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A REVIEW ON UNDERWATER FRICTION STIR WELDING MODIFIED WITH NORMAL FRICTION STIR WELDING SETUP

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ABSTRACT

As the Friction Stir welding is the latest welding technique, Friction Stir welding is now extensively used in the mechanical and manufacturing field; underwater friction stir welding (UFSW) process is having a latest research area. In the present review the study of UFSW process is to understand the defect formation and the structure through which the mechanical properties of the welded joints can be improved and gives finally results a fine and efficient joint. A detailed review is given on how to convert an experimental setup from NFSW to UFSW.

Index Terms: Underwater Friction Stir Welding (UFSW); Normal Friction Stir welding (NFSW);

I. INTRODUCTION

Normal Friction Stir Welding (NFSW) is the process of friction stir welding which is normally done in air and underwater Friction stir welding (UFSW) is the process that is stirred performed under the water. Friction stir welding is a solid state joining method based on friction heating and local plastic flow in the joint region by stirring with a rotating tool pin. FSW is to create high-quality, high-strength joints with low distortion and is capable of fabricating either butt or lap joints, in a wide range of materials thickness and lengths. The process is carried out by plunging a rotating tool made of a wear-resistant and high temperature resistant material that is converting into the material to be joined and translating it along the desired weld line. The heat generated by friction at the tool surface and plastic dissipation in the deforming regions of the work pieces soften the material to a plasticized state. It is then extruded around the tool and consolidates to form a weld. In the UFSW the welding zone surroundings are not affected with high temperatures because of using cooling water. Is the Solid state joining process underwater friction stir welding reduces those problems like hydrogen embrittlement, oxidation and porosity

II. LITERATURE REVIEW

Underwater friction stir welding means the samples are welded of immersed totally in water or with water flowing across the surface in the welding process, which is a new variation to FSW. Sakurada et al. used the

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inertia friction welding method to join AA6061 under water [1]. Comparing the UFSW weld with regular in-air welds, they reported an increase in joint strength and decrease in the width of heat affected zone.

M.A. Mofid et.al.[3]Friction stir welds of Al 5083/Mg AZ31were produced in air and underwater. The temperature profile, microstructure, SEM–EDS analysis, XRD and hardness were evaluated. The stir zone of air welded specimen displayed complex inserted flow patterns, in which recrystallized Mg and Al alloys were swirled together. Brittle intermetallic phases are formed in the stir zone because of constitutional liquation that cause the weld to crack.

The results of XRD analysis showing these intermetallic phases are Al_3Mg_2 and $Al_{12}Mg_{17}$ and Al_2Mg_3. The stir zone of underwater welded specimen showed a smoother interface and less intermixing. Due to a decrease of 25^0C in the peak temperature from a maximum of 403^0C in case of air welded specimen to a maximum of 378^0C for welds made underwater, the formation of intermetallic compounds was suppressed significantly.

Grain growth is not noticeable in the dynamically recrystallized Mg alloy in the stir region because of lower peak temperatures. Some fairly high hardness values were observed in the stir zone of air welded specimen, suggesting the probability for the precipitation of brittle intermetallic compounds. In underwater weld specimen, these high values could not be observed.

S*ree sabari et.al.*[5] The experimental and numerical investigation on underwater friction stir welding (UFSW) and friction stir welding(NFSW) of armour grade, high strength AA2519-T87 aluminum alloy was conducted Under water friction stir welding (UFSW) is a variant of NFSW process which can maintain low heat input as well as constant heat input along the weld line. The heat conduction and dissipation during UFSW controls the width of TMAZ and HAZ and also improves the joint properties.

Fang Chai et.al. [8]Compared with NFSW, UFSW has remarkable grain refinement effect. The microstructures in the TMAZ and HAZ for the UFSW are much finer than those of the NFSW. The yield strength, elongation and ultimate tensile strength of UFSW AZ91 magnesium alloy with much finer-grained structure are much higher than those of as-cast and NFSW materials.

Farshid Malek Ghaini et al. [2]To find out the fracture behavior in AZ31Mg/AA5083, Normal friction stir welding and underwater friction Stir welding welds were done.In result,the fracture occurred in preferentially along the brittle and weak intermetallic layers in normal friction stir welding. The resultant fracture surface shows the cleavage-type brittle fracture. This fracture surface is distinctly different from the microvoid-type ductile fracture in the underwater friction-stir weld. [4]Fu et al. also observed the improvement in the tensile strength of the UFSW joints of AA7075 T87 aluminum alloy by reducing the width of HAZ.

Tokisue et al. [6] were the first to use underwater in a friction joining process. In their research, they were able to join Al-6061 underwater in a rotary friction weld. A friction weld is made by taking a cylindrical sample, rotating at a high speed, and pressing it against another sample. The stirring creates heat and eventually the materials fuse into a solidly welded region.

