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Review on MIG welded stainless steel alloy

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ABSTRACT

MIG welding Arc voltage control, the energy source is given and the wire-feed unit delivers speed control of the welding wire, in MIG it is equivalent to the welding process. Many traditional wire feed systems control the wire feed speed through the thyristor control PCB and the DC motor to offer control of the Armature volts and therefore the RPM of the engine. The wire feed motor spindle is equipped with a feed roller and then additional pressure roller, the variable spring is placed to gently catch the wire and force it up to a MIG torch length.

Keywords: MIG Welding, Vicker Hardness Test, Tensile Test,

1. INTRODUCTION

Welding is often a manufacturing method of forming a permanent joint achieved through the surface fusion of the joining parts, with or without the applying a filler material and a pressure application. The joining materials can be identical or dissimilar to one another. The heat needed to fuse the material can be produced by an electric arc or by gas burning. Because of the higher welding speed, the latter form is often used frequently. Welding is commonly seen as an alternative way for forging or casting in construction and as a substitute for riveted or bolted joints. It is often seen as a repair tool for – for example reuniting a metal at a crack or fixing up a minor portion which has fallen off like a gearing tooth or restoring a damaged surface like a bearing surface.

With the invention of technologies, the current welding advanced technology just before the end of the nineteenth century is used to produce high temperature in the localised region. In general, a heat source is needed to create a high-temperature zone and to melt raw - materials welding, although two metal pieces can be welded without much rise in temperature. Different standards and methods are adopted, and for new and improved method of welding, there is still a continuous search. The demand for the new welding materials having large thickness components increases, mere gas flame welding, usually are welding engineer known, which is not satisfactory and improved as the development in tungsten insert gas welding, metal insert gas welding, laser and electron beam welding [1].

For the binding of various materials such as plastics or alloys, metal in a permanent bonding phase with both the application of pressure or heat is called welding. The workpieces to be combined are melted during interface welding, and after the process of solidification, a permanent joint can be accomplished. In order to form a welding pool of molten steel, often a filler mixture is applied between solidifying materials, which creates a strong bond. Various factors, such as metallurgical shifts, rely on the welding potential of the product that occurs throughout welding, due to the rapid increase in hardness in the welding region, with a propensity to crack forming and oxygen in the air mostly in joint position, due to material reactions there is a degree of oxidation.

1.1 Metal Inert Gas Welding (MIG): When contact is formed between two smooth areas, a welded joint is produced and both are applied, whether by pressure or by heat, for a bonding. The basic cause of the soldering seems to be the atomic tendency to bond [14]. The fundamental concept of all processes of welding is the interdiffusion between combined materials. Diffusion can occur mostly in liquid, solid, or mixed conditions.

MIG i.e. Metal inert gas arc welding or better known as GMAW i.e. gas metal arc welding uses an electricity consumable, and thus the word metal occurs in the description. Other arc-shielding gas-processes are used for consumable electrodes, like FCAW, which can all be represented as MIG. Although GTAW could be used to weld metals of all kinds, it is much more suitable for thin sheets. The need for filler metal allows GTAW difficult to use when thick sheets ought to be welded. The GMAW provides convenience in this case. Figure 1 offers an overview of the scheme of the MIG or GMAW welding process. The consuming electrode is fed by the feed rollers at a constant rate mostly in form of a wire roller.

The welding torch is attached to a gas supply cylinder providing the needed inert gas. The workpiece and the electrode are attached to the welding power supply. The power source is often of a constant voltage form only. The current obtained from the welding machine is altered by the electrode wire feed rate. Usually, DC arc welding devices are being used for GMAW with positive electrode DCRP i.e. direct current reverse-polarity welding. DCRP improves the rate of metal deposition and also guarantees smooth metal electrode transition and stable arc. With DCSP, the arc appears extremely unbalanced and also provides a significant spatter. Although specific electrodes with mixtures of titanium and calcium oxide as coatings often considered being suitable for welding DCSP steel. Throughout the GMAW process, the metal filler is moved from either the electrode to a joint. Probably depends on the voltage and current used for the electrode, the movement of the metal is conducted in various aspects.

1.2 Equipment of MIG Welding

- Wire feed unit
- Torch
- Work return welding
- DC power output source
- Shielding of the gas supply (usually from the cylinder)

1.2.1 Power Source: The MIG welding is usually carried out on the DCEP, i.e. Positive polarity DC electrode. After all, DCEN is being used (for larger burn-off rates) for certain gas-shielded and self-shielded core wires. The power sources of a DC output represent a kind of transformer-rectifier with nothing more than a flat characteristic (constant VS).

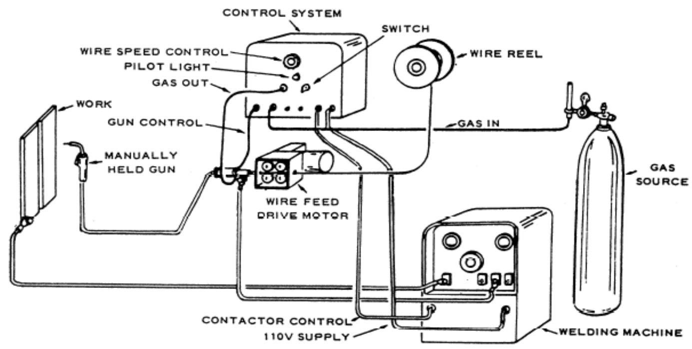

Fig. 1.1 Metal Inert Gas Welding (MIG)

The much more typical method of power source is being used in this method is indeed a switched primary rectifier with constant features of voltage from both 1-phase 240V inputs and 3-phase 415V. DC output on a 3-phase machine after full-wave rectification is quite consistent. A wide capacitor bank across the output is needed to attain even (smooth) output after complete wave rectification with a 1-phase machine. Due to the cost of this, several low-cost 1-phase devices lack this part and thus have poorer welding characteristics. Switches to the primary winding main transformer can provide voltage output measures of the main power terminals. A further way of creating voltage levels at the output terminals would be to use a Transistor and a Thyristor rectifier rather than a basic diode rectifier.

A continuously variable output voltage is being obtained using the device, that can be especially be useful for robot installations, and the expense of such type of rectifier can be partially offset without the necessity for the main voltage switch or switch and a single tapped primary winding transformer. Many MIG sources of power have a contactor or relay that is being used to turn the ON / OFF output with the MIG torch trigger activity. The turn off the activity of this contactor is usually delayed to enable the welding wire to burn out from the molten welding tank. The thermostat is mounted only at the hot point of the source of power, in series with a contactor coil aim of providing thermal safety to the system.

