Review on Tailor Welded Blanks

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Abstract: *Tailor welded blanks is the best way to reduce the vehicle weight and improve the car safety. In automotive industries tailor welded blanks can lead the light weight vehicle as well as the increasing the corrosion resistance and the accuracy .TWB is consisting of the welding of similar metal with different thickness or two dissimilar metals by using suitable welding technique The main objective of this investigation is two study the effect of change in the weld zone and also study the effect of the tensile and formability property on a TWBs .The tensile strength of a welded sample have been determine by using uni-axial tensile test . Forming capability of TWBs sample is studied by using cup cone test tensile test gives the information about young's modulus ,poisons ratio yield strength and strain hardening characteristics .Formability gives us maximum limit to plastic deformation of TWBs.*

Key Words: *Tailor welded blanks; Formability; Weldability; Weight reduction.*

1. INTRODUCTION

TWBs have gain important over the last two decades .It gain demand in design light vehicle .The benefits of using TWBs are reducing wastage of material, improving the efficiency of vehicle by reducing reinforcement [1].A tailor welded blank consist of two or more sheets metal which are welded together prior to its forming the sheets of different sizes, shapes and the thickness are welded by TWBs.

TWBs can be differing in material grades. Some of the manufacturing problems like weld line movement formation of wrinkles and tearing are also associated with it [1]. In Industries material which are weld for TWBs are combination of mild steel to stainless steel of different grades. Aluminium alloy with different grades are also use for making TWBs or also combination of aluminium and steel alloy sheets. Joining material combination like steel alloy and aluminium creates number of problems such as formation of brittle intermetallic compounds, poor welding behavior of aluminium change in physical and chemical properties of base metal [2]. To create tailor welded blanks two or more sheets are weld together by mash seam welding or laser welding. The width if mash seam, welding including heat affected zone is 10 to 15 mm and the width of laser weld including HAZ is 1 to 2 mm [2]. In mash seam welding laser temperature rates are observed. Due to this less martensite is formed and consequently a less hard weld formed .Advantage of laser welding is narrow weld. The benefits of tailor welding blanks technologies are cost reduction, weight reduction by welding sheet materials of different thickness or strength .TWBs are made up of high strength steel and deep drawing steel sheets. TWBs are use for car body parts cause they fulfill the requirement of strength, stiffness and safety of the parts [3].

The important properties of TWBs are weldability and formability the weight reduction of car body can be achieved by using TWB. The weight reduction is achieved by using thick material at location where higher strength is required and the thin material is use at areas that do not require higher strength [4]. Welding of tailor welded blanks: tailor welded blanks consisting welding of the two similar metals with different technique or welding of the two dissimilar metals. Tailor blanks are semi-finish parts which are typically made from sheets of different alloys. TWBs is normally achieved by the laser welding electron beam welding or friction stir welding. The brittle intermetallic compounds layer leads to fast rupture of joint under stress .

1.1 LITERATURE SURVEY

B. C. Patel et al. [2012] studied review on formability of tailor welded blanks. In this paper, an overall review of the different parameter affecting on formability of tailor. Experimental investigation of tension and forming behaviors of dual phase steel tailor welded blanks .Marion Merklein et al [2014] studied tailored blanks -production, application and evaluation. Tailored blanks is the collective for semi-finished sheet products which are characterized by a local variation of sheet thickness, sheet material, coating or material properties. The major advantage of product made from tailored blanks in comparison to conventional products is a weight reduction. Another advantage is their better surface quality because they exhibit no weld seam. Tushar.Y. Badgujar et al [2017] studied tailor welded blanks for+ a sheet metal industry. The tailored blank is a well-established steel semi product enabling optimized car body engineering. The cost performance balance of a tailored blank is the decisive criterion for its application in a car body. The cost of a tailored blank is directly related to the productivity of the welding machine14. Literature review has been categorized based on parameters which decides the successful execution & the quality of the part. These utmost important parameters are: 1. Welding techniques for TWBs. 2. Finite Element Simulation & Numerical analysis. 3. Formability analysis 4. Defects & Failures modes.

B. L. Kinsey [2011] studied tailor welded blanks for the automotive industry. Specific applications of TWBs for the automotive industry were presented focusing on classic references in the area, but also highlighting more recent work and topics. Due to the notable benefits of TWBs, e.g., reduced component weight, decreased cost, less noise, improved crashworthiness and increased dimensional accuracy, TWBs have attracted significant interest from the automotive industry. To address related formability concerns due to variations in the material properties of the weld zone, process modifications were also discussed in this chapter. Finally, typical welding processes and materials used were presented. While this chapter mentioned several key topics with respect to TWB forming, other chapters of this book provide more detailed information and should be consulted as needed.

