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ANALYSIS OF HAZARD IDENTIFICATION AND HEALTH ASSESSMENT USING ULTRASONIC WELDING

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ABSTRACT

In this paper, we analysed the ultrasonic welding with element of an organization's activities, products or services that can interact with the environment. The environment aspects are air leakage, wire and terminal wastage and PVC wastage. The hazard identification and risk assessment in ultrasonic welding, the possible situations of hazard identification and risk assessments are bunching wires in hand, wire holder for crimping and generation of heat. Significance criteria for hazard and consequence are death, loss of any part of body, minor & major injury requires hospitalization/bed rest, injury & temporary treatment, injury that requires first aid at shop floor level only.

Key words: Hazard identification, Health assessment, Ultrasonic welding.

INTRODUCTION

Govindu and Babski-Reeves[1] observed that higher force, non-neutral postures, and presence of repetition and vibration on the job resulted in higher severity ratings and were included either in the occupational factors model, final model or both. This is accordance with previous findings where lifting (force requirements) in addition to bending and twisting (posture) was found to be more harmful. It was observed that the incidence of LBP in workers who performed heavy manual lifting was 8 times greater than workers with sedentary jobs. An explanation for how bending can be harmful is that while bending, muscles are no longer active and only the soft tissues play a role. These types of tasks generate loads on the spine that exceed failure loads.

Fernandez and Marley[2] have reported an overview of psychophysical theory and major methodologies, which can be applied to occupational activities that involve physical stressors that could expose workers to risk of MSDs. Furthermore, we have summarized a series of experiments that were conducted utilizing psychophysical methods to examine the

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interplay between multiple MSD risk factors in the absence of well-defined biomechanical and/or physiological methods. The method was extended to examining upper-extremity tasks having been shown to be useful for whole body activities (i.e., lifting) as well as task elements (i.e., gripping, pinching, etc). Specifically, we documented psychophysically acceptable task frequencies given various posture, force and other conditions for several common tasks and task elements. Frequencies were examined because often posture and force cannot be easily controlled within the workplace. The results of these experiments collectively demonstrate that psychophysically acceptable frequencies are significantly and negatively affected by required posture, force and other conditions such as vibration. In addition, males could adjust to significantly higher frequencies than females under similar working conditions. Design limits were summarized for these conditions. Thus, we have advocated that the method of adjustment can provide the engineer or other safety professional with reasonable work limits. The basic tenet of this approach is that often engineering controls for potentially interacting risk factors may be impractical to implement. But psychophysical methods may be utilized to find a reasonable design solution. We are grateful to Ciriello, Snook, Ayoub, and others for pioneering the use of long-established psychological principles to better understand physical stressors in modern work environments.

Tanaka et al.[3] demonstrated seven types of motion pattern for a 4RE – linkage by straightforward calculations based on geometric considerations, and have also proposed certain motions of the repetitive assemblies to select the combinations of the obtained motions for a 4RE-linkage. To produce a highly symmetric structure with D4 symmetry. We have examined a variety of telescopic motions, which range from those based on the well-known behaviour of square grids to novel mobility modes that are not yet publically available. This movable structure potentially has high stiffness with D8 symmetry if it can be made to transform to the bidirectional square grids (0 -or 45 -axialdirection) in response to changing external loads.

Russo et al.[4] discussed noise exposure and hearing loss was assessed in different instrument groups of a professional ballet orchestra. Those instrument groups experiencing the highest levels of exposure also had the highest pure tone thresholds. Critically, we found that thresholds were not uniform across instrument groups. The greatest difference in thresholds was observed at test frequencies above 2000 Hz, peaking at 4000 Hz where the average difference between groups was as high as 15 dB. The differences could not be accounted for on the basis of age, years of playing, or years of playing professionally, and are thus most likely due to differences in occupational noise exposure. Nonetheless, measured losses for all instrument groups did not approach clinically significant levels.

Fischer and Dickerson[5] consolidated and discussed the current state of research linking psychophysical and biomechanical approaches in ergonomic job (re-) design, with a focus on manual loads and shoulder exposures. Although slighted for its subjectivity and often misestimation of exposure. These arguments articulate the important role that psychophysics can play in shaping guidelines to prevent overexertion in the workplace.