1.2.2 Wire-Feed Unit: The sub-assembly or wire feed unit where it is placed in an available power cabinet (recognized mostly as composite MIG) supplies the regulated supplying of the welding wire to a point to still be welded based on the size of the arc voltage and welding wire given by the source of power, constant wire speed is needed, in MIG welding Arc voltage control, the energy source is given and the wire-feed unit delivers speed control of the welding wire, in MIG it is equivalent to the welding process. Many traditional wire feed systems control the wire feed speed through the thyristor control PCB and the DC motor to offer control of the Armature volts and therefore the RPM of the engine. The wire feed motor spindle is equipped with a feed roller and then additional pressure roller, the variable spring is placed to gently catch the wire and force it up to a MIG torch length.

1.2.3 MIG Torch: This sets out the delivery technique from wire feed unit to a point where welding is necessary. The MIG torch may be water-cooled or air-cooled, and the more current air-cooled devices have such a single cable wherein the welding wire passes via the liner. The gas flows on the outside of the liner and across the liner tube seems to be the trigger wires and the control braid. The exterior insulation provides flexible protection. MIG Water-cooled torches are identical to above, but the liner tube, gas hose, power line (such as a water-return cable), trigger wires, and water-flow cable are all different throughout the external sleeve. Almost all of the commercial MIG machinery utilizes a typical European MIG torch connection for fast torch attachment, several smaller units (low-cost) using specific manufacturer fittings. Upkeep areas are essential: the liners are also in excellent condition and that of the appropriate size and type; the contact points are slightly fitted, of the appropriate strength and high quality.

1.2.4 Shielding Gas: It represents a complex field with many different mixtures accessible, however the original objective of the MIG shielding gas would be to shield the molten welding metal and the heat-affected zone from oxidation as well as other contaminants of the environment. The shielding gas could also have a direct impact on various aspects of its welding process and the subsequent welding.

- Metal Transfer Mode
- Features of arc
- Inclination undercutting
- Welding pace
- Clean-up action
- Welding of metal mechanical properties
- Profile of penetration and weld head

The gases for various materials are as follows:

- Magnesium: helium
- Aluminium: argon
- Copper Alloys: Argon – Helium Blend
- Steel: CO2 not widely; the Ar-CO2 mixture is favoured.

1.3 Advantages and applications

1.3.1 MIG welding advantages

- Welds much of the metals.
- Increased deposition.
- Reduced weld flaws.
- It produces little to no slag.
- Welding out of place can be achieved with the right wire and settings.
- Clear Method and simple to follow and use.
- Substantially increase speed and far more effective than most of the other types of welding.

1.3.2 MIG welding disadvantages

- Sensitivity towards Contaminants.
- Sensitivity towards Wind.
- Limited Positions.

- Lack of Fusion and the equipment is pretty Complex.
- Portability Problem.
- Fast Cooling Rates.
- Time for Metal Preparation.
- Difficulty in getting into Tight Places.

1.3.3 MIG WELDING APPLICATION

(a) Fabrication and manufacturing

- Attributed to the rise in speed and performance, MIG welding has been well equipped for manufacturing and production.
- Clean-up process is significantly reduced to no or little slag.

(b) Maintenance and repair

- Lightweight MIGs may be compact.
- Welds different types of steel.
- Single-phase domestic MIG power source is available.
- Perfect for the agricultural sector via using gasless wire, which makes it difficult to weld outdoor activities.

(c) Professionals

- Panel beaters, body shops, etc
- Truck repairers.

1.4 Metallurgy of A welded joint

Metal is usually heated over temperature range until it is molten, accompanied by a cooling ambient temperature. Due to the differential heat, the materials away from the welding bead would be hot, though as the welding bead reaches an extremely high temperature, due to a complex microstructure. Consequent heating and air conditioning result in the welding of internal pressures and plastic strains. Based on temperature gradient slope, 3 separate zones as seen in Figure 1.2 could be described throughout the welded joint as follows:

- Heat Affected Area (HAZ)
- Base metals
- A fusion zone or Welding metal

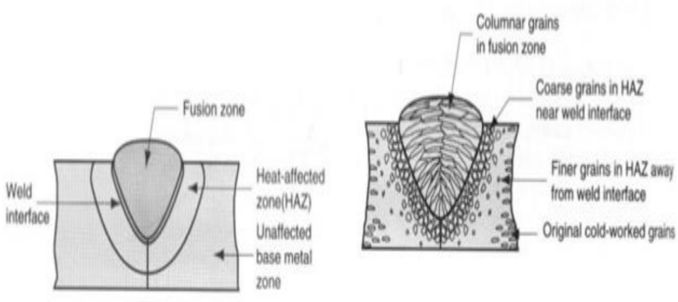

Fig. 2: Zones in Welded Joint

The joint formed without the filler metal is named autogenously and its welding zone is made of the base metal. A connection made of metal filler is named weld metal. As the central part of the welding bead will gradually cool down, large columnar grains will grow and grains in the outer portion of the welding bead may become finer and finer at a distance. Thus, the ductility is slipping away from the welding ring. After all, with distance from the welding bead, the intensity increases. The initial steel structure composed of pearlite and ferrite is converted to alpha iron.

Throughout the molten state, the welding metal does have a strong propensity to dissolve gases that make contacts with it, such as nitrogen, hydrogen, and oxygen. But, throughout solidification, a part of such gases is stuck in a bead named porosity. Porosity is due to the reduction throughout the strength of the welding joint. The rates of cooling can indeed be managed by pre-heating the base metal weld interface prior to welding. The HAZ is inside the base metal itself. This possess a microstructure unique from those of base metal after welding since it is exposed to high temperatures for a considerable period of time throughout welding. In the heat-affected region, the heat is transferred mostly when the welding re-crystallizes the elongated grains of the base metal, and the grains separated from its welding metal may re-crystallize through fine grains.

