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Assessment of Corrosion Properties of Magnesium AZ91D Alloy

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Abstract: *Magnesium alloys are characterized by unique properties and offer opportunities for lightweight applications. The challenge is to correlate the tensile and corrosion properties of the material to provide a holistic insight to its response to corrosion and monotonic loading. This paper presents extrapolating the various properties of the MgAZ91D alloy when it is subject the salt fog spray test. This process is suitable for automotive parts. The alloy composition microstructure and the character of the passive film capacity the corrosion mechanism of magnesium alloy exposed to aqueous solution and simulated saline atmosphere. Corrosion attack is disclosed between phases with different electro chemical behavior. FSP is an effective approach to refine the grain size and enhance the corrosion properties.*

Keywords: Magnesium alloys.

I. INTRODUCTION

AZ91D is a sort of warmth hasten reinforcing medium quality magnesium compound with generally excellent producing capacity and adequate consumption opposition [1]. Focusing on the need of weight decrease, this exceptionally light structure material is being utilized progressively for creating vehicle wheels, the structure of edge work of electric vehicle transport, airplane components[2, 3], and so forth. For magnesium compounds, regular bend joining and welding advances would display a great deal of disadvantages of high recurrence in framing porosity, huge warmth influence zone, the loss of combination components, and high leftover pressure [4, 5]. Magnesium and its composites are of the hexagonal precious stone structure. Thus, the multi-slip planes endanger their formability at surrounding temperature due to the restricted slip and develop worries at the distorting grain limits.

Magnesium forms an oxide layer whose thickness increases at higher temperatures according to the Cabrera–Mott mechanism and which thickens quicker at higher exposure to water vapour.

Unlike the oxide film of Al203 contributed by the Aluminium phase which ensures complete coverage of the underlying metal with a Pilling Bedworth ratio (PBR) of 1.28 (>1), the MgO/Mg(OH)2 layer formed has a PBR of 0.81(<1), which implies poor surface coverage and hence does not provide any effective protection towards further corrosion. The alloy composition/microstructure and the character of the passive film influence the corrosion mechanism of magnesium alloys exposed to aqueous solutions and simulated saline atmospheres. In general, corrosion attack is revealed between phases with different electrochemical behaviour, and degradation is favoured if there are chloride ions, which facilitate the collapse of the inactive film. On the other hand, corrosion mechanism of magnesium alloys in many other environmental conditions remains ill-defined. The vast majority of the distributed papers were centered around the impacts of rotational speed and translational speed on the blended zone characteristics of AZ91D magnesium-base alloy [13]. Mechanical properties of friction stir welded of AZ91D Magnesium combination of the smaller scale hardness and mechanical properties are assessed. Both quality and flexibility of Mg-Al composites are close identified with the hasten which is found as β-Mg17Al12 stage with an incredibly low liquefying purpose of 462°C [17]. So it is accepted that not exclusively could re-crystallization conduct be seen in the weld zone[18, 19], yet additionally convoluted precipitation stage advances [20]. Notwithstanding, in the present state, supposedly, examinations on FSP of AZ91D magnesium combination have seldom been accounted for up until now. The main objective of this study is to explore whether high quality stir processing would be performed with optimum parameters, and if so, what characteristics of micro-structural evolution could be watched and to what degree the welds' mechanical properties would reach in FSP circumstances. So in the present examination, the target of this paper extrapolating the different properties of the MgAZ91D combination when it is subject the salt fog spray test and tensile deformation test Friction stir processed (FSP) is a solid state joining process used for light weight alloys.

II. METHODOLOGY

Magnesium alloy plate (AZ91D) having a thickness of 13mm have been cut as per the requested dimensions of 150 x 150 mm with the help of power hack saw. Inorder to accomplish a single pass friction stir processing for the material selected the tool used is a roating non consumable tool which is made up of HSS having a shoulder diameter20mm and effective length of 8mm.

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The required dimensions of 20 x 15 x 10 mm cut into base metal. The diameter of holes 2mm drilled into diameter 2mm from the corner of the suspension plates. The specimens were followed by standard procedure by using 3.5% Nacl, 7.0 PH value were followed.

