Vandana Publications
IJEMR

Volume-7, Issue-3, May-June 2017
International Journal of Engineering and Management Research
Page Number: 228-232

Latest Advances in Welding Technology to Lower Cost in Automobile Sector

Nagaraj Raikar[1], NirajPai Bhale[2], Amol Patil[3], Parashuram Nandi[4]
[1,2,3,4]Assistant Professor, Agnel Institute of Technology and Design, Assagao, Goa, INDIA

ABSTRACT

Automobile makers all over the world are continuously looking for new ways and technique to reduce manufacturing costs without scarifying built quality and automotive safety. To improve the performance of the car many companies are trying to reduce the weight of the car so that they can reduce the pollution which will reduce the environmental load substance and workability improvement to enhance the international competitiveness among the competitors. Under such circumstances, steel materials are required to have super high tensile strength and to be able to deal with complex structures of parts with high performance. To fully utilize such advanced steel products, the innovations of welding technologies are necessary and various welding technologies have been developed and applied with the progress of steel materials. This paper briefs about the developments and the actual applications of state-of-the-art in welding technologies.

Keywords-- STT, Friction stir, Friction welding

I. INTRODUCTION

In application of different materials which are used for the building car, while development of such materials is very important, progress in welding technologies making good use of advanced materials is also necessary and indispensable. In recent years, high tensile strength materials have progressively replaced mild steel, as exemplified by increasing application of ultra-high strength materials and the tendency of this innovation has been conducted with managing compensated formability and weldability of selected materials. Progress in welding technologies adopting these materials is strongly demanded in order to make the best use of these high tensile strength materials and establish a global position of technological superiority. The requirements in the automotive field are extremely stringent, methods used to join various materials, such as resistance spot welding, arc welding, laser welding, etc., must be on the same level as that of steel, and at the same time, joint strength corresponding to the higher strength of the base metal must be secured, and corrosion resistance, crack resistance, and other properties must be satisfied in the same conventional process. This paper presents an overview of recent developments in welding technology against the background outlined above. In the automotive field, the development of new welding technologies and improvement of weldability are discussed.

II. STATUS OF TECHNOLOGY DEVELOPMENT IN AUTOMOTIVE FIELD

2.1 Surface tension transfer process

Surface tension transfer process (STT) is developed by Lincoln Electric and he has patented this technique, he intended for boostingproductivity of the manufacturing process by reducing waste movements and by replacing older welding methods such as gas metal arc welding, gas tungsten arc welding. Thebenefits of this process includes reducing welding fumes which generally harm and typical spatters, the amount of time which is spent to train the operator will definitely decrease which saves time to market by increasing speed. STT welding is ideal when working withmaterials such as stainless steels and galvanized steel which we generally use for our most of our automobiles.

