WELDING - SCENARIO IN INDIAN INDUSTRY TODAY

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INTRODUCTION

It is a privilage for me to deliver the prestigious Sir L. P. Misra Memorial Lecture at the National Welding Seminar 1995 at Cochin in Kerala. I am specially fascinated to come to Kerala, which is so wonderful in natural resources and greenery. Today, we have here an assembly of renown experts from various sections of industry, welding product manufacturers, R & D centres in the field of welding as well as from various educational institutions.

The topic I have selected for this lecture is basically to assess the status of welding at a time when the economy has been opened up in the country and the investment from outside is coming in a big way to India. Indian economy is poised for a big leap forward with major thrust in iron and steel, power, transportation, automotive and consumer sector industries. In all these sectors of industry, extensive use of fabrication and welding technology are required. We need therefore to find out whether we are adequately equipped in meeting the challenges of 21st century or we have to improve and develop in selected areas pertaining to welding technology.

The Indian fabrication industry is predominantly based on manual joining techniques using conventional consumables. It is imperative that we adopt more of semi-automatic and automatic welding methods that will be required to meet the ongoing rapid industrial growth taking place in the country.

Welding Process and Consumables

Today, in India, there are about 300 manufacturers of manual metal arc welding electrodes with a few giant multinationals making semiautomatic / automatic welding consumables. It is difficult to say whether we are currently depositing 80% of metal by manual process and 20% by others, but it is sure that the rate in which the automatic welding is increasing, specially in the organised sector of industry, it will not be far when at least 20-25% deposit will be made by such automatic processes. The use of MIG/MAG welding with solid wire as well as flux-cored is raising thereby increasing productivity as well as quality. Use of other welding processes like plasma, electron beam and laser are yet to become popular as the benefits of using such processes are yet to be explored fully. Additionally, these equipment are expensive as well. It would be necessary to carry out market survey to identify the areas where these high intensity welding processes like electron beam and laser can be used and whether such equipment can be manufactured within the country and/ or available at relatively cheaper price. Similar study is also required for use of various processes in solid phase welding such as friction, explosive, ultrasonic & diffusion bonding etc. The quality of welding that can be achieved by solid phase processes, need not be over-emphasized here as it is well-known that joint of highest quality can be obtained, even between dissimilar metals, by such processes. However, the application of these processes in India is still limited and it is necessary to explore the possibilities of increased use in industry. In the field of resistance welding like spot, seam and projection welding, the automobile sectors are in the forefront but there is no reason as to why use of resistance welding cannot be extended to join sheet metals in other sectors of industry. For reclamation and rebuilding, there exists of variety consumables available today in India and it is also equally heartening to note that the industry has also several positions in the choice of techniques to be used for reclaimation. While the availability of welding consumables and equipment are adequate, the industry is still shy in changing conventional methods. It is not the welding process or the availability of consumables which will decide the application. What is wanted by industry today, specially in the small scale sector, is not only the selection of the right welding consumables but also requisite expertise to cover the entire range of fabrication methodology specially for those jobs where there is no recommended codes of practice. Guidelines are required for materials identification & straighten-

ing, process of cutting, grinding, rolling or forming, preparation of edges, details of joint edge preparation, selection of process of welding, equipment & polarity, welding consumables - type & size, use of gas for purging & welding if any, purity of gas, testing of welding by NDT, defect acceptance standards, repair procedures, hydraulic and/or pneumatic tests, if applicable, and many such areas. Today, in order to meet the competition from within the country and outside, fabrication industry like others have also to deliver the job within a optimum cost and also with the specified period and in required qualities as well.

Materials

Having discussed some aspects of welding processes and consumables, it is necessary to take a stock of situation on the availability of materials in our country. Steels to specification BIS : 2062 Gr. 2A or 2B are extensively used both for static loaded building structure as well as for technological structures. In most of the Indian steel mills, variety of steel sections are manufactured including those of boiler quality plates. Steel sections are used in the manufacture of cranes, in conveyor equipment, dosers & dumpers and in many such equipment as also for making pressure vessels, tanks, offshore oil rigs and platforms, ship building etc. It is necessary to find out whether we can reduce the weights of our equipment & structures by changing materials from ordinary steel to special varieties, the advantages of new processes of joining being available today. High alloy steels including stainless steel of austenitic type AISI 304 and 316 are extensively used for chemical, fertilizer, petrochemical industries. Ferritic grades of AISI 410 are also used to some extent. In the field of non-ferrous, aluminium alloys - both non-heat-treatable and heat-treatable grades are used for many process plant, equipment, material handling equipment and items where prevention of corrosion, light weights are prime factors. It is felt that use of aluminium alloys must be extended further and our designers must think in this direction also. Sophisticated materials like titanium, copper alloys etc are having specific applications in the aircraft industry as well as in the manufacture of rockets and missiles. While these materials can be brought in from any source, our industry does not have adequate expertise and experience in fabrication & welding in actual production in the manufacturing shops as well as in the site. Necessary expertise in these directions needs to be developed.