The work are carried out by room temperature, and required value of 25°c. In order to conduct 5,8,11 hours. As per ASTM B117 guide lines were followed for before weight of conducting test. After the test weight of base metal, processed metal are kept in air tight chamber. Microstructural examination have been carried out using optical and scanning microscope. The chemical composition of the metal was obtained using a energy dispersive spectrometer.

Experimental plan:

The test plan of the present examination is additionally outlined as stream graph as appeared in fig 2. The definite test methodologies associated with each phase of the exploratory work are advised in the accompanying segments.

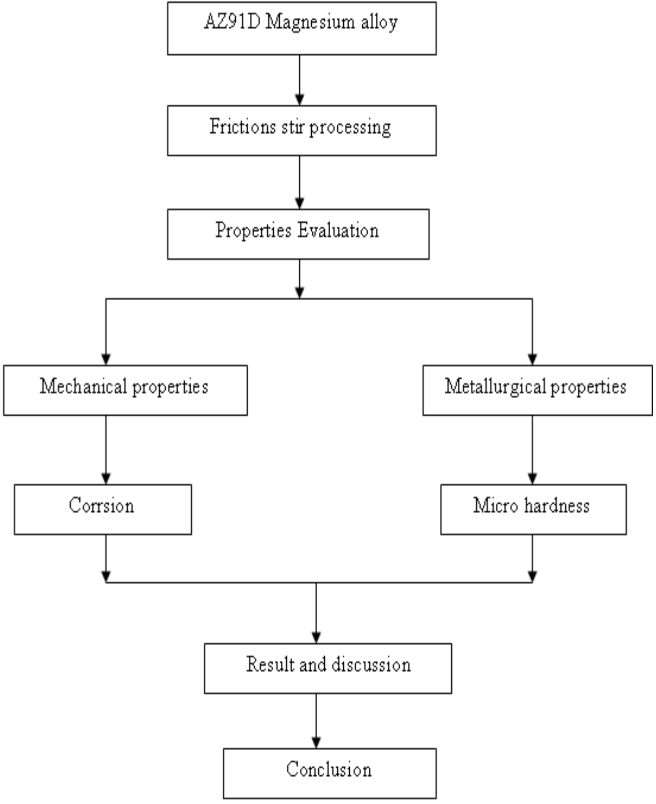


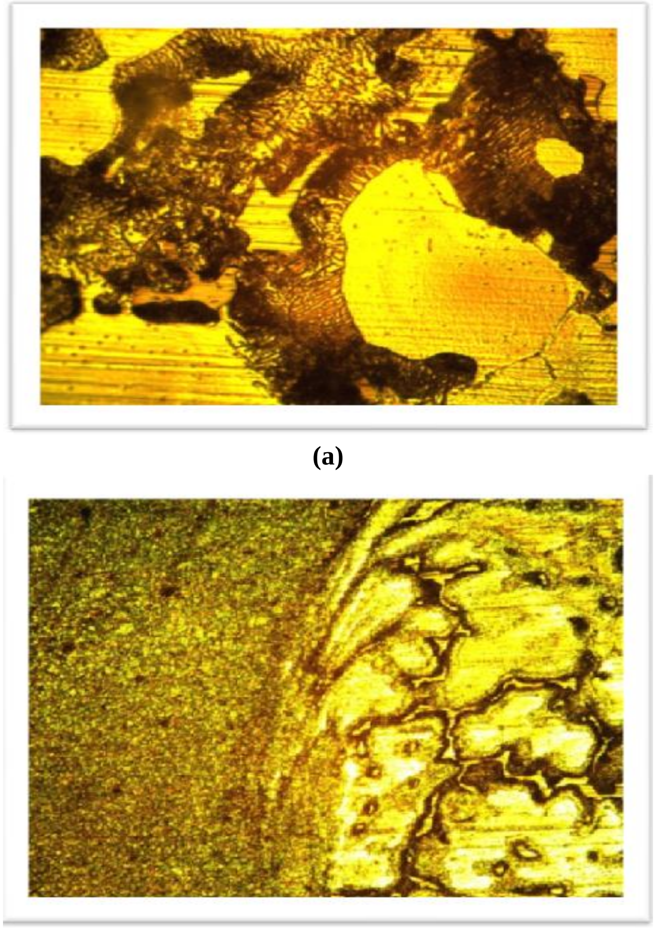
Figure 2: experimental plan Magnesium compounds

Present an incredible potential as basic materials in the aviation and car enterprises as a result of a few points of interest, for example, low thickness, high explicit quality and great machine ability. In any case, AZ91D combination, one of the most well-known business magnesium compounds, experiences the test in meeting the prerequisites of solidarity, malleability and creep obstruction.