B. C. Patel et al. [2012] studied review on formability of tailor welded blanks. In this paper, an overall review of the different parameter affecting on formability of tailor Experimental investigation of tension and forming behaviors of dual phase steel tailor welded blanks welded blanks process is presented so that other researchers can concentrate on same to further critical investigations in this area. Tailor-welded blanks has been widely used in automobile and aerospace application now-a-days. Mohammad Riahi et al [2013] Studied the effect of different combination of tailor welded blank coupled with change in weld location on mechanical properties by laser welding. A flawless, faultless weld with complete depth of penetration was obtained by using optimized parameter of laser in laser welding TWB made of St14 sheet by conducting metallurgical and mechanical microstructure as well as tensile characteristics and formability of TWB was analysed. The increase in proportional length of TWB samples could be calculated via sheets forming it and result obtained from this relation is conformance with result obtained from tensile test. Thus, it is conclude that weld area does not play a major role in tensile forming TWB.

C.Wei et al [2014] conducted a detailed study on improving formability of laser welded automotive dual phase steels with local cooling. A new laser welding process with the local cooling was presented to weld dual phase steel, DP780 and DP980. The conclusion can be drawn the local cooling can strongly reduce the HAZ softening for both DP980 and DP780 joints, since it reduce the temperature of martensite. The size of softened zone can be reduce by 50% and the extent of softening of DP780 joint can also be reduce. For the TWBs with the local cooling failure initiates in the weld and propagates perpendicular to the base metal. Lars Halbauer et al [2016] studied the influence of dilution on dissimilar weld joints with high alloy TWIP sheets. Two different types of joint geometries with varying level of dilution were successfully welded and tested. In overlap joint of steel 16-7-6 and DP590, inhomogeneous welding seams with a hardness decreasing at the top and hardness increasing at the bottom up to 450 HV0.1 independent on the welding depth were observed. The level of dilution was not recognized as the main influence for the mechanical behaviors with increasing heat input a shift from shear stress to normal stress dominated failure was observed. archers can concentrate on same to further critical investigations in this area. Tailor-welded blanks has been widely used in automobile and aerospace application now-a-days.

Marco Parente et al [2016] studied on the formability of aluminium tailor welded blanks produce by friction stir welding. Tailor welded blanks of thin sheets of dissimilar aluminium alloys, AA5182/AA6061 pairs, have been produced by friction stir welding and experimentally evaluated on formability performance by their forming limit curves. The following conclusions were drawn from this research: Friction stir welding produces TWBs with significant loss of hardness, both in the stir zone and the heat affected zone of the AA6061 material side. The load displacement curves of all aluminium TWBs give lower values when compared to the base metals. The longitudinal TWBs have the highest values for the load displacement curves, while the transverse samples exhibit the lowest values. A. Karpagaraj et al [2016] studied on mechanical behaviors and microstructural analysis of tailor welded blanks of Ti-6AL-4V titanium alloy sheets. Ti-6Al-4V alloy sheets having a thickness of 1.6 mm and 2mm are chosen for carrying out weldability studies using gas tungsten arc welding process. The welded specimens were subjected to mechanical test to examine the behaviors of tailor welded blanks.

Gang song et al [2018] studied the effect of laser GTAW hybrid welding heat input on the performance of Mg/steel butt joint. The maximum average tensile fracture load of the joint can reach up to 3265 N. According to study on the 1.6 mm Mg and 1.0 mm steel butt with filling Mg welding wire of laser GTAW hybrid welding process, laser GTAW hybrid butt welding with wire filler was an effective method to join 1.6 mm Mg/1.0 mm steel and obtain exemplary, continuous and defect free butt joint bead shape. The tensile fracture load of the load decreases with the decrease in heat input using optimum parameter. The maximum tensile load up to 3265 N of the joint was higher than that of the steel base metal fracture occur in steel base metal.

1.2 FORMABILITY OF TWBS

The formability of sheets metal depends on various factors like properties of material microstructure and thickness .The formability is define as the ability of sheet metal to be mechanically shaped by plastic deformation without machining. Formability is loosely define as sheet metal ability to be mechanically shape by a plastic deformation without machining process is commonly called as no any material removal process .

