Types and Application of Welding Process: A Review.

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Abstract:-

Quality and productivity play important in today's manufacturing market. Now a days due to very rigid and cut throat competitive market condition in manufacturing industries. The main objective of industries reveals with producing superior quality of product at low cost grow productivity. Welding is the most vital and common operation utilized for joining of two similar and dissimilar parts. In the present review paper an attempt is made to understand in details of welding process. Demands for improved productivity, efficiency, and quality pose challenges to the wedding industry. As material becomes ever more sophisticated in their chemical composition to supply ever - better functionally specific properties, a more complete and precise comprehension of how such materials can be attach for optimal effectiveness and efficiency will become essential. Traditional options for welding will surely involve, sometimes to provide unimagined capabilities. In addition, totally new methods will nearly emerge as evolution of material gives gives way to revolution to meet unimagined new designs and design demands. The objective is to be present various aspects and relative merits of various welding processes in use industries. The important consideration and application of these techniques are discussed in this paper.

Keyword :-

Welding, Steel, Metal, Filler, Automotive.

Introduction:-

Metal industries are always request for different method to join various parts of a component in electronic and automotive devices. In general, the joining method can be non permanent or permanent depending upon the demand and specifications of the part. In terms of metallurgy, attaching is special kind of bonding technique that make a rigid joint comparison between parts to be joined. A metallurgical bond so forms is hard to get divided by ordinary means. Two

different parts are attach together to form of single entity The American Welding society (AWS) defines to the joining process into three major classes, welding, adhesive, bonding , mechanical fastening. The mechanical methods extremely traditional and historic. Metal industries utilizes a diversity of methods to attach many components and the joining methods can be either permanent and non permanent turn on the type and design of the product. the latter methods utilized parts like bolts, screws and rivets, whereas lasting joining usually include welding. Welding is a most common joining process in metal industry applied in provision form job shop outfits to highly-automated computer-controlled industries. The participation of interdependent factors in the process, likes human resources, market conditions and welding machinery, which varies with the type of metals to be welded and the require of customer, wants the utilize of advanced and comprehensive system design When differentiate with other joining methods as riveting and bolting welded structures tend to be powerful, weight less and cheaper to produce. A large number of processes comprise the family of welding technologies and involves method of welding metals polymers and polygamy as well as appear composite and engineering materials. These procedure variats of welding allow the great deal of flexibility in the design of components to be welded. They also inspire designing for optimal cost success in the term of productivity and product production. Protection is also crucial consideration when welding is acquired. This is because it utilized electricity and flammable material and creates a lot of sparks in some instances. Almost of welding processes could not obtaine their importance in the production scenario at the time of their evaluation except for restore welding. However at later stages all of them establish their niches in manufacturing environment. At present welding is widely being utilized in fabrication of pressure vessels, bridges, building structures, air and space crafts, railway lines, shipbuilding, automobiles, electrical, electronic and shielding industries and common applications Welding is the manufacture or sculptural process that attach materials, usually metals or thermoplastics by source coalescence. This is often done by melting the work pieces and attach a filler material to form a pool o f liquefied material that cools to suit a powerful joint, with pressure infinite times used for conjunction with heat, and by itself, to produce the weld. This is in difference soldering and brazing, which includes melting a lower melting point material in middle of the work pieces to form bond between them, without melting the work pieces. [1, 2, 3, 4]