III. RESULTS AND DISCUSSION

3.1. Evolution of Microstructure and Precipitate.

The scanning electron micro graphs of base and friction stir processed AZ91D cast magnesium alloy are obtained. The microstructure of base metal mainly composed α- mg dendrites and coarse eutectic β Mg 17 Al 12 phase. Frictio stir processing resulted in breakup and disappeared in eutectic β Mg 17 Al 12 network.



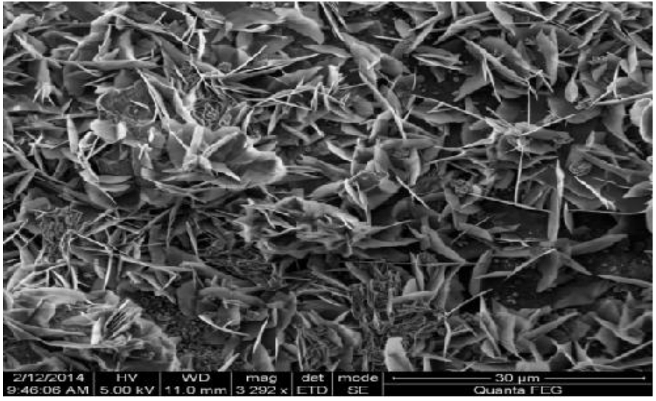
(a)

(b)

Fig.1 (a,b) Microstructure of base and friction stir processed samples.

3.2. Mechanical Properties

The micrographs of base metal contains rosette shape Mg Co3 3 H2O- MgO development of equiaxial growth formation for five hours duration. The friction stir processed samples are having lameller flakes of brucite Mg(OH)3 and developing prismatic nesquehonite Mg(HCO3)(OH)2(H2O). The corrosion products are eliminated by CO2 as shown EDS graphs. Finally base metal improve the corrosion resistence by reduction of salt in the surface.



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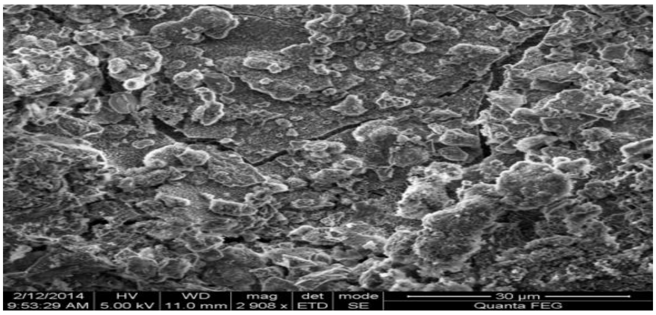

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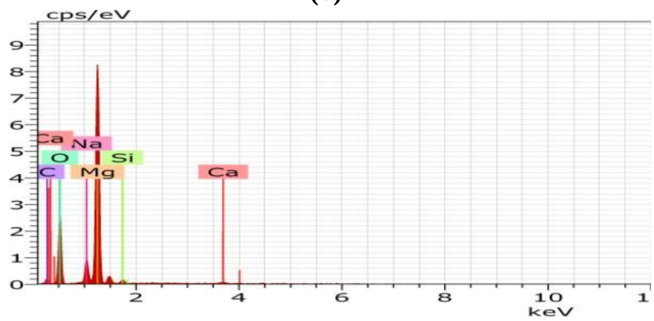