'Welding' in the Drawings and Specifications

Inspite of development that have taken place in the field of welding consumables, process and materials, as already indicated, designers in our country are still selecting the conventional methods and processes for most of the applications. In many of our drawings and specifications other than those for coded vessels, tanks and pipelines, details available for welding are very limited and sometimes inadequate. While weld sizes are generally indicated in drawings, joint designs with edge preparations are not shown for butt, fillet and lap joints including information whether root run is required to be cleaned before a caping pass is used. The drawings and specifications are also not adequately clear about type of welding process, consumables as well as the method of testing and quality of weld by destructive and non-destructive testing. Welding defect acceptance standards are not mentioned in most of the drawings. Many such drawings do not also indicate whether Welding Procedure Sheet (WPS), Procedure Qualification Record (PQR) are necessary to be carried out. These drawings also do not indicate whether the welders are to be qualified. The basic reason for all such deficiencies lies in the fact that the designers are not adequately trained in the field of welding & fabrication technology. In some of our applications, heavy sections used for structural fabrication are specified to have an extra deposit of weld metal, which can be avoided if the designers are trained. It has been told by someone that it is not the "factor of safety" due to which the designers are recommending the extra deposit of weld metal but it is due to the "factor of ignorance".

Human Resources Development

India is a large country and the facility for training of welding personnel at the moment is grossly inadequate. We have at present facility for training welders at the Industrial Training Institute (ITI) and at a few polytechnics. The majority of welders basically get themselves trained at shop floor level without any formal training and some get themselves certified as IBR Welders. At the degree as well as at post graduate levels, there are some institutions offering courses including at various IITs & RECs. Welding Research Institute (WRI) is also offering short term specialised courses. However, till date there is no degree level course available in the field of welding technology in any of our universities. The Indian Institute of Welding (IIW) has, however, started it's Associate Membership Examination a few years back but the participation in such examination is grossly inadequate, mainly due to the reason that the examination is not recognized yet by Govt. of India. Of late we are finding some of the overseas

bodies in the field of welding to have started training courses for certified welding inspectors but on account of higher expenses many cannot afford such courses. Some of the welding product manufacturers are conducting courses for welders & supervisors and some of these courses are quite popular, although number of seats are limited and to some extent, these courses are expensive also.

It is considered essential that training in welding including certification in the level of welding operator, supervisor, instructor must be started all over the country. For this purpose, I would invite professionals on training to join hands together with leaders of core sector industry, educational institutions, welding product makers to formulate training courses & certification scheme for welders for various processes, welding supervisors, instructors, foreman & technicians, all over the country. Vocational training can be formulated also for those, who are not directly connected with welding but for their work execution basic knowledge in the field is necessary. Once such courses are formulated in order to get these recognised it may be necessary to take up this matter with Ministry of HRD, Govt. of India, as well as industry. Alternatively, the norms for vocational training model already formulated by Government, can be followed, with or without modifications. Such training courses must give adequate preference not only to welding but to various areas of fabrication as a whole including testing and inspection.

Standards and Codes for Welding and Testing

At this point of time it is considered necessary to look into the National Standards available in the country and the extent to which such standards are used in the actual application in fabrication of plant &equipment. The Bureau of Indian Standards (BIS), New Delhi has formed a number of committees in the field of welding and published various standards in the field. Those who are closely connected with industry will only know as to what extent such standards are used today by our designers in their drawings and specifications, and also by production and planning engineers, inspection & testing personnel as well as by welding engineers, supervisors, formen, welders in their day-to-day work. Some of the more popular standards are IS:814-1991 - Covered Electrode for Manual Metal Arc Welding of Carbon & Carbon-Manganese Steel, IS:817-1992 - Code of Training and Testing of Welders, IS:3613-1974 - Acceptance test for Wire Flux Combination for Submerged Arc Welding of Structural Steel, IS:9595-1980 - Recommendation of Metal Arc Welding of Carbon and Carbon Manganese Steel.