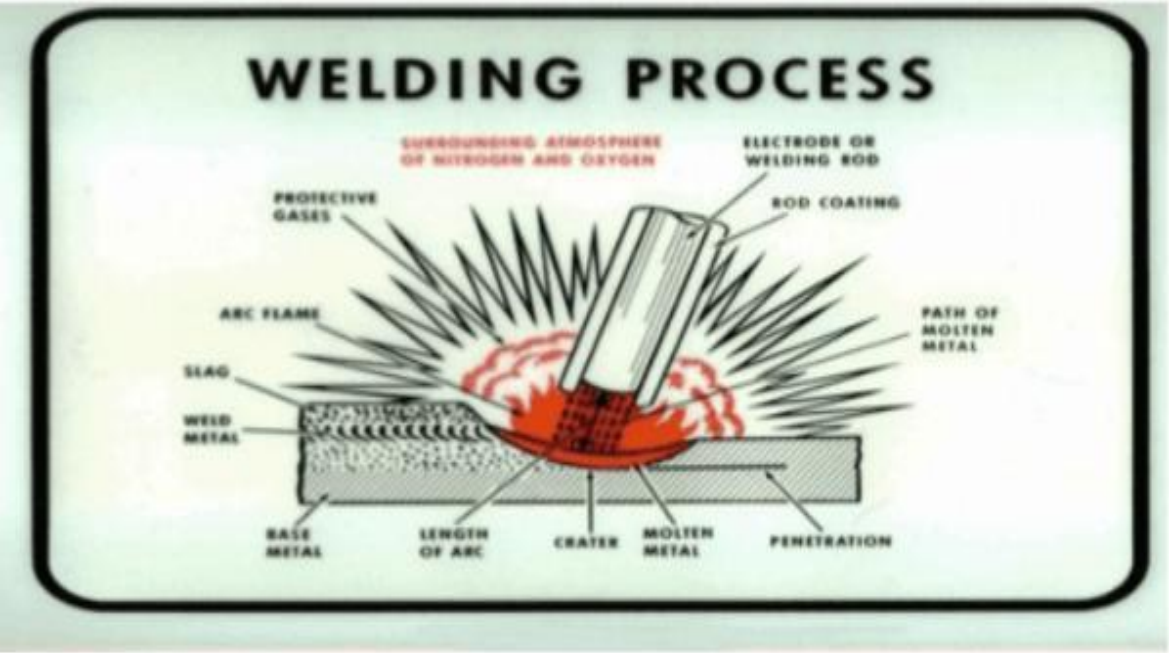


Fig 1: welding process

Classification of welding process:- [1,3]

Based on the method of heat generation and application. Welding processes have be split into seven main categories as given below. Under each main category there are no. of processes each with its independent characteristics and field of application.

The main processes under each category of welding and their sub processes are listed below. [7]

Fig 2: various types of welding process according to their source of a heat application.

A) Gas Welding -

The gas welding involves the kind of gas which the mixture of the oxygen or air with acetylene, for example of the oxygen acetylene welding various other gases the also found the useful place of acetylene is given it with the various temperature ranges. Generally oxy-fuel welding it is used the designate of the gas

welding that utilize of the gas with oxygen to generate the flame. It is most important gas cutting the metal together. The conduction of the welding any various of the oxy-fuel welding including of the acetylene and air. However the air of thermal welding and efficiency speed becomes poor and joint of the distored. Acetylene welding has been applied to the various sheet metal fabrication in automotive industries and repair of parts.

Table 1. Various fuel gasses in a welding and their temperature ranges.

Fuel gases	Max.Temp(° C)
Acetylene	3300
Mythelaacetylene-propadiene	2900
Propylene	2860
Propane	2780
Methane	2740
Hydrogen	2870

B) Arc wedding:-

Arc welding is being frequently used in industries because of its simple, economical, versatile and broad spectrum applications. In an arc welding , electric arc used like heat source from melting. The arc is produced between electrode filler and the part to be joined. . The filler rod consumable rod or wire,andnon-consumable tungsten wire. A shielding gas is also used to prevent oxidation of molten metal carrying welding. Argon, carbon dioxide, helium and various gas mixtures have been design of steel frames for buildings, shipping constructions, galvanized steels for car bodies, motor manufacture, and power plants industries. Arc welding is separated into gas metal arc welding (GMAW) including metal active gas (MAG) or metal inert gas (MIG) welding, submerged arc welding, flux cored arc welding, plasma welding etc. Recent growth include, cold arc welding or cold metal transfer (CMT) have attracted as an alternative to controlled energy transfer in welding. Submerged arc welding (SAW) is a type of arc welding process

where the arc is produced beneath the granular flux or other compounds. The process needs a continuously fed welding filler to the part. SAW is useful in the sense that it can produce high quality, smooth and constant weld joint without any smoke and flash in the process. Nearly all ferrous metals can be attached with exceptional quality, such as alloy and stainless steels for automotive. The only drawback of this process compared to other arc welding techniques is the unsuitability to positional welding. Only flat substrate welding with an inclination up to 15° from the part can be trial out. Flux-cored arc welding (FCAW) is similar type of GMAW where flux is used for protection and is carried within the core of a tubular electrode alternatively of applying over the electrode. Flux core provides a most stable arc, improved weld joint and good, and a better mechanical properties. While FCAW can be configured in some positional welding even the weld slag is hard to control sometimes . FCAW process may or may not need the gas shielding.