ISSN (ONLINE): 2250-0758, ISSN (PRINT): 2394-6962

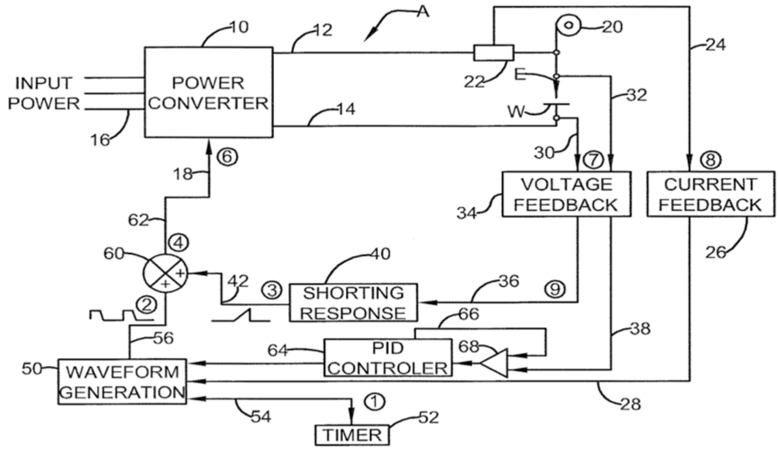

Figure 1: Surface tension transfer process

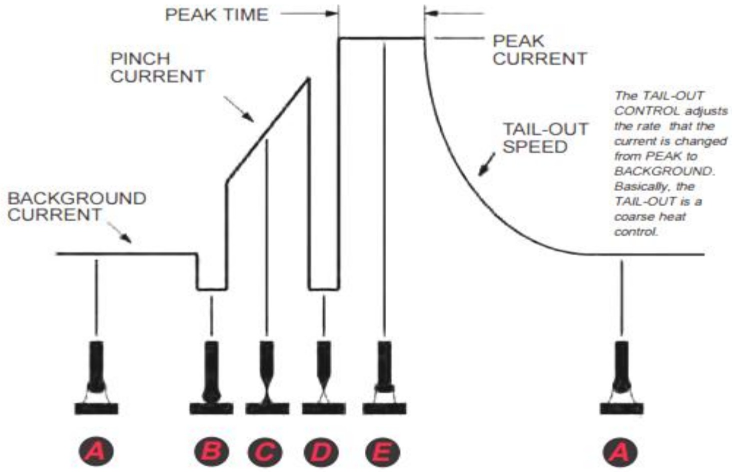

Figure 2: Surface tension transfer process

How STT works: A BACKGROUND CURRENT between 50 amps and 100 amps maintains the arc andcontributes to heating of the base metal. After the electrode initially shorts to the weldpool, the current is quickly reduced to ensure a solidshort. PINCH CURRENT is then applied to squeeze the molten metal down forming a pool and necking of the liquid bridge is monitored with controlling the electric signals. When the liquid bridge is about to break which is formed by the pinch current, the power sourcereacts by reducing the current to about 45-50 amps. Immediately following the arc reestablishment, a PEAK CURRENT is applied toproduce plasma force pushing down the weld pool to prevent accidental short and to heatthe puddle and the joint. Finally, exponential TAIL-OUT is adjusted in such a way that it can regulate overall heat input. BACKGROUND CURRENT this serves as a fine heat control in the process.

Figure 3: Step by step process of STT

2.2 Friction stir welding Automakers

Friction stir welding was first developed at TWI in 1991, and the initial patent application was filed in December of that year (Thomas et al, 1991). Initially, it was seen as a process solely for aluminium, and of limited interestto the offshore industry, but this viewpoint has now changed. Much research has been undertaken worldwide to develop the process for steels and other high strength corrosion resistant alloys, for example nickel and titanium alloys, aluminium and steel etc.

The principles of the process are well documented, and are shown in Figure below. For butt welds, a rotating cylinder is pushed against the surface of the weld. This cylinder is attached to a pin which penetrates almost the entire depth of the weld. Rotation under pressure causes the development of frictional heat, which softens the workpiece material to the point where it can flow. At this point, the rotating tool is moved along the joint line, and the softened material in front of the tool is extruded between the pin of the tool and the cold material on one side of the pin. During this process, the interface is completely fragmented, and so a solid phase joint is formed behind the tool.

The process has the advantage of being fully mechanised, therefore weld quality is reliable and repeatable, and no filler metal is required. However, an inert shielding gas is strongly recommended for welding steels. The process is entirely solid state, so hot cracking, porosity etc are not encountered. The process is also very energy efficient, and produces no fume, spatter or radiation. The principal disadvantages are the need for control of fit-up (although perfection is not required), and the need for more substantial fixturing than is common in other processes, due to the high process forces.

