

EXECUTIVE SUMMARY

- 0.1 Welding electrode is a delicate tool which while in use combines physical, chemical, and metallurgical processes of the flux, core wire and parent metal to achieve a durable weld joint or surfacing. With advent of electronically controlled welding equipments and use of gas as shielding medium the construction of welding electrode has simplified considerably. For mass welding jobs solid continuous welding wires find increasing application. Welding electrodes are used in joining, surfacing and protective maintenance for varied materials and thus their variety is large while their raw material requirement being very specific.
- 0.2 Commercial production of welding electrodes was started in India in early 1960s. In 1970s a number of companies with foreign collaboration or joint venture went into production. Small scale sector entered the scene in 1980. In 1980s too, a number of organised sector units were set up with foreign collaboration but now in special welding consumables.
- 0.3 In Welding Electrode industry there are 28 organised sector units of stick electrodes and 8 manufacturers of continuous welding wires. There are around 100 small scale units in this industry. Stick electrodes, which can be categorised into 8 to 10 broad groups, are of around 150 varieties. Continuous welding electrodes of solid core(MIG and MAG) type and flux cored type are manufactured in India. In stick electrode the product mix is of mild steel electrodes (about 60%), mild steel high tensile and low hydrogen low alloy (about 30%), and special type (about 10%). Indigenously produced electrodes find application in major industries like Railways, Petrochemicals, Fertilizers, Sugar, Automobile, Nuclear Power and others.
- 0.4 Foreign collaborations have continued in welding electrode industry from early 1960s till date. Initially AOL, Philips, and IOL entered the market with joint ventures with their parent companies. GEEL and Modi Arc went ahead with technical foreign collaboration in which know-how and machinery supply were included. In late '80s collaborations were for specialised welding consumables like SAW fluxes,

Flux cored wires, etc. Status of collaborations in welding electrode industry is given at Table-0.1.

TABLE-0.1

STATUS OF FOREIGN COLLABORATION OF ELECTRODE MANUFACTURERS

Sr. No.	Name of the Company	Collaborator	Product Name	Nature of Collaboration	Year	Status
1.	Apar Pvt Ltd.	Westinghouse USA	Welding Electrodes	Technical		Expired
2.	Advani Oerlikon Ltd.	Welding Industries, Oerlikon Switzerland	Welding consumables	Technical	1987	Valid
3.	General Electrodes & Equipments Ltd.	Messer Griesheim GmbH - Germany.	Welding Electrodes	Technical	-	Expired
4.	T&R Welding Products (India) Ltd.	T&R Welding products, UK	Welding Electrodes	Technical	-	Valid
5.	Nucor Weld Pvt Ltd.	UTP Schwissmaterial AG, Germany.	Welding consumables	Technical	1987	Valid
6.	Ewac Alloys ltd.	Entectic Castoline, USA	-do-	Technical	1986	Valid
7.	Krish Brown Welding (P) Ltd.	Alexander Brown U.K.	-do-	Financial	1986	Valid
8.	Aditya Electrodes Pvt Ltd	Ommitrode Edelstahl Electroden GmbH, Germany.	Special Electrodes	Financial	1989	Valid

Table - 1.0 (Contd.)

Sr. No.	Name of the Company	Collaborator	Product Name	Nature of Collaboration	Year	Status
9.	D&H Secheron Electrodes (P) Ltd.	D&H Secheron Germany	-do-	Technical		Expired
10.	Esab India Ltd.	Esab A B, Sweden	Elrectrode Recipes	Technical	1989	Valid
II) Continuous Solid Wires/Flux Cored Wires						
1.	Maharashtra Weldaids Ltd.	Lamnea Bruk AB, Sweden	Copper coated wires.	Technical		Valid
2.	Mig-Weld & Machines (P) Ltd. wires.	Italfil SNC, Italy	CO ₂ Welding	Technical	1986	Valid
3.	Advance Welding Alloys Pvt Ltd.	Welding Alloys Ltd., UK	Tubular welding alloys	Financial	1984	Valid
4.	Kostech India Ltd.	Kostech International ltd. W.Australia	-do-	Financial	1986	Not known
5.	Nucor Wires Ltd.	Alloy Rods Corpn., USA	-do-	Technical	-	Valid
6.	Modi Arc Electrode Co.	Hobart Bros Co., USA	Submerged welding	Technical Electrodes and fluxes	1989	Valid

