [3] shows that friction welding did not use forging parameter but time-contact and rotation speed parameter, thus making the connection quality of this friction welding is most probably affected by pressure during welding process.

2. Literature Review

2.1 Strain Gage

Strain Gage is a passive transducer that converts mechanical friction into resistance one. As pressure and tension are measured, resistance of wire foil (thin tin or silver) changes its length. If one of materials at the gage is attached, it will cause strain or pressure. It is this conversion that is measured with Wheatstone bridge and the output pressure resulted is made as force reference received by load cell.

© 2020 by the authors. This open access article is distributed under a Creative Commons Attribution (CC-BY) license.

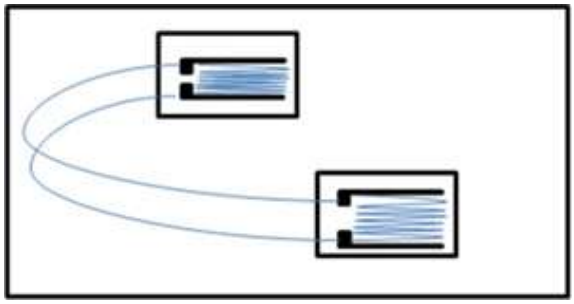


Figure 1. Strain Gage

2.2 Load Cell

Load cell is a transducer to measure force by measuring deflection caused by that force. Load Cell is the core component in digital scale. The sensory component in the load cell used to measure deflection is strain gauge.

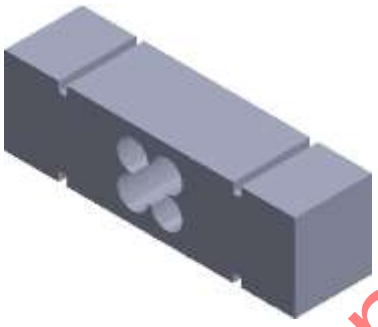


Figure 2. Load Cell

2.3 Micro Controller

Micro controller is a complete microprocessor system in a chip. Micro controller is different from multi-function one in a PC because a typical micro controller contains with supporting components of a minimal microprocessor system, that is, memory and programming of Input-Output. Micro controller is capable for programming to operate a calculation, accepting input and generating output. Micro controller contains with core processor, memory, and programming of Input-Output.

3. Research Methodology

Initial Design of Forging Measuring Instrument for Application of Friction Welding is divided into some phases, namely: conceptual design, embodiment process, and analysis of performance. In conceptual design, there are processes to follow, namely:

3.1Making Conceptual Design

This phase is how the concept is made based on the planning list and its duties. The concept is the solution of the planning that must be solved.

3.2 Selecting Conceptual Design

Selecting concept is aimed at continuing to the phase of embodiment design, in which the best concept is selected on the basis of the availability of the materials, fabrication, the cost of making components, capability of assembling, operating, and maintaining.

3.3 Embodiment of conceptual design

After passing some planning phases above, the next phase is developing the selected concept one based on early requirement, changing into 3-dimension design using CAD application (Computer Aided Design) Solidwork 2016.

Online First

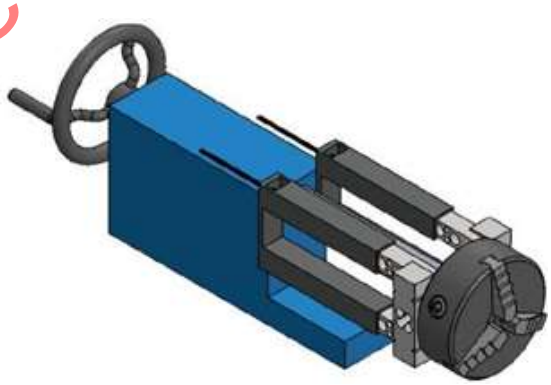


Figure 3. Concept of Forging Measurement Tool for Friction Welding

3.4 Planning of Main Component

In the planning process of forging measurement tool, friction welding consists of four main components. It is necessary to analyze their force before the actual operation starts. These components include hollow U iron, telescopic, telescopic iron with screw, and Arduino system. Arduino system is component that operates load cell as forging measurement tool for friction welding [4,5].