The committees formed by BIS comprise experts from various sections of industry, R & D and educational institutions, various Govt. bodies and similar such organisations. However, very little work is being carried out by most of the members of the committee, excepting a few and the bases on which the standards are prepared, updated and modified have room for considerable improvement. The standards have to be so prepared that the industry will be finding these useful as otherwise practicing engineers will have to refer to overseas standards like ASME, ASTM, DIN, JIS, BS etc. which incorporates definite recommendations with regard to application. You are all aware of the excellent work done by the American Welding society in preparing various documents such as "recommended practice" for welding of all kinds of materials & applications with a clear guideline as regards what is required to be done. It is necessary that such work is taken up jointly by BIS, IIW and similar such bodies in order to help industry in the right manner.

ISO : 9000 : Series of Standards and Quality

During the last few years many of our industries and organisations connected with industry are getting themselves certified either with ISO:9001 or ISO:9002 quality standards. As such, some contractors and manufacturers are making their own quality system and following these meticulously, while others, particularly the ancillaries and those in the small scale sectors, are not acting towards certification under the above international standards. As a result, the products, raw materials, components produced by such ancillaries do not follow any particular system and it is often difficult for the organized sector to accept such materials. This is happening in the field of fabrication of welding as well. Besides, there is a tendency for the ultimate customer today in the country to get their supply materials as fast as possible and often pressure is put on contractors/manufacturers to supply materials to meet the schedule, which may have been prepared on the basis by which quality cannot be ensured under the existing Indian Scenario. While quality policy of most of the company certified under ISO. is to achieve excellence in their products & services to meet Customer's expectation, dilution or shortcuts as above sometime upset the ultimate objective. There is no apparent solution to this problem until and unless most of the organisations find a simple way of following quality system without much interference.

Activities of The Indian Institute of Welding (IIW)

The IIW has completed it's 25 years of existence a few years back and today has grown into a institute to deal with all kinds of problems connected with welding. It has successfully been conducting National Welding Seminars like one starting today, besides National Welding Meet, Seminars by various branches, training courses etc. IIW is also publishing the Indian Welding Journal, Conducting AM-IIW Examination and undertaking many such activities. However, time has come to find out whether our institute is doing any real service to the industry. What benefit the industry is getting today from the IIW ? Are we offering adequate services to the industry who may be facing some problems connected with fabrication and welding, or, is it a body which is connected only to the theoretical part of welding and do not help the ordinary welders and supervisors to solve their day-to-day problems ? Why today in a country of 90 crores people our institute still have bout 2500 members ? What action have we taken with regard to training of welders, supervisors and their certification till date ? Is the efforts made by individual branches are well coordinated and planned with the headquarter and the Council Members ? The IIW had been getting the sponsorship from leading welding product manufacturers for a very long period in the past but today these organisations are not actively involved which has resulted in problems connected with management and finance of the institute. The answers to these queries need to be worked out by all of us so that the institute grows as a proper single & stable body in the country in the field of welding having it's examination facility, duly recognised by the Ministry of Human Resources Development, Govt. of India.

The Task Ahead

Let us now examine briefly the tasks ahead of us in the sphere of welding technology and access how we should address these problems/ tasks. I have briefly enumerated our tasks in the following concluding observations.

1. It is necessary to explore possibility to increase use of Semi-Automatic and Automatic Welding in day-to-day operation to increase productivity at optimum quality. Also to explore possibility of using other joining processes including Solid Phase Welding in Industrial Applications.

2. It is necessary to identify typical application of welding in our industry and prepare recommended code of practices of welding and fabrication for each of such application. This job can be carried out by selected group of people by forming as "Welding Development Council" under the Ministry of Industry, Govt. of India.

3. Today there is a trend for buying old machinery and equipment from overseas which are being dismantled, damages/incompleteness identified, items replaced/re-built, inspected/tested and commissioned after erection. It is necessary that engineers connected in the field of welding take the most important role in such renovation. The knowledge of tribology and reclamation would be a great advantage besides inspection & testing for such jobs.

4. Various overseas Auto-giants & others are planning to source components for their main products from India. As a result, there are possibilities of Indian component manufacturers to export/supply such parts in the international market. This may open up new challenges to Welding Engineers who are specialised in overlaying cladded materials besides reclamation.

5. Attempt to be made to substitute ordinary "Mild Steel" to special grade materials in order to reduce weights of equipment, structures etc.