1.4.1 Dissimilar Welding: Dissimilar metals have been used frequently in the electricity generation, electronics, nuclear plants, chemical and petrochemical industries, primarily in order to obtain tailor-made properties in components and to minimize weight. Nevertheless, effective welding of dissimilar metals was a significant obstacle attributed to the variation in chemical and thermo-mechanical properties of the material to be connected underneath a standard welding environment. This results in a steep-gradient of thermo-mechanical properties all along the weld. A range of issues occurs in various forms of welding such as, migration of atoms, large residual welding stresses, cracking during welding creating tensile stress with one part of welding, tensile and compressive thermal stress, stress corrosion cracking, etc. Currently, before resolving the issues that occur throughout dissimilar welding, the channels beneath shed some light on a few of the triggers of such difficulties. In the case of dissimilar welding, weldability is defined mostly by crystalline assembly, the compositional solubility, and the atomic diameter of the parent metals both in liquid and solid states. Diffusion in case of welding pool also leads to the creation of intermetallic stages, the largest of which would be brittle and hard and are often hazardous to the mechanical ductility and strength of the joint. The thermal conductivity and coefficient of thermal expansion of the material being connected are different, which results in a large quantity of misfit strains and, as a consequence, the stress concentration contributes to cracking upon solidification.

1.4.2 Welding Process Variables: Weld deposition and weld quality rate are highly influenced by the surrounding welding process parameters and joining geometry. Basically, welded joints can be created by different configurations of joints geometry ad welding parameters. Such parameters are basic parameters that regulate the welding efficiency and welding deposition rate. The design of depth of penetration, the welding bead, and the ultimate welding efficiency focus on the following operational parameters.

1.4.2.1 Electrode Size: The diameter of the electrode affects the configuration of the welding bead (like the size), the penetration depth, the width of the bead and has a subsequent impact on the rate of travel of the welding. As a general matter, the arc becomes penetrating with almost the same welding current (speed setting of the wire feed) as the electrode area decreases. In order to achieve the highest deposition rate at a given current, one has the lowest possible wire to provide enough required welding penetration. The greater electrodes diameters produce a weld with much less penetration but with a welder in width. The selection of the diameter of the wire electrode determines the workpiece thickness i.e. to be welded, the necessary weld penetration, the required deposition rate and welding profile, the cost, and the welding location of the conductive material or electrode wire. The sizes of electrode widely shown are (mm): 0.8, 1.0, 1.2, 1.6, and 2.4. Each size seems to have a functional current range-based wire composition and short-circuiting arc or spray- type arc utilized in the operation.

1.4.2.2 Welding Current: The welding current value used during MIG seems to have the greatest influence mostly on deposition rate, the scale, shape, and penetration of the welding bead. In MIG welding, metals are typically welded with direct current polarity electrode positive (DCEP, contradictory to TIG welding) due to the fact that they have the highest heat input for the work and moderately deep penetration can be achieved. If all of its other welding parameters are kept constant, increasing the charging current width and depth of the penetration as well as the size of the welding bead.

1.4.2.3 Welding Voltage: The arc voltage or arc length is considered as the most significant factor in MIG which must be brought under control. Since all factors including the size and composition of electrode, the sort of welding methodology, and a shielding gas are kept constant, the length of the arc is related directly to arc voltage. High or low voltages such as the arc to be unbalanced. The unnecessary voltage causes massive porosity or spatter, rises undercuts in fillet welding and generates smaller beads with higher concavity, but the increased low voltage can cause overlapping and porosity at the corners of the welding bead. Additionally, with a continual source of voltage, the welding current keeps increasing whenever the electrode feed rate increases and decreases as that of the electrode speed decrease, whereas other factors remain constant. It's a very significant consideration in the MIG Welding process, primarily as it governs the quality of metal transfer by affecting the rate of droplet transfer from across arc. The arc voltage that will be utilized depending upon the material of its base metal, the category of joint, the composition and size of the electrode, the structure of its shielding gas, the type of welding, the position of the welding, and other variables.

1.4.2.4 Welding Speed or ARC Travel Speed: The speed of travel seems to be the rate at which the arc moves all along the workpiece. These are governed by a machine in automatic welding and by a welder in semi-automatic welding. The impact of travel speed is due to the notion of arc voltage. The penetration is highest after a certain value and reduces as the speed of the arc changes. For a current-controlled, sluggish travel speeds include a higher heat input and larger bead to the base metal due to longer temperature rise. The elevated input improves the welding penetration and the welding metal down payment per unit length, resulting in such a wider bead contour. If travel speed becomes too slow, uncommon welding build-up tends to occur, resulting in poor melting, porosity, lower penetration, slag inclusions, and uneven rough beads. The travel speed, which is an influential factor in MIG, much like the arc voltage and the wire speed, is selected by the operator based on the thickness of the metal welded, the combined welding position, and fit-up.

1.4.2.5 Welding Position: The wire electrodeposition in relation to the welding joint impacts the shape of the welding bead and the penetration to something like a larger extent than that of the arc voltage and speed of travel. The role of its wire electrodes is characterized by two angles named "travel angles" and "work".

1.4.2.6 Shielding Gas: The primary purpose of shielding gas would be to cover molten and arc weld, a reservoir of nitrogen and oxygen from the atmosphere. If it is not adequately covered, it develops nitrites and oxides and results in welding defects like slag inclusion, weld embrittlement, and porosity. The shielding gas and its rate of therefore have a major impact mostly on the ability to follow: metal transfer mode, arc characteristics, welding bead profile and penetration, action cleaning, welding speed, welding metal mechanical properties. Helium, Argon, and argon-helium combinations are often used in systems for welding of alloys and non-ferrous metals. Carbon dioxide and Argon are utilized for carbon steel.

1.4.2.7 Electrode Extension: The extension of the electrode or stick out would be the length of the filler material in between the end of the electrode and the end of its contact tip. It is the only part of the electrode wire that regulates the welding current. Mostly as a consequence, the rise in the expansion results in an increase with its electric potential and thus causes the temperature of the electrode to increase due to the heating resistance. This preheat will achieve a temperature value exceeding the electrode melting point, such that the low-intensity arc heat is sufficient to be melted only at the welding stage. In a constant - voltage source, a rise mostly in resistance of its stick out induces a higher voltage drop from the contact surface to the job. The CV power supply needs to compensate for a larger voltage drop by lowering the current resulted in a narrower arc resulted in a short, high-crown welding bead for shallow penetration. Decreasing the stick out has only the reverse effect, the heating process of wire is decreased, the voltage drop may not be as large and the energy source offers more current than that of the heat input to a workpiece, which allows a rise in penetration.