Source: Company Annual Reports

0.5 At present there are 28 organised sector welding electrode units with installed capacity of 1054.61 million running meters in India. Out of

the 28 units two units control around 40% of the installed capacity and six units control around 60% of the installed capacity. The rest is fragmented among 22 units. The SSI sector which entered this industry a decade ago has at present a share of 30% of the total stick electrode production. Confirmed production data of continuous welding electrodes is not available. In welding electrodes exports as well as imports have been very limited. In 1991 imports were of the order of Rs.4.10 crores and exports Rs.6.5 crores.

- 0.6 For majority of the electrode manufacturers the major manufacturing processes involved in production of stick electrode are wire drawing, wire cutting to size, flux constituent grinding, dry mixing, wet kneading, slug preparation, wire coating, brushing, printing, drying and packing. They have similar manufacturing facilities which includes major machinery like drawbench, dry and wet flux mixers, slug press, wire feeder, extruder, baking oven, and packing machine. A few units have very sophisticated inspection and testing facilities and observe stringent quality control procedures.
- 0.7 The technology with respect to welding electrodes around the world is basically based on extrusion press. Leading manufacturers have automated their plants by process control equipments, and material handling equipments. They have introduced computerised batching plants, X-ray fluorescent testers, high speed extrusion presses, digital concentricity testers etc. Use of such equipments is economical for them as they have very high plant capacities. Special purpose electrode manufacturers attain their leadership by carrying out research in specific application areas like protective maintenance, in their research centres spread world wide. In continuous welding wires automatic drawing plants and coating plants are used.
- 0.8 Technology for welding electrodes imported over the last 3 decades has been fully absorbed and adapted. Indian collaborators have been able to improvise and indigenous flux formulations and all manufacturing machinery. However no further innovative changes have been carried out in manufacturing machinery design.

0.9 CONCLUSIONS

- 0.9.1 Welding electrodes are required for joining, hard facing and protective maintenance. They are delicate tools. Their end results are dependent on interplay of physical, chemical and metallurgical process. There are wide variety of welding processes but all do not use electrodes. Nor are all processes which use electrodes have wide commercial application and large consumption. The process which uses electrodes and has largest commercial application and consumption in India is Manual Metal Arc welding process. It is carried out by stick electrodes and continuous welding wires. Stick electrodes of 8 to 10 broad varieties find wide application in India. CO₂ type continuous welding wires and to some extent MIG wires are finding increasing acceptance. Flux cored wires are yet to be accepted for regular commercial use.
- 0.9.2 Welding technology is practised in India since last 3 decades. At present there are 28 organised sector welding electrode units with installed capacity of 1054.61 MRM in India. A matrix of products and companies is given at Annexure-16. Out of the 28, two units control more than 40% of the installed capacity. There are no public sector units producing welding electrodes. The SSI sector which entered this industry a decade ago has a share of 30% of the total stick electrode production of India. Its significant growth is attributed to its low price product, which has been well accepted.
- 0.9.3 Basic technology of welding electrode production was received from developed countries like Sweden, Germany, USA, and UK through foreign collaborations and joint ventures. Initially basic machines like extrusion press, wire feeder, etc. were imported with the know-how of electrode recipes and method of preparing flux compositions. Most of the organised sector units who have had foreign know-how have assimilated the technology and now do not depend on imported raw materials and equipments except for very sophisticated requirements. M/s. Advani Orlikon Ltd. has played a lead role in technology assimilation and upgradation as well as in training of technical manpower. At present quite a few manufacturers have not extended their decade long collaboration agreement. An assessment indicates that those with extended foreign collaborations of joint ventures are more up-to-date technologically and have synergic advantage in export market.

