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Recent Publications

Published

1. AA Ghaffar et al., The Int. J. Adv. Manuf. Technology, 331(1), 379-388, 2021.
2. MF Jamaluddin et al., Design for Sustainability, 435-463, 2021.
3. KAHA Razak et al., IOP Conf. Series, 1078(1), 012008.

Accepted

1. MZ Rizlan et al., The Int. J. Adv. Manuf. Technology, accepted, 2021

Active Grants

RU Grant
Title: Formability Analysis of Tailor Welded Blank of Steel and Aluminum Alloys, 2019-2021

PRGS Grant
Title: Prototyping of hybrid machine; 2019-2022

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Preface

Alhamdulillah, Bulletin MFRL is now on issue Q2 the 5th year of publication. Many issues and group activities were shared until now to the public. Editorial board will try our best to ensure sustainability of the publication and will ensure the highlighted issues relevant and appropriate to all readers.
For this issue, editor want to highlight on the new research area that the lab going to explored as part of our main contribution in metal additive manufacturing research i.e. on tribological performance of wire arc additive manufactured profile.
In this, issue as well, report on participation of our group member in one of the international conference that organized recently.
For the article, this issue will present an article by Amer Isyraqi, one of PhD student on part of his experimental setup for his PhD work.
Last words, hope the reader will enjoy reading and keep supporting our publication. Thank you

AB Abdullah
Editor-in Chief Bulletin MFRL

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Continue ….

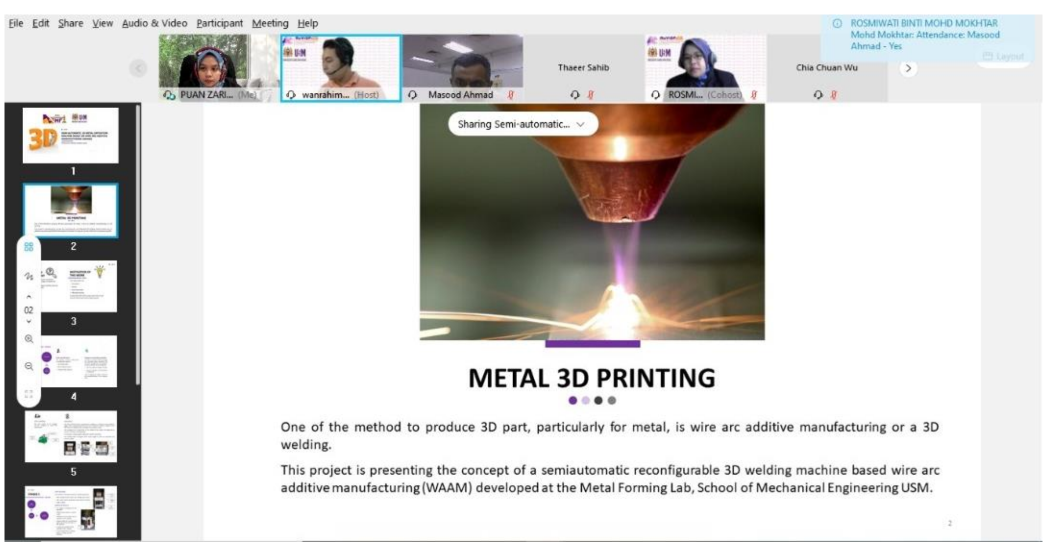
By knowing the wear behavior and other tribological performance of the additive manufactured material on the repaired area, the potential of the WAAM can be determined in part repair.

Issue Highlight

Wear is the major causes of part failed during application. Automotive parts, which involve sliding like an engine bearing may facing this problem. Note that the part is either has three layers/tri-metal (steel-cooper-nickel) or double layer metal/bi-metal (steel-aluminum. The abrasive wear is typically found at the middle of bearing lining, which tend to cause engine performance drop. Severe wear is most likely send to scrap yard, as cost of repair is higher the part itself. Wire arc additive manufacturing (WAAM) offers quick and flexible fabrication of part and has a great potential in part repair. However, WAAM requires post-processing like machining to get the net shape. Furthermore, tribological performance of the deposited material still not explore much related to the application. A new area that is exploring by our researcher, focusing on the aluminum alloy, which known as material with complex wear behavior. Under sliding wear conditions, the wear rate of aluminum alloy is affected by many factors including load, sliding velocity, type of counterface material, lubrication, sliding distance and many more. Pin-on disc test is one of the testing method that is commonly used to investigate the wear behavior of materials in contact with a sliding motion. Typically, the tests are performed under the standards: ASTM G99, ASTM G133 and ASTM F732. Pin shape, pin alignment, pin location and pin material are the factors that should be considered in designing the test procedure. From the surface topography analysis, wear volume and surface roughness evolution can be observed. By using Scanning Electron Microscopy and Energy Dispersive X-Ray, chemical composition/particles can be analysed. Furthermore, tribofilms, micro-structural analysis also can be determined. Under lubricated condition, wear particles size and additives deterioration of the oil also can be analyzed.

Participation in Rovisp 2021 – Virtual Conference

One of our group member has presented her work on 3D welding machine design at Rovisp 2021 (https://rovisp.eng.usm.my/) this morning. She is one of the researchers at the Metal Forming Research Lab who are actively working on wire arc additive manufacturing (WAAM). This conference is an annual event organized by School of Electrical and Electronics Engineering USM but due to pandemic, it was successfully conducted virtually.