2. RELATED WORK

Hongtao Zhang et al. 2011 tested the impact of galvanised zinc coating and aluminium coating on fusion metal spreading potential on lap joints of 1Cr18Ni9Ti stainless steel and aluminium alloy 2B50, welded with 4043 Al-Si filler metal using MIG welding – brazing technique. The aluminized coating had a small impact to facilitate the presence of a welded surface and evident micro-cracks between the steel side and compound layer were discovered. The rupture in tensile testing took place at the weld's interfacial layer with a low tensile strength of around 60 MPa. Joints among galvanised steel and aluminium alloy had a better surface image, and Al 4.5 FeSi was really the intermetallic compound near the joint interface throughout the fusion zone area. Due to the heat input, the surface area of the intermetallic compound layer differed to around 5.m to 15.m and the greatest lap joint tensile strength may reach 193.6 MPa whenever the heating rate is 0.846 KJ / cm. Dissimilar materials joints have been made among 2B50 stainless steel and aluminium alloy by MIG welding – brushing with ancillary coating, that also encourages the wetting property of filler metal. As per the sequence features; a thin transitional discontinuous layer has been obviously indicated only at welding interface, the thickness from which differed from about 5.m to 15.m depending on the heat input in the experiments; the intermetallic compound in the seam region near the welding interface was Al 4.5 FeSi; the average lap joint tensile strength was 193.6 MPa when the heat input was 0.846KJ/cm.

Abdul Wahab et al. 2011 analyzed the role of welding parameter using some MIG spot welding in welding joints of dissimilar metal. The basis material chosen for welding in this research is austenitic stainless-steel type carbon steel and AISI 316L. The use of filler metal to weld this dissimilar metal seems to be E80S-G, including the use of CO_2 as shielding gas. The testing was conducted by considering the input parameter of wire feed, weld current, and feed time. Then doing the experiment the impact of such variables on shear force and spot diameter was anticipated. From the consequence, they reach the conclusion that with increasing welding current, the size of shear force and spot weld increases whereas the sheer force decreases with increased welding time. There have been apparent micro-cracks between the steel base metal and compound layer; crack surface at the steel interfacial layer/welded seam, with a lap joint tensile strength having reached approximately 60 MPa. Sound dissimilar metal joints were acquired between galvanized steel and aluminum alloy with excellent appearance; the joints seemed to have three visible areas: interfacial reaction layer, zinc-rich zone, and the fusion zone. They also discovered that perhaps the expanding welding current, the time of welding will also boost the diameter of the welding zone and reduce the sheer force [1].

R. Sudhakaran et al. 2012 researched processing parameter optimization utilizing PSO to minimalize angular distortion in tungsten arc welded plates of 202-degree stainless steel gas. Angular distortion is indeed a big issue and is most pronounced among different kinds of distortion in plates welded to the butt. For the research, the parameters of the process control chosen seem to be the welding speed, welding current, welding gun angle, and flow rate of the gas. The studies were conducted out by using the technical design of experiments with an adjustable layout of five-level (five factor-based) central composite with full replication methodology. A mathematical model has been developed in which processing parameters were correlated with angular distortion. A code to do the analysis based on optimization was established in MATLAB 7.6. The optimum processing parameters managed to give an angular distortion value of 0.0305 ° which illustrates the effectiveness of the model. The findings suggest that the optimized values are able to produce a weld with minimal distortion for the processing parameters. We arrived at the following conclusions from the research. The quadratic model of second-order can be efficiently used to anticipate angular distortion of the stainless steel 202-grade plates in gas tungsten arc weld. The maximum amount of angular distortion validated with experimental research findings was 10 °, when process parameters like gas flowrate, gun angle, plate length, welding speed at 110 mm/min, and welding current were preserved at 60°, 10 litres/min, 80 amps and 125 mm respectively, and were maintained.[24]

Suresh Kumar et al. 2012, discussed the mechanical properties of austenitic stainless steel 304 with TIG and MIG welded dye penetrate testing. The TIG welding generated the lesser hardness value than that of the MIG welding in this study. The stainless steel TIG welds survive the heavy loads and generated an elevated ultimate strength compared to MIG welds. Austenitic grains have been described in the microstructure and the Dye Penetrate Testing showed no phenomenal indication. The HAZ has been enhanced by adding the welding current. This can be reached the conclusion that the above principles for the process variables will further alter the plate and therefore should be prevented. The minimum angular distortion based on experimental research was 0.4 ° if the procedure parameters like gas flow rate, gun angle, plate length, and welding current were retained at 70 °, 15 lit/min, 90 amps and 150 mm respectively, and the welding speed at 100 mm/min was preserved. Max strength joints for whom fracture took place in Al alloys HAZs i.e. heat-affected zones at 89 MPa have also been acquired up to 72 per cent of Al alloy tensile strength with such a desired target of 0 and 1 mm for the torch. This can be reached in the conclusion that in the process-based parameters minimal angular distortion can be obtained using the value systems above. The percentage of error of angular distortion between both the observed and predicted value is 1.66 percent. Therefore, the developed model should be used precisely to anticipate angular distortion. The optimum processing parameters for angular distortion tried to give a value of 0.0305 ° that also illustrates the effectiveness and accuracy of the model established [26].

Monika K. et al. 2013 evaluated the mechanical properties of MIG Welded Dissimilar Joints. The determination of the heat input is done by the welding current, wire-speed, and voltage. The base material was used during the IS 2062, IS 45 C8, IS 103Cr1. Copper coated mild steel with a diameter of 1.2 mm has been used as a filler wire. Both joints (IS2062 & IS 103 Cr1) and (IS 2062 & IS 45 C8) increases the tensile strength when increased with heating rate, and also increased the surface hardness when reduced with heat input. Dissimilar metal joints were acquired among galvanized steel and aluminum alloy with excellent appearance; joints had three visible regions: the interfacial reaction layer, the fusion zone, zinc-rich zone depending on the phase attributes, a narrow discontinuous intermediate layer is now easily noticed at the welding interface, the hardness of which differed from about 5 m to 15 m depending on the energy input in the studies; the intermetallic compound within seam region near the welding site. [6].

Pradip D. Chaudhary et al. 2014 studied the impacts of the GMAW i.e. Gas Metal Arc Welding processing parameters mostly on tensile strength of the SS 3Cr12 steel material sample. Throughout this research, wire feed rate, welding voltage, gas flow rate, welding seed and were regarded to be an inflating input parameter. The study was conducted with a central composite design matrix and the study was applied using Minitab software. The assessment showed that the strength increased with an increase mostly in gas flow rate and welding speed, while the increase increased with a decline in the welding voltage and wire feed rate. Less coarsening is noted in the metal welding. The massive chunk of austenite is maintained in the austenite matrix including a tiny portion of ferrite. The transverse pattern, microstructure characteristics, and appearance of the joints have been evaluated. Significant study results could be summed up as follows: the aluminium coating would have a small impact on the wetability of aluminium filler metal; a large number of compounds were present on the aluminium steel surface, part of which has been melted, and a further part of the compounds entered the melting zone after fragmentation as a result of the welding heat input; there had been an existence of tempered martensit. [11].