Fig 3: Arc welding

C) Resistance Welding -

Resistance welding (RW) is a non - fusion welding process which includes the burning of metals through the electrical resistance of the part opposition to current supply. Application of process to the part and the contain resistance heating at the weld results in the joining. RW is utilize for joining several metals and alloys, motor parts, fuel tank, radiators, gas and oil pipeline parts,train tracks, turbine parts, etc. The principal of the RW is the m manufacture of heat energy when electricity is proceed across a smaller cross section contacting metal parts. If I is the current flow for the time t, the heat H generated can be stated by :

$$H=I \times R \times t$$

At sufficiently high temperature, enough pressure is applied at a joint produced the rigid bonding. The quantity of heat generated further depends upon the current, time, pressure, also on the thickness of the part.Various variation of RW are spot welding, seam welding, protection welding and flash Welding. In spot welding, the parts to be attach in overlapped position and two filler rods are put down on both sides of the part. Spot welding is favour in automotive industry for joining several points on the parts. Seam welding as similar to spot welding is constant welding of sheets placed one to another. Flash welding includes producing an arc into two ends of a rod, tube or sheet by resistance heating and put in pressure to form the weld. The butt welding is same to flash welding, expect the pressure or current applied at the same time. In flash welding, the electric current is manufacture after the application of pressure. A more variation of spot resistance welding is shielding welding where the welding is done shielding sites in the plates or sheets via applying pressure and current. Protection welding is hopefully for mass manufacture and where a series of spot welding is needed in a given area. Normally, protection welding is utilized for welding steel brackets, clamping and encapsulation of parts.

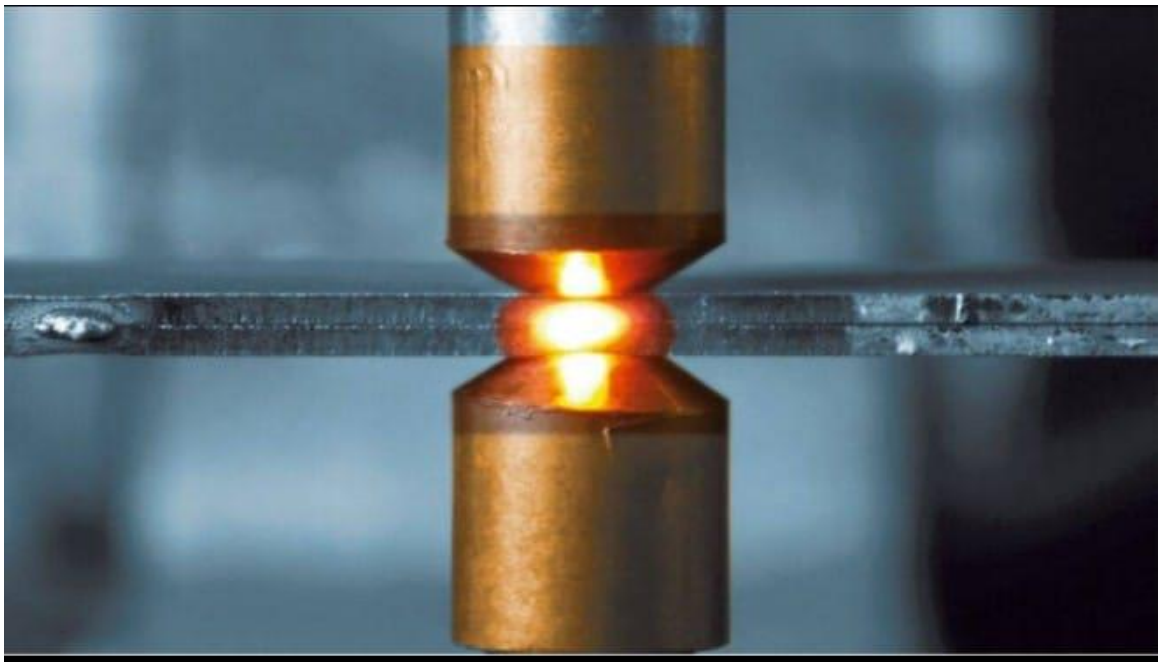


Fig.4: Resistance Welding.