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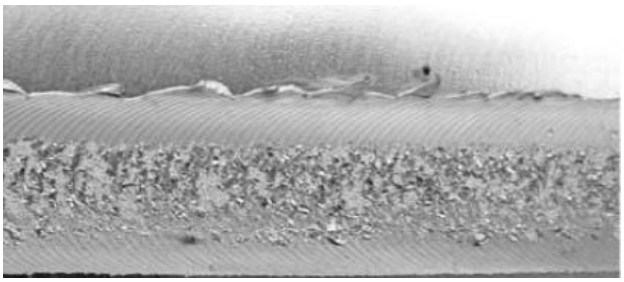

Fig.1. Surfacial morphologies of NFSW at 800 rpm

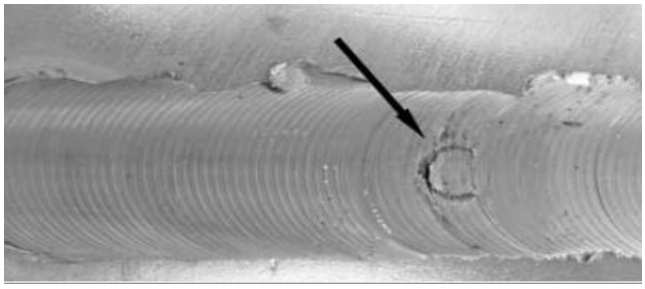

Fig.2 Surfacial morphologies of UFSW at 800 rpm

Their results showed that it was possible to generate enough friction for welding even though the samples were underwater. Some remarkable results were obtained through the use of underwater friction stir welding. The stirred region of the underwater weld showed the very important characteristic of having a finer microstructure than a similar weld made in air. This was due to the limited recrystallization and grain growth in the aluminum when it is cooled under water. Specimens of elliptical stir shape and onion-ring patterns can be seen clearly in the stir Zone.

Douglas C et. al. [7]UFSW is an improved method compared to NFSW for the creation of ultra-fine-grained bulk samples. The addition of water dramatically reduces the amount of conductive heat flow typically generated by multiple passes of NFSW done in air. In addition, the grain size achieved through UFSW can be reduced below200 nm, even in aluminum alloys, where fast recrystallization kinetics generally prevents ultra refined grain sizes from being obtained.

III. EXPERIMENTAL SETUP

The underwater friction stir welding setup and the tool defines the processing coordinates. The sump is manufactured with Epoxy glass by using surface plate dimensions The processed plate was fit into a tank, which was filled with room temperature water. A backing plate made of steel was used. The work piece was rigidly clamped on the backing plate in the tank. The water has entered into the inlet valve above the level of the tool shoulder and the used water is come out through the outlet valve.

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IJARSE
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Fig.3.Normal Friction Stir welding Machine

During welding, the inlet and outlet valves are adjusted to control the water flow in such a way that would maintain the temperature of water below 60°C near the welding zone. The temperatures of the work piece at different distances of advancing and retracing side can be measured by using those thermocouples.

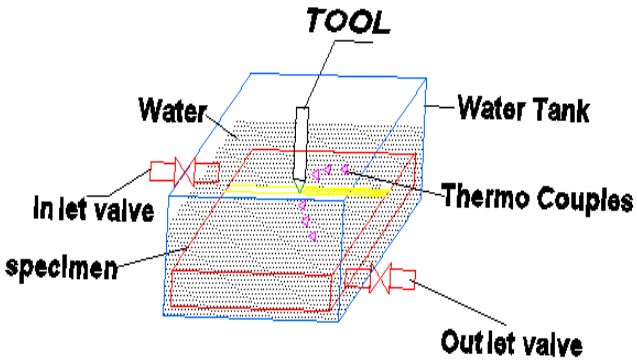

Fig.4.layout diagram of the UFSW

Fig.5.Underwater Friction Stir welding Machine

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Normal friction stir welding machine can be shown in figure 3),layout diagram of the UFSW is shown in figure 4) and to finally UFSW Experiment setup is shown in the figure 5). By using this UFSW experiment setup the two experiments NFSW and UFSW can be done.

IV. ADVANTAGES OF UFSW

It is very useful for Indian Navy. It also reduces the energy consumption of their joining processes. Ship building industries, Cryogenic fuel tanks, military vehicles, rolling stock, and cold plates for thermal management. Underwater Friction stir welding machine for less consumptions of energy.

V. CONCLUSIONS

Underwater friction stir welding is a new technology. In the earlier days the researchers have done many experiments on Normal Friction stir welding and in the present days the researchers are working on underwater friction stir welding. In this research area a very less and insufficient work is done. The scope of work is so high to research on this area for researchers as well as academicians. Besides this Normal friction stir welding machine can be converted easily into Underwater Friction Stir Welding machine.

VI. ACKNOWLEDGEMENT

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