Sahil Bharwal et al. 2014 studied the GTAW i.e. gas tungsten arc welding process for the AISI 202 SS grade weld metal. The GTAW process benefits the welded joint with better rate of deposition, and maximum strength. The obtained results after welding of AISI 202 are similar to the AISI 304 type which meets the requirements for the recommended characteristics including its welded joints. Therefore, 202 form SS should be used instead of 304 type SS the above-mentioned applications. In the current study, grade 202 stainless steel has been used to explore strength utilizing input processing parameters chosen from the welding test run. The tensile strength acquired is reasonable enough just to cover the service life of AISI 202 throughout the recommended applications. This can be mentioned that 202 SS could even be used instead of 304 SS. The values acquired from the microstructure exhibition that the structure is composed of austenite grains throughout the heat-affected zone and also the parent metal. Eventually, this can be concluded that AISI202 grade stainless steel has sufficient corrosion resistance to pitting and progressive grain growth in the heat affected area. Throughout the metal welding zone, there is a substantial part of austenite with a tiny portion of tempered martensite and ferrite. The microstructure seems to have a ferrite delta framework in the austenite matrix of the welded metal. This study proves prior findings by a few authors [7].

R. Sudhakaran et al. 2014 explored the role of GTAW parameters on pitting corrosion on AISI 202 chromium manganese stainless steel. An empiric mathematical model that correlates PREN i.e. pitting resistance equivalent number with welding parameters like welding speed, welding current, gas flow rate, and welding gun angle has been established. The central composite response surface methods, with five levels and four parameters, was used to test the study hypotheses. The suitability of the proposed model has been inspected utilising ANOVA. The significant effect of processing parameters on the PREN of its welded joints have been researched utilising contour and surface plots. The speed is 0.87 m / min. The melting current of the filler increases after the bypass current was applied. Whereas the current density was generally reduced and the constant heat centre offset was identified, the arc features in DSAW altered. Whenever the angle of the weld gun is retained at a reduced level of 50 °, the affected area by the heat gradually decreases because of less exposure of the welding metal to the arc. Gross grains are noted in the metal welding zone and the substantial part of austenite is maintained. The tempered martensite is widely spread during this zone. When the welding gun angle is retained at an elevated level of 90 °, there seems to be a rise in the affected area by the heat high levels of exposure of the welding metal to the arc. The presence of martensite increases the tensile strength of the welding metal. The existence of ferrite in the austenite matrix shows that the welding metal does have phase stability, adequate capacity and corrosion resistance [24].

Jong Young Lim et al. 2015 especially in comparison the productivity in enhancing material characteristics of rolled steel (SS400) with stainless steel (STS304) welded both by the MIG (metal inert gas) welding and CO 2 weld area method. Multi-tests were performed on the welded sample, such as X-ray irradiation, Vickers' hardness, tensile test, fatigue test, fatigue crack growth test. Predicated on the fatigue crack development procedure done by two techniques, the interaction between dN and da was analysed. And although hardness of the two techniques was comparable, the fatigue properties and tensile test of the MIG weld zone were higher than that of the CO2 welded one. In this research, the mechanical properties, fatigue and hardness properties of SS400 and STS304 welded materials utilizing different types of welding techniques were evaluated. From hardness test, the two CO2 welding specimens had comparable hardness, the hardness observed in the metallic weld zone and heat affected region and base metallic region, respectively, demonstrates that perhaps the metallic zone had the highest, welded CO2 TS of 463.4 MPa with deformation at 39.88 per cent. SS400-STS304 welded by MIG has a tensile strength of 623.4 MPa with elongation of 48.42 percent, which is really the greatest of all specimens, and STS304-STS304 welded by MIG does have a TS of 598.3 MPa with elongation of 26.02 percent. Because high current is quickly induced by a MIG weld area, both and SS400 and STS304 can be melted due to increased current induction, and that is why the MIG welded SS400-STS304 indicates the largest fatigue limit. From crack growth test, the heat affected MIG welding region and welded metallic region showed a slow crack rate of growth. However, CO2 welded SS400-SS304 and CO2 welded SS400-SS400 showed an opposite trend [14].

Yugang Miao et al. 2015 examined the potential of BC-DSAW (Bypass Current Double-Side Arc Welding) for high-speed welding on 2 mm thick 304 stainless steel. A high-speed camera was used to screen the arc behaviour and the metal transfer process. The existing density distribution of a MIG – TIG coupling arc was evaluated using the cope up. The bypass current doubled the melting efficiency of the filler wire as well as reduced the heating rate of base metal; the current density at the arc centre reduced by 30% with bypass current introduced. Due to pre - heating effect of a bypass arc upon filler wire, the metal transfer method was changed from short-circuit transfer to the growing time of the droplet and globular transfer was cut short to boost the transfer frequency by 50%. The viability of implementing BC-DSAW with welding at a high-speed for thin plate was verified (however the welding bead can be further optimized) and the impacts of bypass current mostly on texture of the seam, current density, and heat input metal transfer have been studied. Depending on the outcomes, the following conclusions can be made that the performance of thin-plate joints could be acquired utilizing BC-DSAW. The metal transfer mode was changed from SC to globular mode and the transfer frequency increased by 50% just after bypass current has been applied, that the welding efficiency and also the stability of BC-DSAW. The BC-DSAW droplet ended up taking less chance to develop due to the pre - heating impact of a bypass arc [16].

S. Jianxiong Li et al. 2015 studied the impacts of angle and torch position mostly on the stability and quality of the welding process of Pulse MIG weld-brazing of 6061 aluminium to 304 stainless steel in lap setup. cArc images, electrical signals of welding voltage and current were obtained in synchronous mode by either an electrical signal acquisition system or a camera with high-speed. The obtained results showed that the shape of the arc, the microstructure, the macrostructure, and the mechanical characteristics are delicate to the desired target of the torch whenever the working angle is 0 ° and the travel angle of the torch is 20 °. Even so, when the working angle is 20 ° and the travel angle is also 20 °, the impact of the desired target of a torch is unimportant. It's indeed simpler to hit and hold arc mostly on the exterior of the aluminium alloy as compared to the surface of the stainless steel. High-strength weld joints, the fracture of which took place in the HAZ of the Al alloys at 89 MPa, up to 72% of the TS of the Al alloys, were obtained. The following conclusions are made that perhaps the shape of the arc, the microstructure, macrostructure, and the mechanical characteristics are responsive to the target position of the torch whenever the travel angle of the torch is 20 ° and the working angle ß is 0 °. Even so, when the ß is 20 °, the torch is 20 ° and the impact of the torch is unimportant. This evaluation tool can indeed be efficiently and rapidly integrated into the real-time control of the weld metal, that also measures aim guidelines for the MIG welding – brazing of aluminium alloys to stainless steel [10].