D) Thermite Welding:-

Thermite material utilize for melting the parts and pouring the molten metal into the two parts to be joined. It is a kind of exothermic process and dont's need any current source. The joining is achieved using a thermite reaction into a reducing metal and metal oxide, for example, Al and a Fe_2O_3. As a result, Al_2O_3 and a molten Fe are manufacture. Due to the volatile nature of this process, this is utilize in particular conditions situation like butt joining of train tracks, thick parts of cast iron and steels bars; or where there is no other process is relevant for welding. This process is as well as used dissimilar metals joining like Cu to steel or Cu to Al welding in electricity moving. Suban and his co-workers have utilize this method to join steel surface and Cu according the reaction.

$$3CuO + 2\,Al \rightarrow 3Cu + Al_2O_3 + Heat$$

Another method has been used by Rajdak to join Al to other metals

$$3SnO + 4Al(s) \rightarrow 2Al_20_3 + 3Sn + Heat$$

$$3SnO + 2Al \rightarrow Al_2O_3 + 3Sn + Heat.$$

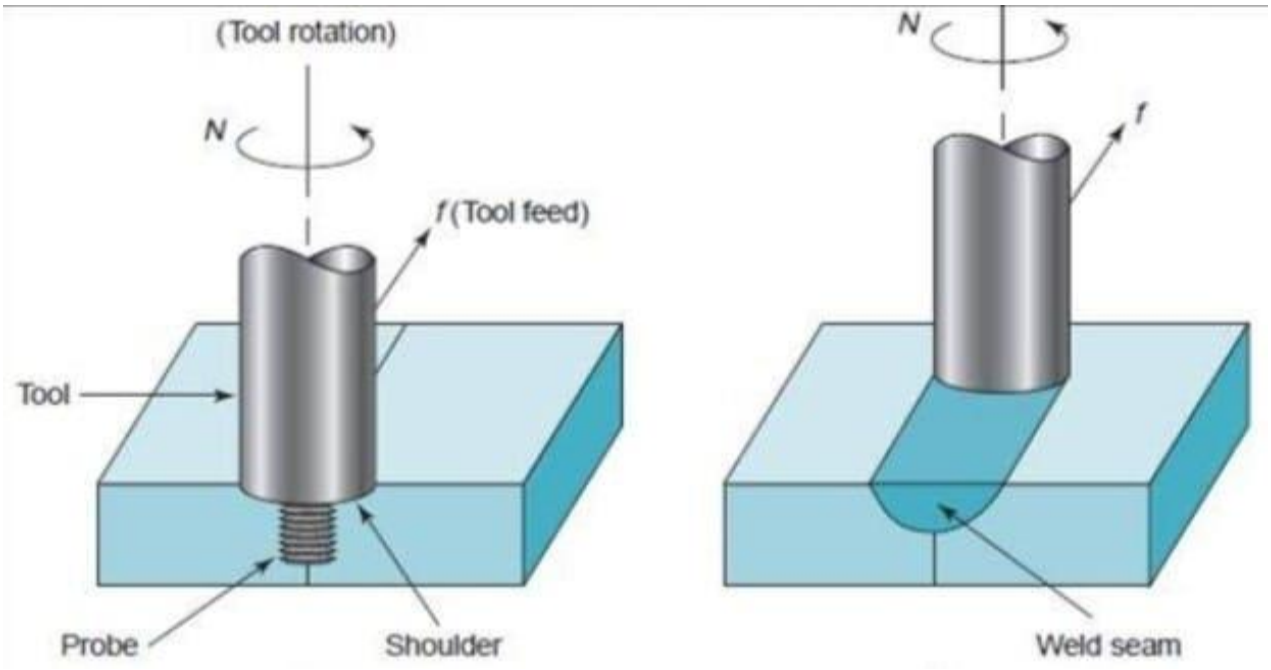
Fig.5: Thermite welding

E) Solid-State Welding :-

The solid-state welding group is oldest joining process also it is modern process Each process in this have way of creating the bond at the faying surfaces commercial process include frictional welding which is widely used.The process was developed within the (former) Soviet Union and introduced into the United States around 1960.Friction welding (FRW) is process in which coalescence is achieved by frictional heat combined with pressure The friction is induced by mechanical rubbing between the 2 surfaces, usually by rotation of 1 part relative to the opposite , to raise the temperature at the joint interface to the recent working range for the metals involved. Then the parts are driven toward one another with sufficient force to form a metalluraical bond. Solid state welding has various types which include friction welding, ultrasonic welding, diffusion and cold welding, explosive welding, forge welding etc. In welding process heat is the

frictional force between the two contact surfaces with pressure to the extent the interface becomes soften

The frictional heat is used to weld the parts. Solid state welding process is used in automotive bodies, high-speed tool steels, and twisted drill.



1) tool just prior of feeding into joint. 2) Partially completed weld seam.

F) welding process:-

Electro slag welding (ESW) is process where the parts to be joined are melted down by a molten slag which protect the weld pool. ESW offers fine productivity and quality in heavy design and pressure vessel fabrication. For a steady welding, the molten slag temperature should be confirmed. ESW process is completely continuous and filler metal or flux. Electro beam welding (EBW) consist heat source acquired by the impact of high-velocity high-density electron beam on the part. The kinetic energy of the electrons is transformed into heat energy which

vaporizes and melt the parts. Electron beam welders focus the electron ray very precisely to divert the beam up to 10 KHz. Current development in electron beam machine can make it to go up to 200 KHz. Like to electron beam, in the laser welding method, the metals are joined by concentrating a laser be am on the part under high velocity. it has high-productivity, better speed and greater penetration as compared to other welding method with an exception of electron beam welding, because of that they received great attention in past of few decades. Its most used application are in the locomotive transmission gears, pipeline welding, clutch, ship building and nuclear plant etc.