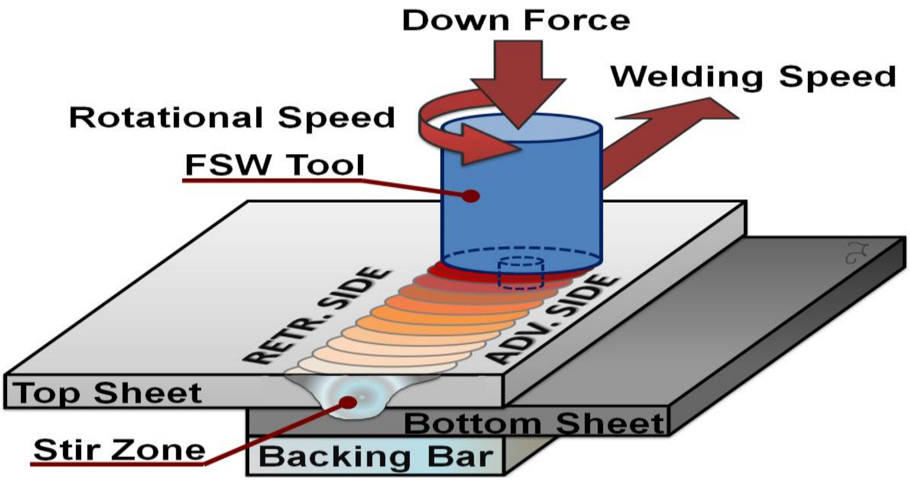

Figure 4: Principle of Friction stir welding

Companies like Honda Motor have relied on aluminium as a lower costmaterial, and to ensure the process of joining aluminium and steel is simple and safe, they have innovated newforms of friction stir welding. This new method helps generate more stable, secure bond between two materialsby moving a rotating tool on the top of aluminium, which is then bonded to steel.

Honda engineers also have developed assembly line techniques that helps with mass production of vehiclesutilizing friction stir welding – for example, a sixaxisrobot. According to the Assembly Manager, by replacingthe conventional steel subframewith one comprising aluminium and steel, Honda engineers can reduce bodyweight by 25%. This highly efficient method also helped reduced up to 50% electricity costs during the welding
process.

2.3 Laser welding

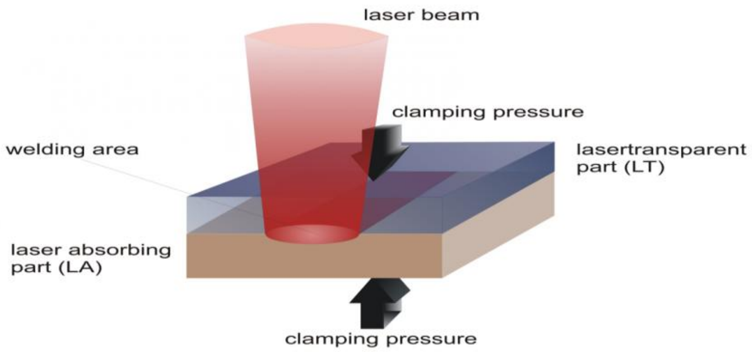

Figure 5: Laser Welding

Laser welding is quite new technique that involves conversing light energy into heat energy. The radiationemitted through laser welding allows beams to travel larger distances with suffering considerable loss of quality.Though initial costs for laser welding is higher than conventional spot welding methods, a significant reductionin cycle time eventually makes laser welding more efficient option.

LASER is an acronym for “Light Amplification by the Stimulated Emission of Radiation.” Laser welders produce a sharp, focused light beam that melts a very small area of metal. The benefit of this technology is that very little heat is generated at the weld point, allowing users to easily weld 0,05mm (.002”) away from the most complicated and intricate component parts without damaging heat sensitive materials.Solid state laser welder operators hold parts in their hands while viewing the application through a stereo-microscope in the welding chamber. An internal cross-hair allows the operator to easily align and weld the parts at the correct location.

The application range covers finest welding of non-porous seams in medical technology to precision spot welding in electronics or the jewelry industry, to deposit welding in tool and mold-making and welding complete car bodies in automobile construction.However, new and efficient production processes are often not possible without the advantages of laser technology. Thus, diverse sheet thicknesses and qualities are turned into tailored blanks by welding and resistance spot welding is replaced by laser seams.

2.4 Resistance spot welding

Resistance spot welding is a thermo-electric process where heat is generated at the interface of the parts to be joined by passing an electrical current through them or a precisely controlled time and under a controlled pressure (also called force). The name “resistance” spot welding derives from the fact that the resistance of the workpieces and electrodes are used in combination or contrast to generate the heat at their interface.

Key advantages of the resistance welding process include:

- Very short process time
- No consumables, such as brazing materials, solder, or welding rods
- Operator safety because of low voltage
- Clean and environmentally friendly
- A reliable electro-mechanical joint is formed

Resistance spot welding is a fairly simple heat generation process: the passage of current through a resistance generates heat. This is the same principle used in the operation of heating coils. In addition to the bulk resistances, the contact resistances also play a major role. The contact resistances are influenced by the surface condition (surface roughness, cleanliness, oxidation, and platings).