Jianxiong Li et al. 2016 studied the impacts of pulse on the stability of the traditional P-GMAB i.e. pulse gas metal arc brazing process, which has been defined by metric of welding voltage and current signals. Outcomes-based on the time domain and frequency domain analysis shows that the stability of the pulse weld zone on PP-GMAB i.e. pulses gas metal arc brazing far exceeds that of P-GMAB. Such quantitative data shall be developed and tested with observational data. The P-GMAB based metal transfer mode was a mixture of one drop per pulse (MDPP) and one drop per pulse (ODPP). Even so, for the high-energy pulse of PP-GMAB, the droplet transfer mode is mainly ODPP with several figures of TDPP i.e.; for a low-energy pulse, ODPP is maintained via the entire weld metal. Enhanced welding while using the pulse in pulse mode seems to be attributable to the more stable weld metal and the findings are as continues to follow that whenever the pulsation time intervals of a PP-GMAB and P-GMAB waveforms are, all the same, the pulse amount of the single pulse is narrower than those of the pulse in pulse mode, that can be attributed to the reduced duty cycle of the lower peak current and low-energy pulse. The PDD welding current curves are indicative of the double hump shape and the ratio of PP-GMAB is narrower, that also means that the welding process is much more stable. For the PDD including its welding voltage, the welding stability of the welding voltage can indeed be demonstrated by the area of the base current region which would be comparable to modification of the low-energy and high-energy pulse groups. Lower porosity creation in PP-GMAB weld zone is attributable to the more turbulent flux of molten metals [9].

F. Varol et al. 2016 tested the impact of welding process on gas metal arc brazing 304 stainless steel and EN 10292 galvanized steel plates with a copper thickness of 1 mm S Cu 6100 (CuAl8) wire. Argon has been used as brazing operations and shielding gas was carried out at a gas flow rate of 12 L / min. Brazing procedures were carried out with 7 distinct welding currents like 40, 45, 50, 55, 60, 65 and 70 A. On further completion of brazing operational activities, the combined tensile strengths have been evaluated and the macro and microstructures of joints were assessed in order seeing the joint strength of EN 10292 sheets of steel and 304 stainless steel using a different current intensity by gas metal arc brazing technique. A total of 10292 galvanised steel and 304 stainless steel were brazed. It has been noted that the strength has increased with an increase in the current intensity. The analysis revealed most of the tensile test specimens were fractured from the base metal EN 10292 galvanised steel. No fractures were noted throughout the joint zone whenever the bending results of the tests were reviewed. All fractures occurred at the average tensile strength and base metal was 618 MPa. The amount of heat of the base metal was reduced with the bypass current applied, which helped lead to a decrease in the amount of the melting and the region of the HAZ. The MIG-brazing approach requires low thermal input compared to many other fusion techniques. The molten metal Steel wetted stronger while using 65, 70 A current intensities, going to compare brazed specimens in 65, 70 A at reduced thermal intake to brazed specimens in 40, 45, 50, 55, 60 A [27].

Chuang Cai et al. 2016 investigated the effects of different gas flow behaviours mostly on welding features of 3 distinct gas shielding valves for the narrow-gaps laser-MIG hybrid welding of stiff-section steel. Extremely unstable droplet transfer type of behaviour with welding current waves and spatters due to the high velocity and unstable of shielding gas have been noted when using the shielding gas nozzle with straight-trapezium. The pore mass welding in the honeycomb distribution at the surface has been generated by the use of a straight trapezium nozzle, as the rear part of the molten weld pool could not be efficiently safeguarded mostly during the welding process. Stable current wave and droplet transfer behaviour were actually realized; trained welds for almost no pore spaces were collected by the use of a circular outlet nozzle with a boss or square-based outlet nozzle with boss. In this research, three distinct gas shielding nozzles have been engineered for the laser-MIG hybrid welding. In this research, three distinct gas shielding nozzles have been engineered for the laser-MIG hybrid welding of the thick steel section. The behaviour of the droplet transfer and the appearance of the weld were comparatively analysed. The shielding behaviour of the gas flow of the three nozzles has been researched. The primary contributions are summarized: when using a shielding gas nozzle with straight-trapezium, unpredictable droplet transfer type of behaviour with spatter was noted due to the volatile and high speed of shielding gas. A mass of pores throughout honeycomb allocation developed mostly on welding surface when using a straight-trapezium nozzle, as the rear portion of the molten pool could never be efficiently shielded. When using a circle outlet nozzle or a square-outlet nozzle with a boss, stable droplet transfer behaviour patterns and qualified welds were achieved with almost zero pores upon the surface [4].

C.W. Dong et al. 2016 have researched a new mechanism of processing extra shielding gas to compensate for structural defects which often happen if extreme temperatures liquid and solid phase welds were often exposed to the atmosphere. This technique correctly involves changing the existing pulsed MIG welding machine by attaching an air circulation control section of the shielding gas to compensate for all of this, such that welding of the high-temperature, liquid-solid phase of the welding torch nozzle can be intervened on a manual basis and welding surface tertiary gas protection can be enacted. This customized airflow welding machine can then be used to undertake bead-on-plate pulsed MIG welding experimentation utilizing 18-8 type austenitic stainless steel as its base material. The research of the physical properties and microstructure of the welding implies that even after the introduction with a certain proportion of shielding gas for compensation, not only the welding creation is improved significantly, but there is timely protection and tracking of the welding surface. r It noticeably alters the welding which is badly or moderately molded because of mismatching of the welding parameters in comparison to the current MIG welding technique, the speed of the welding is continued to increase by 40–60 per cent to enable greater efficiency [5].