Current trend welding technology:- [2,5]

Metal industries uses a variation of methods to combine different components and the joining methods can be either life long or temporary depending on the type and structure of product.The later methods use component like bolts, screw, and rivets, where permanent join usually contain welding. Welding is one of the most general joining process in the metal industry, applied in facilities from job shop outfits to hugely-automated computer-controlled factories. Involvement of co-dependent factors in the process, such like human resources, market conditions or welding machine, which varies with the type of metals to be welded and the require of the customer, demand the use of modern and comprehensive system design and inspection. Designers and manufacturing engineers needs to knew the total potential of all available welding and joining processes so they can made the best choice of potential manufacturing methods.

Scientific knowledge , engineering,and practicing must be most closely integrated into the welding process if it to compete with other technologies and complete it's potential. Another main determinant of the future of welding is the operate to improve efficiency and productivity. For manufactured products to be capable to compete, they must be constructed faster, cheaper,and better than those of rivals or competition. continuous develop in welding equipment purchases shows that over all world utilization of welding is still increasing and its use is expected to grow further because of its economic advantages.for the certain future, intelligently designed weldments will always be less valuable for similar applications than will products made by other manufacturing methods.

The last couple of decades have seen the remarkable development in the fields of laser welding, brazing , FSW, Multi-thread techniques, powder plasma, narrow gap techniques, TOPIG or colf-arc technology.The future development of welding depends highly on the absorption of modern welding process and on developments in the materials used. Such material or new highly-alloys include high-strength , low-alloy steel or new high-alloy, high-temperature steels. Thus, new techological strategies are require, in order to develop welding technology simultaneously with the development of new materials. Extensive research will also be required to develop new filler metals and to improve the purity of definite products associated with welding. Improve filler metals with elevated deposition rates and the increasing productivity of welding, and why welding will continue to control the material-joining industry. Replacement technologies such as polymer bonding, adhesive bonding, and abrasion are being improved and only if welding technological development will they be capable to with stand increased competition. The progress in engineering, construction engineering, shipbuilding, and other trends, the big cost of welders , 'labour and social problem require new solutions.This paper talk about different aspects of the welding industry , considering changes to improve productivity or allow welding to be an engine of growth. Approaches to mitigation the result of the downturn and safeguarding the future of welding are considered and explained. The paper narrate new welding materials that permit such improvement and outline difficulties that need to be solved to achieve further progress in welding process. [2,5]

H) Practical Application of Welding:- [6,7]

Welding have been employed in Industry as a tool for:

Regular fabrication of automobile cars, air-crafts, refrigerators, etc.