Alexander et al.[6] discussed analysis of workflow and communication paths is a necessary prerequisite to facilitate better design and implementation of clinical technologies. System design requires that we understand how people work before and after implementation of technologies; however, in many situations these activities are not carried through before clinical systems are put into place. Rarely these processes are evaluated post clinical system implementation. The design of embedded IT systems effects how clinical information is transferred between nursing staff and other patient care providers. Assessing how embedded IT systems affect the timing and placement of provider/patient interactions has important implications for clinical workflow, patient safety and quality measurement. Ethnographic methods including systematic observations of staff using various communication systems, including IT, provide a rich source of data that illuminates current clinical workflows, process change, and efficiencies that can improve care delivery. These types of organizational assessments are novel to NHs who are implementing IT systems. These evaluations can lead to better metrics in care delivery and improved healthcare system administration.

Malinowska-Borowska and Zielinski-in[7] studied smaller coupling forces during cutting with larger, high-power chain saws. It must be noted, however, that the increasing weight of the chain saw increases the strain on the cardiovascular system. The heavier chain saw has greater power but it imposes a significantly greater cardiovascular strain than a lighter chain saw. Coupling forces exerted on high-power tools are smaller than forces exerted on small, universal saws. It seems that from ergonomic point of view, the most desirable chain saw should possess both a low weight and a high power potential.

Park and Han[8] studied various previous studies on value and proposed a new concept for user value. This new concept of value distinguishes life value from user value, and describes detailed definitions and meanings of those values. In consequence, life value can be defined as desirable states of existence or modes of behaviour; and user value, as a part of life value, depends on the type of product or service. A certain product or service cannot meet all the universal value elements at a time.

Adewusi et al.[9] reported the power absorption (VPA) of different hand-arm sub structures and estimated using biomechanical models of the hand-arm system in the bent-arm and extended arm postures, derived from impedance and transmissibility responses. The distributed VPA due to broadband random excitation and vibration spectra of different hand-held power tools were estimated. The results showed that the extended arm posture should be avoided since higher power (1.63 Watts) was absorbed in the hand-arm system in the extended arm posture than in the bent-arm posture (0.67 Watts) for identical hand forces and excitation level.

Dumpala and Lokanadham[10] discussed conventional milling machine, which is converted as CNC milling and best suited for friction stir welding. Synthesis of rice hush ash nano particles is prepared by high energy ball mill and characterized by SEM. The good dispersed nanoparticles are possible with ultra sonicator. Weld bead characteristics are studied along with the weld strength in feature.

The tool material and rotational speed have been identified as the important parameters that affect the stirzone microstructure and properties of FSW process[11]. The following conclusions can be obtained. SS tool material provided fine grained microstructures and better mechanical properties as compared to HSS. The low rotational speeds provided high stirred zone micro hardness values compare to the base material. There exists a particular combination of tool rotational and tool material at which high strength properties may be achieved in the stir zone. The joint fabricated at a tool rotational speed of 900 rpm have shown lower ultimate tensile strength, yield strength, percentage of elongation, weld nugget hardness and impact test compared to the joints fabricated at a tool rotational speed of 1120 rpm. The joint fabricated at a rotational speed of 1400 rpm and 1800 rpm have also shown lower tensile strength properties compared to the joints fabricated at a rotational speed of 1120 rpm. Of the four joints fabricated using four different tool rotational speeds. The joint fabricated using with SS tool material with rotational speed of 1120 rpm exhibited superior tensile strength properties.

Kesharwani et al.[12] presented effect of tool rotational speed, worktable translational speed, tool shoulder diameter and tool pin geometry on weld quality. Based on the analysis following conclusions can be made. According to applied grey based approach, 1800 rpm of tool rotational speed, 50 mm/min worktable translational speed, 20 mm of tool shoulder diameter and square pin geometry are the optimum parameters for fabrication of AA5052-H32 and AA5754-H22 dissimilar 2.0 mm thin tailored friction stir butt welded blanks.

FSW using 1800 rpm of tool rotational speed, 50 mm/min of worktable translational speed, 20 mm of tool shoulder diameter and square tool pin geometry gives maximum weld strength (UTS = 175 MPa, approx) and maximum % elongation (13.854, approx). Location of fracture in uniaxial tensile test of the welded sample using optimized parameters is at TMAZ, which confirms relatively higher strength of the weld NZ.

Magudeeswaran et al.[13] presented that –

1. The electrode gap is the predominant factor that affects the aspect ratio of DSS welds fabricated using ATIG welding process.
2. The optimum welding parameters are found to be electrode gap of 1 mm, travel speed of 130 mm/min, current of 140 A, and voltage of 12 V.
3. The confirmation experimental results for aspect ratio is in good agreement with the data analyzed by the Taguchi method.
4. The aspect ratio is found to be 1.24 for the joints fabricated using the optimized process parameters and is well within the acceptable range to avoid solidification cracking.