The formability term define as the plastic deformation of the metal sheet without machining, the sheet metal ability to be mechanically shaped by plastic deformation without machining. The plastic deformation capacity of material however ,it is limited to certain extent at which point the material could experience of facture one. Main failure mode is cause by facture of the material ,this is typical form sheet forming operation. Sheet metal forming occurs when sheet is clamp around the edge of die and punch forces the sheet through activity where sheet is conform to shape of tool[11]. The formability of sheet metal can be measured at the two method that are stretch forming and hemispherical punch test respectively. The cimitiny dome height test commonly known as L.D.H is a stretch forming test gives the high degree of reproductivity as compare to other test.

In this test draw beads are used to hold steel shits firmly in place to prelist drawing in during forming process. The result is round domed shape metal is formed. The resulting part look like a cup and these test is mostly used for the forming cups, shell short tubes automobile bodies and gas tanks[16].with a flat plane on the bottom.

2. WELDING TECHNIQUESOF TWBS

There are a number of different laser welding systems available. CO2 and Nd: YAG lasers are already in use in industry. Low power Nd: YAG lasers are used in the electronics industry. Rapid improvements in technology mean that diode lasers of sufficiently high power and power density for the production of good deep penetration welds are now available. [5] CO2 lasers These operate on a wavelength of 10.6 µm and have a power range 1.5-6 kW, although some work at continuous power levels of 10 kW and beyond. The energy absorption of the laser beam by metals is low, with an overall efficiency of up to 15%, although the energy transfer efficiency from the laser beam to the work piece can be as much as 0.8.The optical system consists of mirrors and Zn Se lenses. These lasers are used for sheet welding at high weld speeds. [5]

Nd: YAG solid-state laser The operating wavelength is 1.06 µm. Most have average powers of several hundred Watts with pulses of peak power 1-10 kW (although 1000 kW is possible). Lasers with continuous powers of up to 3kW are now commercially available. Metals also have a higher surface absorptivity at this lower wavelength. Their overall efficiency is about 3-5%. Unlike CO2 lasers, the beam can be guided through flexible glass fibers, due to its smaller wavelength. This makes it attractive for 3-D operations combined with articulated arm type robots, providing greater flexibility, accessibility and lower costs. In comparison CO2 lasers have to use a complicated mirror system. The optical lenses and fiber optics provide a source of well-defined size and angular radiating cone, with an even (top-hat) energy distribution, in contrast to the Gaussian energy distribution associated with a CO2 laser source coupled to a mirror-based delivery system.

3. DISCUSSION

As demand of light weight and high strength vehicles is increased ,the TWBs gain huge demand in automobile and aerospace application the formability of TWBs has been check by various investigator [1]the analysis done by using various tests and this data compared with analytic data but due to absence of different software application which are necessary and certain limitation in testing, the further research need to be done more work the various forming parameter has been check analytically with help of graph comparing it with conventional data The forming test like FLD ,DLH and wrinkling behavior the data is verified analytically using software like ABAQUES, AUTOGRID[1]The aluminum shoes lower formability and less weldability compare to other material. The investigation has determine a formability behavior of cylindrical cup deep drawing process by using software like finite element code DD31MP The analysis of forming behavior of cylindrical cup deep drawing process at elevated and superplastic temperature has been done using software finite element code DEFORM- D.The weight reduction in the automotive application is achieved by using TWBs made from aluminium alloy Since aluminium alloy has poor weldability due to its high reflectivity ,low molten viscosity and existence of oxide layer therefore much research was done on aluminium TWBs having different thickness and alloy combinations manufacturing by various welding methods.

4. LIMITATION

A forming problem is created if strain transvers to the weld line is present. In the tailor welding blanks formability decrease .the formability can occurs in weaker material. Reduced plastic strength in the thicker material lead to increase spring bags. Due to uneven spring bags create distortion in the spring. Cost of the blanks is a big issue for making the tailor welding blanks the initial cost is high because it involve AHSS the market cost of the AHSS is high and also it require laser welding so cost of the TWBs get increase this is compensate by the advantages brought by the end users such as the grater safety and reduced fuel consumption Higher cost of machinery because TWBs require high accuracy during machining .the affect of weld line movement as the TWBs related to the heterogeneous nature of the blanks in the given disadvantage about the TWBs due to the different thickness of the material .material may deformed preferentially and tear prematurely in stamping with result in weld line movement's.TWBs parts are assemble with other parts hence devotions of the weld line in the and affect on final product assembly

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