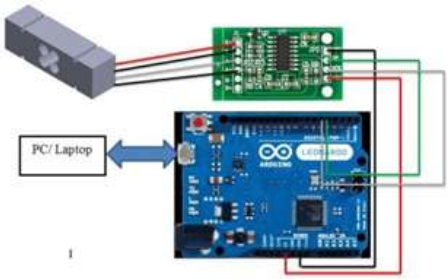


Figure 4. Scheme of Face Tracking Diagram of Arduino System

The next phase is embodiment process, as the continuation of conceptual design phase. This phase is aimed at identifying the force of selected concept in the previous phase. The output of this phase is the form of tool frame that has been assembled and tested by forging measurement tool.

Analysis of performance phase will show the test result of forging measurement tool of friction welding. It will add positive and negative points of friction welding.

4. Results and Discussion

4.1 Process of Embodiment

This is continual phase of conceptual design. It aims at assessing whether or not forging measurement tool of friction welding capable of processing trial data by calibrating height using height scale and testing with wood and magnesium AZ31B. Prior to this phase, the third concept to develop has been chosen. This concept is superior as it has unattached load cell mechanism so as to pull and press the force optimally. This third concept has some components, namely: hollow iron U, telescopic, telescopic iron with screw, and load cell.

The following is the result of calibration value and forging measurement tool testing [6].

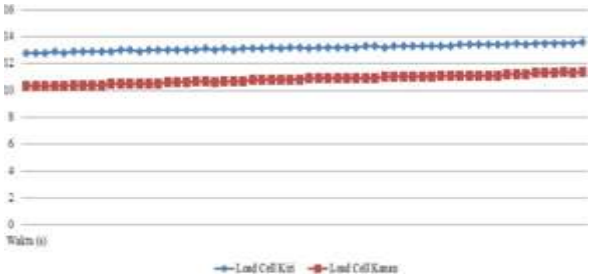


Figure 5. Calibrated Value Graphic of Forging Measument Tool of friction welding

This trial test shows that the calibrated value of load cell on the left is 430,00 with approximate output value of 1,07 kg. If calibrated value is elevated to 440,00, the result will be less satisfactory as its approximate value is less than 1 kg of the height scale. This value is derived from 1 minute trial test of load cell. While, the calibrated value of load cell on the right is 970,00 with approximate value of 0,997 kg. This calibrated value is bigger than on the left one due to their difference in shape. However, their maximal height value is the same, that is, 500 kg. The load cell on the right has more satisfactory value as it generates a more stable trial testing, that is, 1kg.

After calibrated value was performed to find out each calibration in each load cell, then the actual testing on wood and magnesium AZ31B was performed. Firstly, testing on wood was performed to find out the measurement force on highly elastic materials. To make it as an actual condition, a specimen was tried on lathe to find out the force of forging measurement tool of friction welding. The result showing forging testing on wood as on Figure 6.

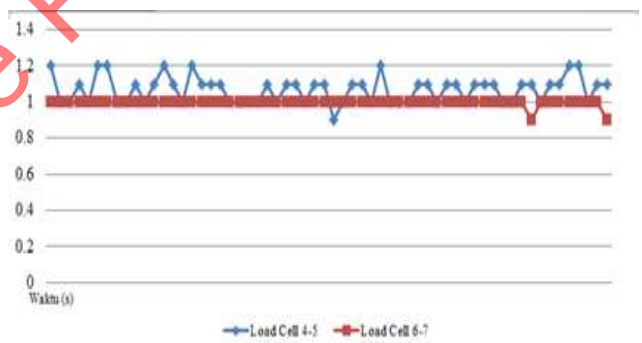


Figure 6. Forging Testing on Wood

Forging testing on wood shows that the output value of load cell on the left is 128.3717 kg with calibrated value of 430.00. It is bigger than the output value of load cell on the right, that is 53.33833 kg with calibrated value of 970.00.

Next, the testing using magnesium AZ31B was performed. It is already known that magnesium is one of the materials used in friction welding process. The size of magnesium used in this testing is 141mm × 132mm × 56mm. The tested object is attached to the chuck so as to generate optimal force. The following is graphic and table of forging measurement tool using Magnesium AZ31.