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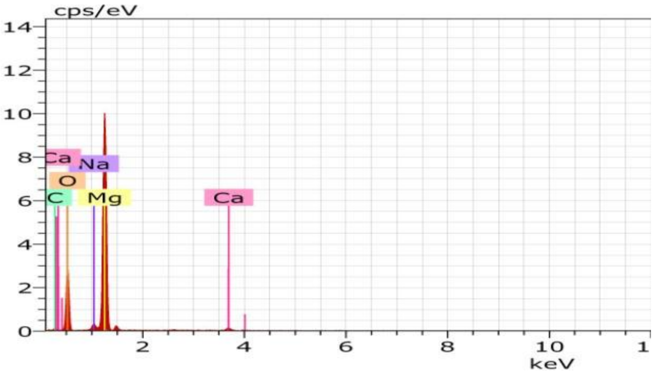
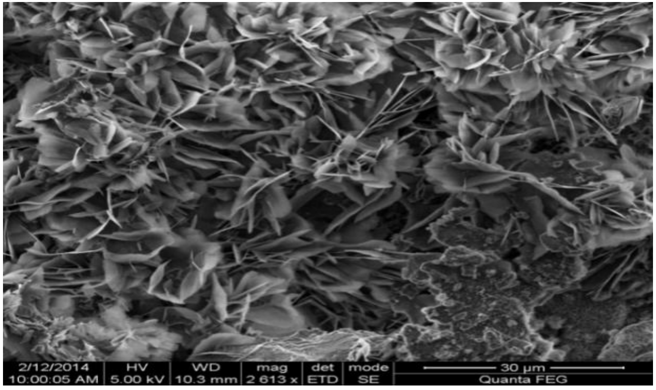


(d)

Figure 3: Corrosion morphology of the base and FSP samples after 5 hours exposure.

3.3 Corrosion morphology of the base and FSP samples after 8 hours exposure.

The concentration of Al(2%) will be improved after 8 hours in EDS graph. Before that no evidence for aluminium produced in the corrosion products β- base is vital role played because of homogenization and oxygen is also played in magnesium ratio. The base metal structure shows that breakdown the protective film and brucite Mg(OH)2 are formed. Finally friction stir processed structure produced fine grains due to Al(OH)2 layer.



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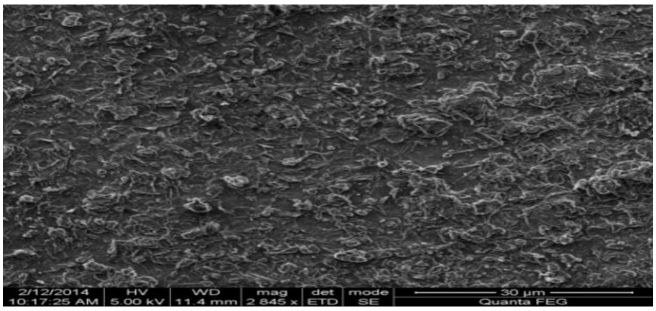

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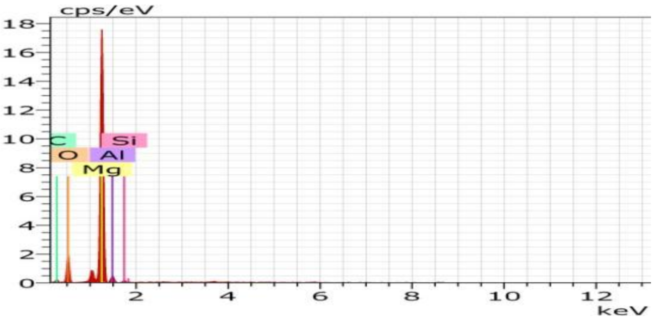

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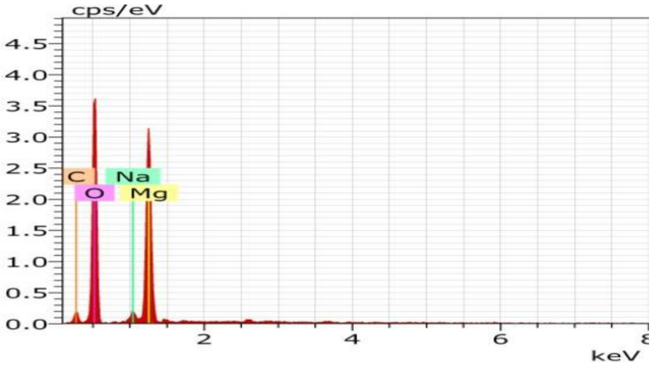
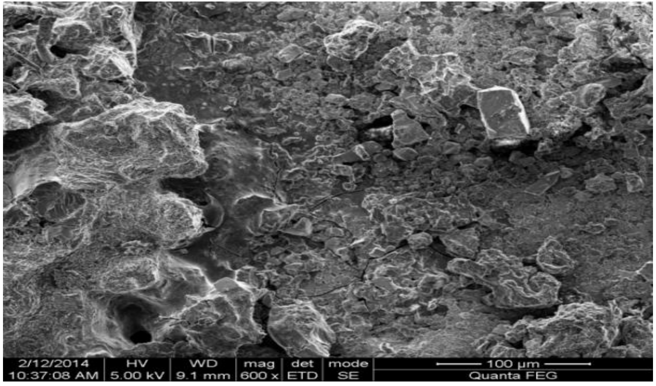