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CYCLIC BEND TEST ON ALUMINUM TAILOR WELDED BLANK

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Bending of material occurs due to the direction of a perpendicular force applied to the material. The constant load to test the flexibility of this material is called cyclic bend test. The need to perform a cyclic bend test on Tailor Welded Blank (TWB) is to see the ability of the welding line of the two materials to withstand the load applied directly on the surface by cyclic impact. Engineers often want to understand various aspects of material's behaviors, but a simple uniaxial tension or compression test may not provide all necessary information. As the specimen bends or flexes, subjected to a complex combination of forces including tension, compression, and shear. For this reason, cyclic bend testing is commonly used to evaluate the reaction of materials to realistic loading situations. Since they are limited study involve Cyclic Bend Test on TWB, this future study is significant to be explore. Very few studies have been done to assess the strength of friction stir welded aluminum joints under bending load (Ranjan et al., 2019).

These cyclic three-point bending tests experiment and set-up according to BS EN ISO 5173: 2010 + A1:2011. Aluminum was chosen as the material for bending tests because it is widely used in the automotive industry especially in the production of vehicle (Liu et al., 2017). For this experiment, three types of Aluminum TWB were selected which is the combination of AA6060/AA5052, AA(6061/7075) and AA(6061/1100). The entire specimen are not heat-treated before and after the bending test. Rectangular plate will be used in the cyclic bend test. For this test, the specimen size is 42.5 X 55 mm and thickness of the specimen is 3 mm. The two types of tests that will be performed on the UTM INSTRON BIAXIAL (figure 1) are transverse face bend test (TFBB) and longitudinal face bend test (LFBB). The orientation of the specimen as shown in figure 2 and figure 3.

Figure 1: UTM INSTRON BIAXIAL 8874

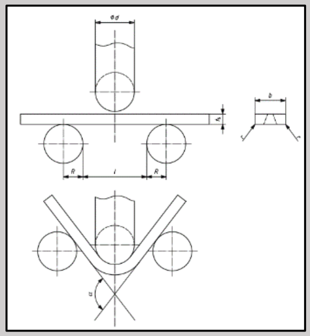

Figure 2: Transverse Bend Test

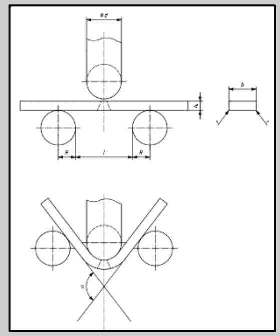

Figure 3: Longitudinal Bend Test

The test shall be carried out by placing the test specimen on two support consisting of parallel rollers (see figure 4). The weld shall be at the mid-point between the rollers, except for longitudinal bend tests. The specimen shall be bend by impact in the middle of the span, on the axis of the weld, with selected speed applied by a former perpendicular to the test specimen surface.

The diameter of the former is 12 mm and the support roller need to use the same size of 12 mm diameter for the cyclic bend test standard. The distance between the rollers is 21 mm. The values of diameter and distance between two rollers are obtained from the following calculations;

Diameter of former and support roller, d

$d = 4ts$

$d = 4(3) = 12mm$

Distance between roller, l

$d + 2ts + 3 \leq l \leq d + 3ts$

$12 + 2(3) + 3 \leq l \leq 12 + 3(3)$

$21 \leq l \leq 21$

$l = 21mm$

After test, both the external surface and the sides of the test specimen shall be examined. Any defect on the surface will be recorded in the report. Bending angle is measure (Figure 5) and comparison is made for different combination of TWB material and different parameter use. The angle of each sample then will be plot in graph to select the best sample that has small value of bending angle.

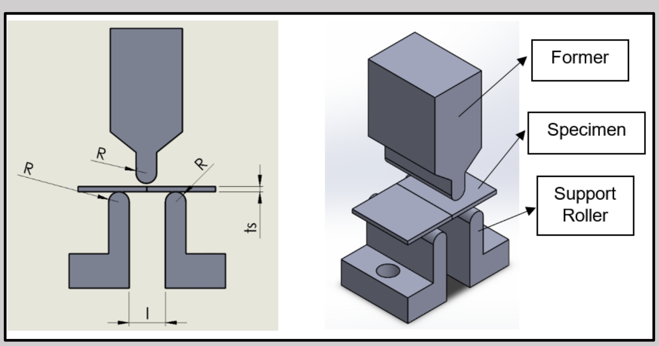

Figure 4: Cyclic Bend Test Experiment Set-Up

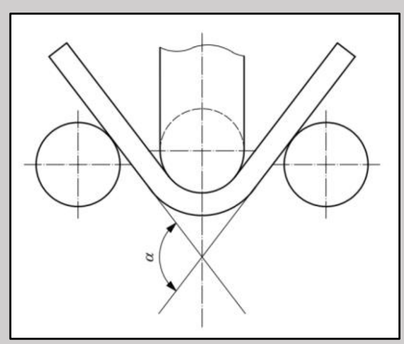

Figure 5: Bend angle of the test specimen

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Ranjan, R., de Oliveira Miranda, A. C., Hui Guo, S., Walbridge, S., & Gerlich, A. (2019). Fatigue analysis of friction stir welded butt joints under bending and tension load. *Engineering Fracture Mechanics*, *206*(September 2018), 34–45. https://doi.org/10.1016/j.engfracmech.2018.11.041

BS EN ISO 5173: 2010 + A1:2011, Destructive Test On Weld in Metallic Materials – Bend Test, UK, 2011