Borle et al.[14] used alternating current (AC) when welding chromium carbide hardfacing alloys has a pronounced effect on the resulting welds. To examine exactly the effect of AC balance (fraction of time in electrode positive) on FeCrC hard facing, six different samples were made varying from 50 to 75% balance in 5% increments. The heat input was found to increase from 3.82 to 4.30 kJ/mm and dilution along the centreline increased from 3.7 to 31.1%. The ultimate consequence of increasing the balance was a decrease in the volume fraction of primary carbides from 21 to 3% and a decrease in average diameter of carbides from 30.3 to 21.8 mm with the increase in balance. The increase in the volume fraction of carbides also coincided with microstructures that had higher percentages of hypereutectic microstructures that should lead to more uniform wear throughout the height of the hardfacing. The increase in volume fraction of carbides as the balance decreases should also increase the wear resistance. The use of AC waveform with balances near 50% gave microstructures expected to perform the best.

Zhang et al.[15] investigated a novel real time induction heating assisted underwater wet welding process. The addition of induction heating could reduce the cooling rate of the joint in underwater wet welding. The macro and microstructures, mechanical properties such as tensile, impact, and bending properties, and Y slit restraint testing were studied. The results showed the content of marten site (M) and upper bainite (BU) phases decreased, while the proeutectoid ferrite (PF) and acicular ferrite (AF) phases increased as the induction heating voltage increased. Mechanical properties of the joint were improved through addition of induction heating and fracture morphology with characteristic uniform dimples belonging to ductile fracture. The cracking ratio of Y slit restraint testing was also decreased. Therefore, the susceptibility to cold cracking of the wet welding joint was improved.

Kim and Eagar[16] presented for better understanding of basic phenomena of resistance spot welding, temperature profiles were measured by monitoring the infrared emissions at 5 kHz from one dimensionally simulated welding of sheet metal disks between the electrodes of a resistance spot welding machine. The weld variables included the zinc coating thickness, coating morphology, work piece thickness, and electrode force.

Stockdale et al.[17] used low nitrogen oxide (NOx) boilers in coal fired power plants in corrosive combustion conditions that have led to a reduction in the service lifetime of water wall tubes. As a solution, Ni based weld claddings are being used to provide the necessary corrosion resistance. However, they are often susceptible to premature failure due to corrosion fatigue cracking. In order to mitigate the cracking problem, significant research efforts are needed to develop a fundamental understanding of the corrosion fatigue behavior of Ni based claddings. In this work, an experimental method was developed to characterize the corrosion fatigue behavior of weld claddings. A Gleeblethermo mechanical simulator was adapted to permit the exposure of samples to a simulated corrosive combustion gas at a constant elevated temperature while applying a controlled cyclic stress. The results demonstrate that this experimental method can be used to accurately simulate the corrosion fatigue mechanism of weld claddings that has been observed in service. The implementation of this experimental method will allow for a better understanding of the corrosion fatigue behavior of water wall claddings in combustion environments and provide a tool for optimizing the corrosion fatigue resistance.

Nabavi et al.[18] studied the effects of nitrogen addition in Ar gas on weld metal microstructure and mechanical properties of Alloy 263 (UNS N07263) and Alloy X (UNS N06002). Autogenous gas tungsten arc welding (GTAW) was employed by adding 0–4 vol% N2 in Ar. Welding speed and heat input rate were measured as functions of gas composition. The weld metal microstructure was studied by optical and scanning electron microscopy. Experimental results demonstrated that the dendritic structure of the weld was refined by increasing N2 in Ar for both alloys. An addition of 4 vol% N2 to Ar decreased significantly the columnar region in Alloy 263 fusion zone (FZ), while no similar change was observed in Alloy X. This difference is discussed based on microstructural characterization. Finally, it was found that the tensile strength and hardness have been augmented with increased nitrogen in the shielding gas.