Repair and maintenance work, e.g., attach, broken parts, rebuilding worn

out components, etc.

A few important applications of welding are is :-

1. Aircraft Construction Welded engine mounts. Turbine frame for jet engine. Rocket motor fuel and oxidizer tanks. Ducts, fittings, cowling components, etc.

2. Automobile Construction Arc welded car wheels Steel rear axle housing. Frame. side rails. Automobile frame, brackets, etc.

3. Bridges Section lengths. Shop and field assembly of lengths, etc.

4. Buildings Column base plates Trusses Formation of structure, etc.

5. Pressure Vessels and Tanks and Clad and lined steel plates &Shell construction Joining of nozzles to the shell, etc.

6. Storage Tanks Oil, gas and water storage tanks.

7. Rail Road Equipment Locomotive Under frame Air receiver Engine

8. Piping's and Pipelines and Rolled plote piping and Open pipe joints, Oil gas and gasoline pipe lines, etc.

9. Ships And Shell frames. And Deck beams and bulkhead stiffeners.

Girders to shells Bulkhead webs to plating, etc.

10. Trucks and trailers.

11. Machine tool frames, cutting tools and dies.

12. All commonly accessible metals or their alloy can be wilded.

13. Also utilized for maintenance and repair work.

Conclusion:-

This paper has presented an overview of recent trends in the evaluation of welding technologies in the JFE Group by reviewing typical technologies in the automotive material field and the plate and steel pipe fields. Trends in basic research on the microstructure of the weld metal, which has running an early date, technical progress by welding methods which are being upgrade from the viewpoint of fatigue and fracture of welds, and recent standard manage technologies for welds and attaching technologies were also introduced. These technologies have already reached the level of practical application, and their

application is necessary and indispensable presence as major key technologies when responding to the strict requirements placed on steel materials. JFE Steel is engaged in technical development on a daily basis in order to provide advanced steel products and state-of-the-art use technologies to customers. Engineering is endeavoring to achieve higher efficiency in welding and to secure steady quality in a diverse range of steel structure products. This paper introduced four examples of welding automation technologies which were developed independently by JFE Engineering. Because welding is a critical technology which holds the key to the protection of the social infrastructure, industrial machinery, and energy-related products, the company is putting great effort into technical evaluation in order to create the foundation for a shielded and secure life. The JFE Group is positive that development of these welding and joining technologies, use technologies, and automation technologies in the group will enhance global technological competitiveness while also contributing to society.

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Reference:-

1. A.K.Srivastava, A.sharma, "Advances in joining and welding Technologies for Automotive and Electronic Applications, "American Journal of material Engineering and Technology, Bol.5, PP. 7-13,Aug.2017.

2. P.Kah, J. Martikainen, "Current trends in welding processes and materials: improve in Effectiveness, Advanced materials science, Bol.30, PP. 189-200, sep.2012.

3.K.chaudhary, "A Review on Advance welding processes, International Journal of Engineering and Techniques, Bol.3, PP.86-96, Dec.2017.

4.J.Kazi, S.Zaid, S.Mohd, M.Yasir, D.Akib, "A Review on Various welding Techniques, International Journal of modern Engineering Research, Vol.5, PP.22-28,Feb.2015

5.O.I.Kenji, M.Masatoshi," Recent Trend of welding Technology Development and Application, JEE Technical Report, Vol.34, PP.1-7,Aug.2014.

6. D.Devarasiddapp, "Automotive Application of welding Technology - A Study, " International Journal of Modern Engineering Research, Vol.4, PP.13-19,Sept.2014

7.A.B.Auti, P.G.Jamdade, G.G.Momin, P.S.Gorane, First Addition 2019, System in Mechanical Engineering, Tech-Neo Publications, 2020