Online First

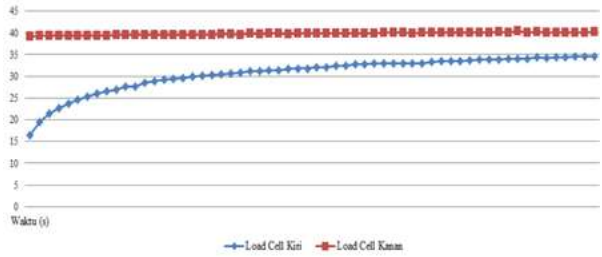


Figure 7. Graphic of Forging measurement using Magnesium

Forging testing shows that the output value of load cell on the left is approximately 211.935 kg with calibrated value of 430.00. While, the output value of load cell on the right is approximately 155.1867 kg with calibrated value of 970.00. It tells us that the output value of load cell on the right is higher than the forging testing using magnesium AZ31B [7,8].

4.2 Analysis of Performance

This phase is the continuation of embodiment process which aims at analyzing working and performance of forging measurement tool of friction welding. There are two important points of positive and negative ones for this forging measurement tool of friction welding [9].

It can be resume that the tool is capable for improvement on acquisition of Arduino data system by conversion on datalogger component. Related to moving mechanism, greasing can be added to ease forward and backward movement. By doing so, a more optimal data collection using datalogger software will work well in doing acquisition of forging data process. For the accuracy of tool when performing forging, the testing indicates an excellent description as it is capable of generating force. However, there is still problem with the weight of tool that needs solution to decrease its weight [8,9].

5. Conclusion

Conceptual design of forging measurement tool of friction welding uses mechanism of telescopic iron, screw locking method at the top part, and loose mechanism at down part. This concept is the best to the extent of its capacity, accuracy, operation, and maintenance. Forging testing on wood at load cell on the left generates 128.3717 kg with calibrated value of 430.00 and load cell at the right generates 53.33833 kg with calibrated value of 970.00. Forging testing on Magnesium AZ31 at load cell on the left generates 211.935 kg with calibrated value of 430.00 and at load cell on the right generates 155.1867 kg with calibrated value of 970.00. The differences of model design between load cell on the left and load cell on the right also cause differences of calibrated value, yet both load cells have the same maximum forces of 500kg.

Acknowledgement

The writer wishes to thank for the financial grant for this research to Hibah Kompetensi Kemenristekdikti TA 2016.

References

[1] Ardianto , A.F, 2015. Kekuatan puntir sambungan las gesek Al-Mg-Si dengan variasi sudut chamfer dua sisi dan kekasaran. Universitas Brawijaya. Malang.

[2] Nasution.A.K, 2014. Partially degradable friction-welded pure iron-stainless steel 316L bone pin. Faculty of Biosciences and Medical Engineering, Universiti Teknologi Malaysia, Johor Bahru 81310, Malaysia.

[3] Solihin, 2016. Pengaruh Kecepatan Putar Dan Waktu Kontak Pada Friction Welding Magnesium AZ31 Terhadap Kualitas Sambungan Las, Jurusan Teknik Mesin, Fakultas Teknik, Universitas Lampung.

[4] Magga, R, 2011.Penggunaan Strain Gage (Load Cell) Untuk Analisa Tegangan Pada Pembebanan Statik Batang Aluminium. Jurusan Teknik Mesin, Fakultas Teknik, Universitas Tadulako.

[5] Handinata, O, 2012, Pengembangan Rancang Bangun Alat Pengukur Indeks Massa Tubuh Berbasis Atmega8535 Dan Databasenya Berbasis PC, Jurnal Fisika, Fakultas MIPA, Universitas Sumatera Utara.

[6] Nurcahyono, D, 2017.Analisis Kalibrasi Load Cell Tarik Tipe Pancake Dengan Metode Kalibrasi Tekan. Pusat Penelitian Metrologi-LIPI. Banten.

[7] Nuryanto, R. (2015). Pengukur Berat dan Tinggi Badan Ideal Berbasis Arduino. Karya Ilmiah Program Sarjana. Surakarta: Universitas Muhammadiyah Surakarta.

[8] Oktariawan, I. 2013. Pembuatan Sistem Otomasi Dispenser Menggunakan M ikrokontroller Arduino Mega 2560. Jurusan Teknik Mesin, Fakultas Teknik, Universitas Lampung.

[9] J.K.Gupta, R.S.Khurmi. (2005) A Text Book Of machine Design, Ram Nagar, New Delhi.

Online First