The brazeability of AZ31BH24 magnesium alloy sheet to Sn coated plain carbon steel sheet using a MgAlZn alloy filler metal and a diode laser heat source has been investigated by Nasiri et al.[19] While the Sn coating promoted good wetting between the molten filler metal and the steel sheet, it did not play a role in forming the final metallic bond. Its primary function appeared to be in maintaining an oxide free steel surface until the molten Mg filler metal could come in direct contact with the steel surface. In all cases, failure of transverse tensile shear test specimens of the joint occurred in the steel base metal. Metallic bonding between the magnesium alloy and the steel was facilitated by the formation of two transition layers, including a Fe(Al) solid solution formed on the surface of the steel and a nanoscale layer of Al8 (Mn, Fe)5 phase on the Fe(Al) surface layer. Examination of the Fe(Al)Al 8 (Mn, Fe)5 and Al8 (Mn, Fe) 5 Mg interfaces using HRTEM showed that orientation relationships (OR) with a low angle of rotation of the matching planes and low interplanar mismatch and therefore low interfacial energy density existed at the Fe(Al) Al8(Mn,Fe)5 interface (i.e., when [1011]Al8Mn5//[111]Fe(Al), {110}Fe(Al) was 4.2 deg from {3033} Al8Mn5 with 5.2% interplanar mismatch) and a high angle of rotation of the matching planes and large interplanar mismatch, and therefore, high interfacial energy density existed at the Al8Mn5Mg interface (i.e., when [1011]Al8Mn5//[1010]Mg, {3033}Al8Mn5 was within 47.4 deg of the {0002} Mg with 16.8% interplanar mismatch). These results were further validated using an edgetoedge crystallographic matching model of the Fe(Al) Al8 (Mn, Fe)5 and Al8 (Mn, Fe) 5Mg interfaces.

Blecher et al.[20] discussed even though laser and hybrid laser arc welding processes can produce single pass, Complete joint penetration welds in excess of 12 mm, root defects, such as root humping, have been observed at these greater plate thicknesses. The competition between the surface tension and the weight of the liquid metal in the weld pool is expected to govern root defect formation. A series of laser and hybrid laser gas metal arc welds has been completed in which each force is independently varied. The internal morphologies of the resulting root defects are characterized by X-ray computed tomography and found to vary significantly when welding with either the laser or hybrid laser arc process. In order to compute the surface tension and liquid metal weight, a model based on the approximate geometry of the weld pool is developed and successfully predicts the range of processing conditions where root defects form. Process maps are then constructed for low carbon steel and 304 stainless steel alloy systems. These maps can then be used to select welding parameters that produce defect free complete joint penetration welds over a wide range of plate thicknesses.

Ultrasonic welding

Ultrasonic welding is an industrial technique whereby high-frequency ultrasonic acoustic vibrations are locally applied to work pieces being held together under pressure to create a solid-state weld. It is commonly used for plastics, and especially for joining dissimilar materials.

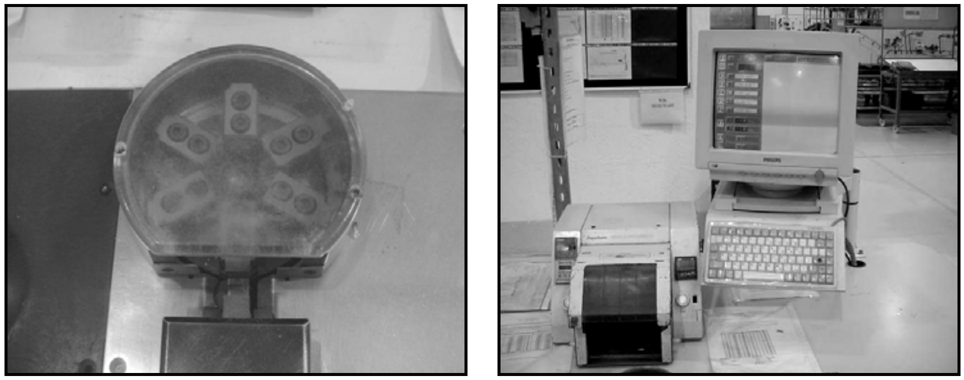


Fig. 1: Ultrasonic welding machine

Fig. 1 shows the ultrasonic welding machine is interfaced with the computer. The Stepper Welder System (E-Press Model) is designed for precision plastic welding applications with dimensional requirements beyond the capabilities offered with a standard air actuated ultrasonic press. The system will control the final weld position with a tolerance of +0.0003 inches. Finished assemblies are produced with a weld repeatability that is not possible with any other plastic welding process. The advancing speed of the ultrasonic horn is controlled with a stepper motor drive, which exactly repeats the defined profile for position and velocity every time. The results are repeatable welds with exact final dimensions of the bonded components when compared with air driven actuators (material dependent). The system is offered as a transport option with standard Sonics & Materials 20 kHz and 40 kHz ultrasonic power supplies. Setting up the system to weld a typical part is really very easy but can seem involved due to the movement and ultrasonic controls required. In order to make full use of the precise distance and velocity welding functions, the ultrasonic power supply will be set so that the time or energy settings are beyond the expected weld requirements.