The general heat generation formula for resistance welding is:

Heat = I2 x R x t x K

Where “I” is the weld current through the workpieces, “R” is the electrical resistance (in ohms) of the workpieces, “t” is the weld time (in hertz, milliseconds or microseconds), and “K” is a thermal constant. The weld current (I) and duration of current (t) are controlled by the resistance welding power supply. The resistance of the workpieces (R) is a function of the weld force and the materials used. The thermal constant “K” can be affected by part geometry, fixturing and weld force.

The bulk and contact resistance values of the workpieces, electrodes, and their interfaces both cause and affect the amount of heat generated. The diagram (above right) illustrates three contact and four bulk resistance values, which, combined, help determine the heat generated.

Resistant spot welding has to do with direct application of opposing forces using the pointedtipelectrodes.General Motors has availed this technique in producing lighter weight, more fuelefficientvehicles fromaluminium. By getting rid of about 2 pounds of rivets from the vehicles’ hood, doors and lift gates, engineers canutilize that weight surplus in other vehicle areas if necessary. Thanks to the resistance spot welding technology,aluminium pieces can be directly welded together using a multiringeddome electrode.

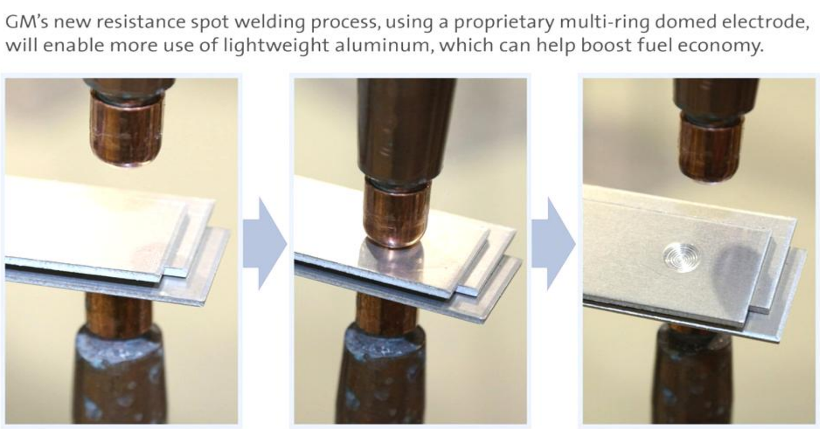

Figure 6: Resistance Welding

III. CONCLUSION

This paper has given an overview of the trends in the developmentof welding technologies for the steels and other materials over the lastyear. To improve the performance of the car, industries are coming up with new technologies to reduce the weight of the automobile without compromising with the quality of the product. To continue to manufacture reliable steel structures efficiently, it is increasingly important to developsteel materials and welding consumables of higher quality based ongood understanding of the basic phenomena of welding and joining different materials, and respond to customers' need based onunderstanding of their field practice of joint design, welding workand control.

REFERENCES

[1] Seto, Kazuhiro. Journal of Society of Automotive Engineers of Japan. 2010, vol. 64, no. 11, p. 29–34.
[2] Nakashima, Koichi; Hase, Kazukuni. JFE Technical Report. 2015, no. 20, p. 8−13.
[3] Nakagawa, Kei; Ueki, Takuya; Nanba, Takayuki. JFE Technical Report. 2014, no. 19, p. 1–8
[4] Sugitanji, Yuji at el. Development of Highly Efficient and Unmanned Welding System for Pipeline Construction, Welding Guide Book IV; Recent Technology of Arc Welding in Vessel and Pipe. 2000, II-231–236.
[5] Yamamoto, Ryuichi. WE-COM mail-magazine. Welding Technology Information Center of the Japan Welding Engineering Society. 2013, no. 8, p. 1–9.
[6] Uemori, R.: Technical Trend of High-performance Steel Plates. Proceedings of 182nd and 183rd Nishiyama Memorial Technical Conference, 2004, p.89
[7] Ikeda, Rinsei; Okita, Yasuaki; Ono, Moriaki; Yasuda, Koichi; Terasaki,Toshio. Quarterly Journal of the JWS. 2010, vol. 28, no. 1,p. 141–148
[8] Kojima, K. et al.:18th International Conference on Offshore Mechanics and Arctic Engineering (OMAE). St. John's, Newfoundland, Canada, July 1999.