6. Full details of welding must be provided in drawing & specifications for plant, equipment & structures including defect acceptance standard.

7. Formulation of Training & Certification Schemes for Welders, Supervisors, Formen, Technicians must be started all over the country in proper manner in line with TWI or AWS programme.

8. To get the Associate Membership Examination of IIW recognized equivalent to Bachelor of Engg. Degree.

9. Making Indian standards more attractive to industry so that there is a growing tendency of industry to use these regularly without referring to American and other International Standards in the field of welding & fabrication.

10. Introduction of proper "task force" in IIW to revitalize it in order to bridge the existing gap already explained, to make IIW more useful to Indian Industry.

Concluding Remarks

Today's talk must not be taken as

a criticism against what we are doing in the field of welding. Our aim is to prepare ourselves to meet the requirements of standards in the field of welding for 21st century. We must mechanise and modernise with innovative approaches which are particularly required for our industries. We must also start using computer in as many areas as possible, which not only helps to keep the data in floppies but also help in finding solutions for many problems in a shorter period than were possible earlier. The use of computer and robotics has got to increase with time. I would fail in my duty if I do not mention about the contribution made by the manufacturers of welding equipment who are already making sophisticated welding and cutting machineries. But time is perhaps now ripe for them also to think in terms of making "welding system" doing a number of operations rather than welding only. Our team of research scientists and R&D engineers, specially from IGCAR, Kalpakkam and WRI, Trichi, together with those from IITs and RECs are doing excellent work. It is, however, necessary to have close interaction with the industry and it is for these scientists and scholars to prove to the industry that problems on welding can be taken up on a project basis and same can be solved with an active sponsorship from the industry without increasing cost and time over-run.

I like to thank the President of IIW and my fellow Council Members for giving me this opportunity to present today's deliberations in such an august gathering, and I also wish to thank the management of M.N. Dastur & Company Ltd., Consulting Engineers, Calcutta for kind permission to deliver this talk.

Thank you all,

List of Common BIS Standards in the field of Welding

IS:812-1957 Glossary of terms relating to welding and cutting of metals

IS:813-1986 Scheme of symbols for welding (A4-size) (Reaffirmed 1991)

IS:814-1991 Covered electrodes for manual metal arc welding of carbon and carbon manganese steel (A4-size)

IS:816-1969 Code of practice for use of metal arc welding for general construction in mild steel (Amendments 2)

IS:817(Pt.1)-1992 Code of practice for training & testing of metal arc welders - Part 1 - Manual metal arc welding (A4-size) -Reaffirmed 1991.

IS:818-1968 Code of practice for safety and health requirements in electric and gas welding and cutting operations (Reaffirmed on 1991)

IS:819-1957 Code of practice for resistance spot welding for light assemblies in mild steel (Reaffirmed 1992)

IS:822-1970 Code of procedure for inspection of welds (Reaffirmed 1991)

IS:1179-1967 Equipment for eye and face protection during welding (Amendment 1/Reaffirmed 1991)

IS:1182-1983 Recommended Practice for radiographic examination of fusion welded butt joints in steel plates (Reaffirmed 1991)

IS:1261-1959 Code of practice for seam welding in mild steel (Reaffirmed 1992)

IS:1278-1972 Filler rods and wires for gas welding (Amendment-2/Reaffirmed 1991)

IS:1323-1982 Code of practice for oxy-acetylene welding for structural work in mild steels (Reaffirmed 1987)

IS:1393-1961 Code of practice for training and testing of oxy-acetylene welders (Reaffirmed 1991)

IS:2879-1975 Mild steel for metal arc welding electrode code wire (Amendment-4/Reaffirmed 1992)

IS:2927-1975 Specification for brazing alloys (Amendment-1)

IS:3023-1965 Recommended practice for building up by metal spraying (Reaffirmed 1992)

IS:3525-1983 Code of practice for use of metal arc welding for hull construction of merchant ships in mild steel (Reaffirmed 1992)

IS:3600 (Pt 3) - 1984 Method of testing fusion welded joints and weld metal in steel. Part 3 - Transverse tensile test on butt welds (A4-size) (Reaffirmed 1990)

IS:3600 (Pt 4) - 1984 Method of testing fusion welded joints and weld metal in steel. Part 4 - Longitudinal tensile test on cylindrical weld metal test pieces on butt welds (A4-size)