- 0.9.4 In India, basic manufacturing technology for welding electrodes has remained same over the years. Various electrode coating plant designs have been tried out by the Indian electrode manufacturers. At present horizontal type (angular and rightangled both) electrode coating plants have found wide acceptance. Screw type press was also tried out but was found commercially unviable. Indian electrode manufacturers and electrode plant manufacturers can now develop complete stick electrode manufacturing plant as well as CO₂ wire plant. Capital equipment in new organised sector units and all the SSI sector units are largely Indian.
- 0.9.5 In Welding Electrodes, export as well as import have been quite limited. Exports are increasing although the pace is slow. Imports have decreased over the years. However they are mainly for small highly specialised application requirements.
- 0.9.6 The demand of general purpose mild steel and special purpose electrodes has been estimated at 867 MRM and 96 MRM in 1994-95. Increase in the demand in the coming decade is dependent on steel consumption. The demand of continuous weld wire is estimated at at 12040 Tonnes in the year 1994-95.
- 0.9.7 Research and development activities in this sector are carried out by leading 5 private sector companies and public sector Welding Research Institute, Tiruchy. Electrode manufacturers who do not carry out in house research suffer from limited product range.
- 0.9.8 Welding Research Institute, Tiruchy has done considerable work in development and spread of welding electrode production technology. Its work has specially benefitted small scale sector units. The later have received technology for general purpose electrodes, SAW fluxes, hard facing and super hard facing electrodes etc. and welding equipments.

0.10 RECOMMENDATIONS

Recommendations with respect to status of technology in the field of welding electrodes and its upgradation, adoption and absorbtion of existing and future technologies in the field are as follows :

- 0.10.1 Due to lack of knowledge of its application and cost economies, to a large extent, higher productivity welding consumables like CO₂ continuous welding wires and flux cored wires fail to find higher demand. In view of this it is pertinent to start vigorous marketing efforts by existing leading manufacturers of consumables and equipments to educate the users.
- 0.10.2 Majority of organised sector units have quite low installed capacities to enable them to use modern machinery set up like computerised batching plant, X-ray florescent tester, etc. The electrode plant manufacturers should arrange these technologies and try to adopt it for lower capacity plants if possible
- 0.10.3 The organised sector manufacturers are adequately equipped for physical part in electrode production. However testing facilities and quality assurance systems are inadequate. Approval of inspection agencies, Indian and foreign, is for limited specific types of electrodes. Quality and reliability of other varieties are dependent on Quality Assurance Systems of the manufacturer. The manufacturers need to be exposed to international practices in Quality Assurance Systems like ISO 9000, which are desirable, in order to face international competition.
- 0.10.4 Erratic supply of rutile and electrode quality steel is affecting capacity utilisation of electrode manufacturers. With full fledged commissioning of IRE, Orissa plant the Rutile shortage is expected to be relieved. Teething trouble of the plant need to be quickly resolved.
- 0.10.5 Electrode quality steel shortage is felt in summer months due to power cuts at major producer plants. It is met by Mini steel plants by non-rimming semi-killed steels but they have higher tramp elements, TISCO has established metallurgy, drawability and consistency of non rimming semi-killed steels. Future trend of concast route of steel production will lead to tramp element free steel from Mini Steel plants. Concast route of steel production should be encouraged.