The computer is used to program the stepper distance and velocity controls. Once the application is setup and running properly, the computer may be removed. The system will run the programmed profile without further commands from the computer. A termination jumper must be connected to the stepper controls in order to terminate the communication signals.

Environmental aspect

Element of an organization's activities, products or services that can interact with the environment. The environment aspects are air leakage, wire and terminal wastage and PVC wastage. The type of aspect used is either direct or indirect. The conditions of aspects are normal, abnormal or emergency conditions. Resource depletion and land pollution are the environmental impacts.

Hazard identification and risk assessment

In ultrasonic welding the possible situations of hazard identification and risk assessments are bunching wires in hand, wire holder for crimping and generation of heat. The conditions of aspects are normal, abnormal or emergency conditions. Hazard identifications are conductor touches the finger, finger touches the movable parts and finger touches the hot circuits over heat generation in machines. Consequence types are health and safety. Consequence impacts of the employee or other business associate are skin damage, finger injury and burn injury.

Significance criteria for hazard and consequence are death, loss of any part of body, minor & major injury requires hospitalization/bed rest, injury & temporary treatment, injury that requires first aid at shop floor level only.

RESULTS AND DISCUSSION

During welding process the following parts of the body has to be protected and check the personnel protective equipment history details.

Eyes and face

Protect eyes and face wear Welding helmet, hand shield, or goggles.

Purpose of wearing helmet is Protects from:

- Radiation
- Hot slag, sparks
- Intense light
- Irritation and chemical burns

Wear fire resistant head coverings under the helmet where appropriate.

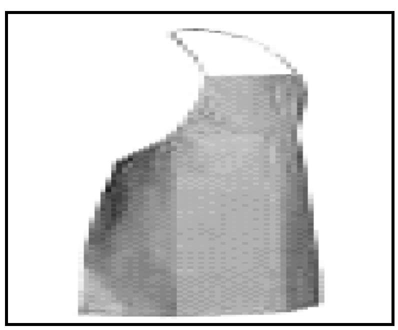
Lungs (breathing)

Wearing respirators is used to protect Lungs (breathing).

Purpose of respirators is protects against from fumes and oxides.

Exposed skin (other than feet, hands, and head)

Exposed skin like feet, hands, and head protected from Fire/Flame resistant clothing and aprons.



It protects against from heat, fires, burns.

Ears – hearing

Ear muffs, ear plugs are used to protect Ears-hearing.

Protects against: Noise.

Use fire resistant ear plugs where sparks or splatter may enter the ear.

Feet and hands

Boots, gloves are used to protect feet and hands.

This protects against heat, burns, fires.

Table 1 shows for hazard identification and risk assessment points of view. The death criteria effecting more than 10 persons, the scale of consequences is 5 and the occurrence of consequence is continuous. Loss of any part of body criteria affecting 7-10 persons, the scale of consequences is 5 and the occurrence of consequence is several times a day. Minor & major injury requires hospitalization/bed rest effecting 4-6 persons, the scale of consequences is 5 and the occurrence of consequence is once a day. Injury & temporary treatment effecting 2-3 persons, the scale of consequences is 5 and the occurrence of consequence is once a week. Injury that requires first aid at shop floor level only effecting 1 person, the scale of consequences is 5 and the occurrence of consequence is once in a month.

Table 1: Significance criteria for hazard and consequence

Severity of consequence (5-1)			**Scale of consequence (5-1)**			**Occurrence of hazard (5-1)**	
Score	Criteria	Significance (Y/N)	Score	Criteria	Significance (Y/N)	Score	Criteria
5	Death	Y	5	Effecting more than 10 persons	N	5	Continuous
4	Loss of any part of body	Y	4	Effecting more than 7-10 persons	N	4	Several times a day
3	& Major injury requires hospitali-zation/bed rest	N	3	Effecting more than 4-6 persons	N	3	Once a day
2	Injury & temporary treatment	N	2	Effecting more than 2-3 persons	N	2	Once a week
1	That requires first aid at shop floor level only	N	1	Effecting more than 1 person	N	1	Once a month

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