IS:3600 Pt 7) - 1984 Method of testing fusion welded joints and weld metal in steel. Part 7 - Longitudinal root and face bend test on butt welds A4-size) Reaffirmed 1991)

IS:3600 (Pt 8) - 1985 Method of testing fusion welded joints and weld metal in steel. Part 8 - Nick break test and fillet weld fracture test (A4-size) (Reaffirmed 1991)

IS:3600 (Pt 9) - 1985 Method of testing fusion welded joints and weld metal in steel. Part 9 - Macro and Micro examination (A4-size) (Reaffirmed 1991)

IS:3613-1974 Acceptance tests for wire-flux combinations for submerged arc welding (Amendment-1/ Reaffirmed 1987)

IS:4804(Pt.3)-1969 Resistance welding equipment. Part III - Single-phase spot and projection welding machines (Amendment-1/Reaffirmed 1991)

IS:4972-1968 Resistance spot welding electrodes (Reaffirmed 1991)

IS:5206-1983 Covered electrodes for manual metal arc welding of stainless steel and other similar high alloy steels (Reaffirmed 1991)

IS:5897-1985 Aluminium and aluminium alloy welding rods and wires and magnesium alloy welding rods (Reaffirmed 1991)

IS:6419-1971 Welding rods and bare electrodes for gas shielded arc welding of structural steels (Reaffirmed 1991)

IS:6560-1972 Molybdenum and chromium molybdenum low alloy steel welding rods and bare electrodes for gas shielded arc welding (Reaffirmed 1991)

IS:6916-1973 Code of practice for fabrication welding of steel castings (Reaffirmed 1992)

IS:7255 (Pt 1)-1974 Methods of chemical analysis of solders for use in goldware. Part 1 - Determination of gold, silver and copper (Reaffirmed 1992)

IS:7280-1974 Bare wire electrodes for submerged arc welding of structural steels (Reaffirmed 1991)

IS:7303-1974 Specification for covered electrodes for surfacing of metal by manual metal arc welding.

IS:7307 (Pt 1) - 1974 Approval tests for welding procedure. Part I - Fusion welding of steel (Reaffirmed 1991)

IS:7318 (Pt 1) - 1974 Approval tests for welders when welding procedure approval is not required. Part I - Fusion welding of steel (Reaffirmed 1991)

IS:7318 (Pt 2) - 1974 Approval tests for welders when welding procedure approval is not required. Part 2 - TIG or MIG welding of aluminium and its alloys (Reaffirmed 1991)

IS:7653-1975 Manual blowpipes for welding and cutting (Reaffirmed 1991)

IS:7931 (Pt 1) - 1975 Automatic and semi-automatic welding equipment with self-adjusting arcs (MIG/MAG processes) Part 1 - DC welding generator power source (Reaffirmed 1988)

IS:7931 (Pt 2) - 1975 Automatic and semi-automatic welding equipment with self-adjusting arcs (MIG/MAG processes) Part 2 - Transformer rectifier power sources (Amendment-1/Reaffirmed 1988)

IS:7931 (Pt 3) - 1975 Automatic and semi automatic welding equipment with self-adjusting arcs (MIG/MAG processes) Part 3 - Welding, gun and ancillary equipment (Amendment-1/Reaffirmed 1988)

IS:8002-1976 Recommended procedure for welding of flexible PVC (Reaffirmed 1987)

IS:8363-1976 Bare wire electrodes for electroslag welding of steels

IS:8666-1977 Copper and copper alloy covered electrodes for manual arc welding (Reaffirmed 1991)

IS:8987-1978 Recommended practices for air carbon arc gauging and cutting (Reaffirmed 1992)

IS:9006-1978 Recommended practice for welding of clad steels (Reaffirmed 1992)

IS:9524-1980 Recommended procedure for repair welding of steel components by alumino-thermic process (Reaffirmed 1987)

IS:9595-1980 Recommendations for metal arc welding of carbon and carbon manganese steel (A4-size) (Amendment-1/Reaffirmed 1992)

IS:10178-1981 Recommended procedure for CO_2 gas shielded metal arc welding of structural steels (Reaffirmed 1992)

IS:10186-1982 Recommendations for manual tungsten inert gas arc welding of copper and copper alloys (Reaffirmed 1992)

IS:10793-1983 Classification of defects in metallic fusion welds with explanations (A4-size) (Reaffirmed 1990)

IS:11991-1986 Recommended practice for flash butt welding of tubes, rods, and other sections in carbon and alloy steels (Reaffirmed 1992)