(d)

3.4 Corrosion morphology of the base and FSP samples after 11 hours exposure.

The base metal structure after 11 hours duration will be formed in dolomite crystals and pitting corrosion. EDS graphs Ca concentration are also improve and removed by rosette and needle shaped crystals. The corrosion effects will be improved processed structure and compared with base metal when increasing in time duration, oxidation will be also improved, In CO2 concentration are also improved in the processed metal (30-40%) at weight. Finally reduce the porosity and shrinkage of the processed samples due to the reduction surface are developed in (OH) film on magnesium.



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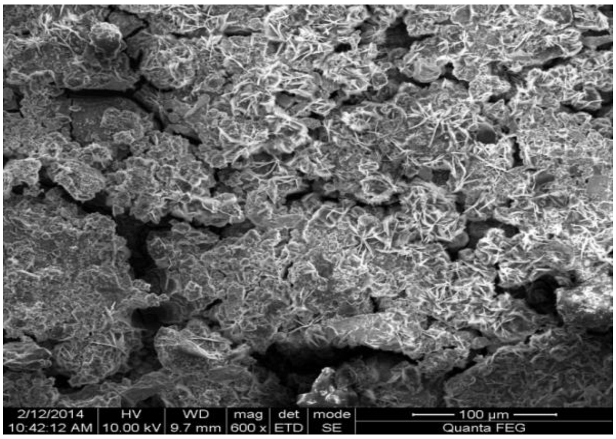

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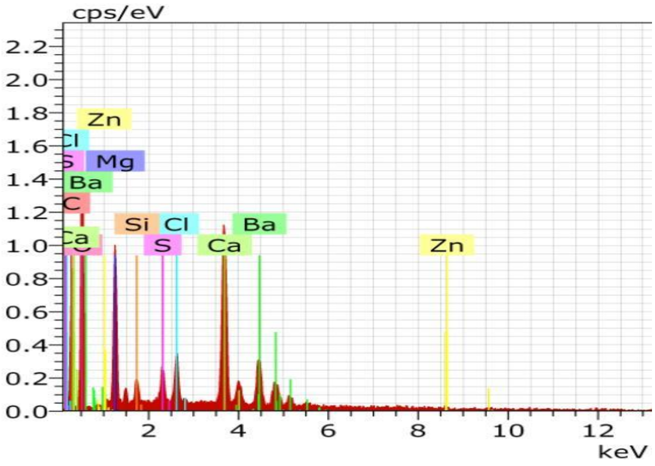

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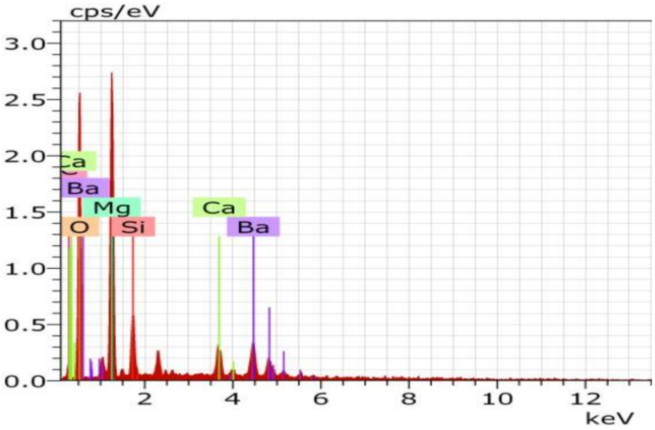

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IV. CONCLUSION

- By empowering the dissipating of the cathodic auxilliary organize and diminsing any revealed porous surface locales. Consumption advancement will be diminished due to FSP.
- Friction stir processing surface will be improved due to minimizing the galvanic α and β phase interaction.
- The development in Galvanic cell friction stir process surface due to rebets of cathodic Al- rich β phase and Mg- rich α phase.

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