- 0.10.6 Electrode manufacturers have to deal with 10 to 12 different Indian agencies to get and maintain their approval. Large organised sector units can cope up with it but small organised sector units and SSI units find it difficult. Bigger units get advantage of size while dealing with large number of approval agencies. A centralised inspection agency can go a long way in encouraging SSI units and organised sector units to go in for more approvals.
- 0.10.7 For electrodes for sour gas pipe lines, centralised corrosion testing facility based on NACE standards needs to be put up. It is difficult for any one unit to have such a facility.
- 0.10.8 R & D effort in India for welding electrodes is fragmented among few leading manufacturers and WRI, Tiruchy. Very frequently research effort is being spent on already developed products. Majority of the manufacturers cannot offer to carry out research on their own. Department of Science and Technology, New Delhi has worked out SERC joint funding scheme for cooperative research after deliberations in 1990 seminar on Welding Equipment and Consumables. Details of the scheme are given at Annexure - 17. Department of Scientific and Industrial Research (DSIR) under one of it's scheme Programme Aimed at Technological Self Reliance (PATSER) provide partial support to approved Research, Development, Design and Engineering (RDDE) projects proposed by industry for :

- Absorption and Upgradation of imported technology.
- Indigeneous development of Capital Goods.
- Development and demonstration of new or improved technologies.

Bulk of the financial support to the project is to be from Industry's resources, the Department's support is mainly to meet part of the developmental expenditures for :

- Prototype or pilot plant development.
- Raw materials and components.

- Research consultancy and assistance from National research Organisations.
- Consumables and other operational costs in experimental work and field/users trials.

Electrode manufacturers should take lead role in such schemes.

- 0.10.9 Over the years Electrode manufacturers have not been export oriented. Exports have been less than one percent of total stick electrode production. With new exchange rate of rupee, Indian electrodes are becoming internationally competitive. Electrode manufacturers need to approach Ministry of Commerce, Govt. of India with proposals to get Input/Output norms and Value Addition norms. These are necessary to get export incentives. Priority in quota supply of raw materials like EQ steel and Rutile should be given for requirements of export orders. Exposure among electrode manufacturers to world markets need to be increased by concerned institutions, like EEPC, through seminars etc.
- 0.10.10 Comparison of prices and quality of welding electrode plants of European and Indian plant manufacturers reveal that the former's prices are quite high relative to their quality. Indian plant manufacturers can be competitive in exports if they improve their workmanship, basic engineering and stick to delivery schedules.
- 0.10.11 Majority of the existing small scale manufacturers are not quality conscious and are inadequately equipped in terms of testing facilities. Experts estimate that a fullfledged laboratory would cost around Rs. 20 lakhs. Sophisticated testing and inspection equipment should be arranged by these manufacturers through securing finances from financial institutions and others.
- 0.10.12 Till date there are 11 foreign collaborations in stick electrodes and 5 foreign collaborations in CO₂ wires/FCW wires/copper coated wires. Five of these have been in form of joint ventures. These have proved to be more successful in terms of benefits accrued to the Indian unit. In future, new collaborations can be encouraged for products not manufactured in India like SS flux cored wires, TIG wires, SAW fluxes, special application FCW, etc. Units may critically examine

before entering into any foreign collaboration for electrode of Mild Steel, Mild Steel High Tensile, Low Alloy Low Hydrogen and CO₂ wire. Hard facing electrodes, heat resistant electrodes and stainless steel electrodes available in India fulfil the Indian requirements.

- 0.10.13 Large organised sector manufacturers should work on projects for electrode plant with technology supply to developing countries.
- 0.10.14 National level research effort, in welding in general and welding electrodes in particular should be coordinated by a centralised agency like WRI, Tiruchy. This will help to focus scarce resources better. The funds may be sources from leading fabricators, electrode producers and others and for special projects joint sponsorship of two or more can be considered.
- 0.10.15 In MIG wires, low and high alloy continuous filler material and fluxes both for joining and surfacing need to be developed. Leading manufacturers can take up such development work.
- 0.10.16 In India there is no one point national level testing facility with adequate equipment, trained manpower and national and international recognition. WRI has the first two ingredients. With installation of testing facilities as per NACE standards, WRI can be recognised as National Test House for welding consumables and power sources. A brief writeup on WRI facilities, to work as national Test House is given at Annexure - 18.