N. Ghosh et al. 2016 researched the welding characteristics of materials and optimized parameters of welding by technique. The study uses a signal-to-noise ratio (S / N), an analysis of variance (ANOVA), and an orthogonal array. The investigators of Welding investigators have often been looking for the best quality of welding. In the present work, the gas flow rate, plate distance nozzle, and effect of current on welding quality in metal gas arc welding of Austenitic stainless steel AISI 316L has indeed been explored via experiments and assessments. The butt-welded joints are made up of a few levels of current, gas flow rate, and nozzle to plate distance. The measured result seems to be in the form of a contribution of each parameter that identifies optimum parameters for percentage elongation and maximum tensile strength. Restrictions and consequences of research involve the worst outcome in tensile testing obtained for specimen No. 7 (correlating to gas flow rate 10 l / min, plate distance no. 15 mm, and current 124). The aim of Taguchi's single-objective optimization is to maximize the percentage elongation (PE) and ultimate tensile strength (UTS) individually, i.e. individually. The S / N ratio idea of Taguchi is used and it has been established that I the optimum condition for maximum UTS [C1F3S2] (i.e. gas flow rate 20 litres/minute, nozzle for plate distance 12 mm, current 100 A) (ii) the optimal conditions for highest PE is (i.e. gas flow rate 20 litres/min, nozzle for plate distance 9 mm, current 100 A). The optimal parameters established by the single-objective optimization techniques have also been verified by the confirmatory tests [6].

Nabendu Ghosh et al. 2017 studied in detail the impacts of the welding parameters: gas flow rate, plate distance nozzle, welding current, percentage elongation (PE), and final tensile strength (UTS) in MIG welding of AISI409 ferric stainless materials. Trials were performed according to the orthogonal L9 array of the Taguchi technique. X-ray radiographic testing and Visual inspection were also designed to detect subsurface and surface defects of the weld zone. The observed UTS and PE data were perceived, analyzed and discussed using the Taguchi research methods and the SNR analysis. Some concluding remarks have been drawn from the study. Visual inspection results indicate that undercutting and blowing holes were also found in a few samples, uneven deposition, and excessive penetration. The X-ray radiography test results indicate lack of penetration, low-level porosity, lack of fusion, welding depression and surface marking in some of the samples. The results of the visual inspection and the X-ray radiographic tests are compared and some consistency is found. ANOVA test results indicate that welding process parameters do not have a significant influence on both responses. Optimal parametric welding condition is (i.e. current (C) = 124 A, gas flow rate (G) = 10 l / min and late distance nozzle (S) = 9 mm) obtained by the Taguchi method to maximize both reactions: UTS and PE. The results of the confirmatory experiment confirm the validity of the optimized findings acquired by the Taguchi technique. The Taguchi design technique is particularly useful for the analysis of ferric stainless-steel welding in welding operation of the MIG [7].

Eszter Kalacska et al. 2017 evaluated the welding process of various kinds of AHSS in dissimilar weld joints. The TRIP (transformation induced plasticity) and TWIP (twinning induced plasticity) steel sheets have been used to stimulate the production of mass of thin steel sheet structures (like automotive parts) of automated MIG i.e. metal inert gas welding process. The parameters of welding for butt welded joints have also been optimized effectively. The joints were examined by tensile testing, visual inspection, hardness measurements, and quantitative metallography. The TRIP steel side of the joints reported greater microhardness up to (450-500 HV0.1) due to the increased percentage of martensite and bainite. On a macroscopic basis, the tensile specimen demonstrates ductility and ended up breaking in the austenitic welding material. The following conclusions are drawn to the above-mentioned investigations: effective thin TRIP 800 welding to TWIP 1000 steel sheets (thickness around 1–1.5 mm) is achievable with the welding processes of MIG with AWS 307 filler inside the range of heat input Q=0.5–0.65 kJ·mm-1. As the martensite and bainite ratio throughout the HAZ of TRIP 800 steel rises and with is the value of hardness also tends to increase (to ~450–500 HV0.1). The welded joint is ductile (owing to the austenitic filler) and also has a massive (> 10 percent) deformations prior to actually fracture. The attainable ultimate strength is close to TRIP 800 base material (~700 MPa) [11].

3. CONCLUSION

sets out the delivery technique from wire feed unit to a point where welding is necessary. The MIG torch may be water-cooled or air-cooled, and the more current air-cooled devices have such a single cable wherein the welding wire passes via the liner. The gas flows on the outside of the liner and across the liner tube seems to be the trigger wires and the control braid. The exterior insulation provides flexible protection. MIG Water-cooled torches are identical to above, but the liner tube, gas hose, power line (such as a water-return cable), trigger wires, and water-flow cable are all different throughout the external sleeve. Almost all of the commercial MIG machinery utilizes a typical European MIG torch connection for fast torch attachment, several smaller units (low-cost) using specific manufacturer fittings. Upkeep areas are essential: the liners are also in excellent condition and that of the appropriate size and type; the contact points are slightly fitted, of the appropriate strength and high quality.

4. REFERENCES

[1] Abdul wahab H. Khuder and Esam J. Ebraheam, “Study the factors effecting on welding joint of dissimilar metals”, Al-Khwarizmi engineering journal, April (2011), Vol 7, No. 1, pp.-76-81.

[2] Bharwal S. and Vyas C., International Journal of Advanced Mechanical Engineering. ISSN 2250-3234 Volume 4, Number 6 (2014), pp. 695-700 Weldability Issue of AISI 202 SS (Stainless Steel) Grade with GTAW Process Compared to AISI 304 SS Grade

[3] Bharwal S., Vyas C., “Weldability Issue of AISI 202 SS (Stainless Steel) Grade with GTAW Process Compared to AISI 304 SS Grade”, International Journal of Advanced Mechanical Engineering. ISSN 2250-3234 Volume 4, Number 6 (2014), pp. 695-700.

[4] Cai C., Li L., Tai L, “Narrow-gap laser-MIG hybrid welding of thick-section steel with different shielding gas nozzles”, Int J Adv Manuf Technol.

[5] Dong C.W., Xue J.X., Jiang X.M., “Effects of Additional Compensation Shielding Gas on Stainless Steel Pulse MIG Welding”, 2016 IEEE International Workshop on Advanced Robotics and its Social Impacts (ARSO) Shanghai, China, July 8-10, 2016

[6] Ghosh N., Pal P.K., Nandi G., “Parametric optimization of MIG welding on 316L austenitic stainless steel by Taguchi method”, Archives of Material science and Engineering, Volume 79 Issue 1 May 2016 Pages 27-36.

[7] Ghosh N., Rudrapati R., Pradip Pal K, Nandi G., “Parametric Optimization of Gas Metal Arc Welding Process by using Taguchi method on Ferritic Stainless Steel AISI 409”, Materials Today: Proceedings 4 (2017) 2213–2221.

[8] https://ewi.org/gas-metal-arc-welding-basics-travel-speed-and-contact-to-work-distance-ctwd/

[9] Jianxiong Li, Huan Li, Chaoqun Huang, Ting Xiang, Yanbing Ni,vHuiliang Wei., “Welding process characteristics of pulse on pulse MIG arc brazing of aluminum alloy to stainless steel”, Int J Adv Manuf Technol

[10] Jianxiong Li, Huan Li, Huiliang Wei, Ying Gao., “Effect of torch position and angle on welding quality and welding process stability in Pulse on Pulse MIG welding–brazing of aluminum alloy to stainless steel”, Int J Adv Manuf Technol.

[11] Kalácska E., Kornél M., Eniko R., Fábián, Russo S., Materials Science Forum ISSN: 1662-9752, Vol. 885, pp 80-85 .

[12] Khan E.A.A., Debroy T., “Alloying Element Vaporization and Weld Pool Temperature during Laser Welding of AISI 202 Stainless Steel”, Metallurgical Transactions b volume 15B, December 1984—641.

[13] Kumar A., Sundarrajan S. “Optimization of pulsed TIG welding process parameters on mechanical properties of AA 5456 Aluminum alloy weldments”, Materials and Design, Vol.30, (2009) p.p.1288–1297.

[14] Lim J.Y., JinYoon M., Kim S.Y., Shin H.S., Kim T.G., “Mechanical properties of CO2 /MIG welded structural rolled steel and stainless steel”, Journal of Mechanical Science and Technology 29 (1) (2015) 103~108 .

[15] Lothongkum G, Viyanit E, Bhandhubanyong P. Study on the effects of pulsed TIG welding parameters on delta-

ferrite content, shape factor and bead quality in orbital welding

[16] Miao Y., Xu X., Wu B., Han D., Zeng Y., Wang T., "Effects of bypass current on arc characteristics and metal transfer behaviour during MIG–TIG double sided arc welding", Journal of Materials Processing Technology 224 (2015) 40–48.

[17] Monika K., Bala Chennaiah M., Nanda Kumar P. and Prahalada Rao P., "The Effect of Heat input on the Mechanical Properties of MIG Welded Dissimilar Joints". International Journal of Engineering Research & Technology, (2013), vol 2, pp. 1406-1413.

[18] Prabhu R., Alwarsamy T., "Effect of process parameters on ferrite number in cladding of 317L stainless steel by pulsed MIG welding", Journal of Mechanical Science and Technology 31 (3) (2017) 1341~1347.

[19] Pradip D. Chaudhari and Nitin N. More, "Effect of welding process parameters on tensile strength", IOSR journal of engineering, May (2014), Vol. 04, Issue 05, pp.- 01-05.

[20] Raafal M. Molak, Krystian Paradowski, Measurement of mechanical properties in 316L stainless steel welded joint, Int. J. Pressure vessels an piping, 86 (2009) 43-47.

[21] Radhakrishnan V.M., "Welding Technology & Design", McGraw Hill, New York (2006).

[22] Singh L., Kumar R, Gupta N and Mayur Goyal M. "To investigate the effect of tig welding parameters on 5083 aluminium alloy weldability", Mechanica Confab ISSN: 2320-2491, Vol. 2, No. 4 (2013).

[23] Singh L., Vinay Shah V. and Singh N.K. "To study The influence of TIG Welding Parameters On Weld Characteristics Of 5083 Aluminum Alloy", ISSN: 2319-5967 International Journal of Engineering Science and Innovative Technology (IJESIT) Volume 2 (2013).

[24] Sudhakaran R., Murugan V., Sivasakthive P.S., "Optimization of process parameters to minimize angular distortion in gas tungsten arc welded stainless steel 202 grade plates using particle swarm optimization", Journal of Engineering Science and Technology Vol. 7, No. 2 (2012) 195 – 208.

[25] Sudhakaran. R, Sivasakthivel. P.S, Nagaraja S., and Eazhil. K.M., "The Effect of Welding Process Parameters on Pitting Corrosion and Microstructure of Chromium-Manganese Stainless Steel Gas Tungsten Arc Welded Plates", Procedia Engineering 97 (2014) 790 – 799.

[26] Suresh Kumar L., Verma S M., Suryanarayana B. and Kiran Kumar B., "Analysis of Welding Characteristics on Stainless Steel for the Process of TIG and MIG with Dye Penetrate Testing". International Journal of Engineering and Innovative Technology, (2012), Vol 2, pp 283-290.

[27] Varol F., "Investigation of Mechanical Properties of MIG-Brazed 304 Stainless Steel and EN 10292 Galvanized Steel Joints using Direct Current Intensity", Vol. 131 (2017) ACTA PHYSICA POLONICA A.

[28] Velmurugan, V. (2005). Some studies on angular distortion, residual stresses and heat flow of GMAW process. PhD Thesis, Faculty of Mechanical Engineering, Bharathiar University, Coimbatore, India.

[29] Zhang H., , Liu J., "Microstructure characteristics and mechanical property of aluminium alloy/stainless steel lap joints fabricated by MIG welding–brazing process", Materials Science and Engineering A 528 (2011) 6179–6185. Degarmo, Black & Kohser 2003.

[30] Harvey Brown "The theory of the rise of sap in Trees: Some Historical and Conceptual Remarks" in Physics in Perspective vol 15 (2013) pp. 320–358

[31] "Tensile Properties". Retrieved 20 February 2015.

[32] E.J. Pavlina and C.J. Van Tyne, "Correlation of Yield Strength and Tensile Strength with Hardness for Steels", Journal of Materials Engineering and Performance, 17:6 (December 2008)Rosa,

[33] Jorge Luiz; Robin, Alain; Silva, M. B.; Baldan, Carlos Alberto; Peres, Mauro Pedro. "Electrodeposition of copper on titanium wires: Taguchi experimental design approach". Journal of Materials Processing Technology. 209: 1181–1188. doi:10.1016/j.jmatprotec.2008.03.021.

[34] Rao, Ravella Sreenivas; C. Ganesh Kumar; R. Shetty Prakasham; Phil J. Hobbs (March 2008). "The Taguchi methodology as a statistical tool for biotechnological applications: A critical appraisal". Biotechnology Journal. 3 (4): 510–523. PMID 18320563. doi:10.1002/biot.200700201. Retrieved 2009-04-01.

