

GROWING CONCERN ABOUT HEALTH, SAFETY AND ENVIRONMENT IN WELDING

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ABSTRACT

There are probably not many other crafts with so many risks as are associated with welding and cutting, which ask for continuous improvement and development of an improved working environment and higher safety. At this time we must give high priority to a sustainable environment by reducing the consumption of resources.

These efforts will result in cost savings but can also result in increased sales. In other words the bottom line can be improved by committed actions in these areas

GENERAL

Oscar Kjellberg, the inventor of the coated electrode and the founder of ESAB AB, expressed already in 1904 the importance of health and safety in welding. He wrote :

The execution of work –

The work must be executed with the greatest possible accuracy and the one who makes it, must on no conditions drink alcohol, wine or beer before or during the work. Already after a consumption of half a beer the worker is during the first two hours unable to accomplish a good work, as the visible lightbeams as result of the work seem together

with a small amount of alcohol to cause a paralysing effect.

The importance of good craftsmanship can be illustrated with a repair of ship propeller (Fig. 1).

Since then our knowledge and experience has grown much and we must by all means continue working for an improved working environment for welders and cutting operators. Otherwise we will face difficulties to recruit welders. This matter is judged to be of such an importance by different associations eg European Welding Association that campaign for improvement of image of welder's craft is initiated.

In addition to this a sustainable environment is introduced on everybody's agenda meaning governments, communities, companies, employees and citizens.

Therefore it has become fairly common to use the word environment as a concept for both health and safety in working and a sustainability, which is applied in this paper. An overview of the hazards in welding and cutting and how to reduce the risks and what measures are recommended will be briefly covered. The continual actions for a sustainable world will also be described.



Fig 1 : Repair of ship propeller

Electromagnetic fields

The question of the health hazards associated with electromagnetic fields has still not been fully clarified even though a lot of research has been made. Today this matter is causing more questions than many others are. Precautionary principal and best available technology must be applied for welders, who belong to one of the occupational groups, which are exposed to the highest strengths (Fig. 2).

A great deal can very definitely be achieved by eg :

- Ensure that welding cable and return cables are together whenever this is practically feasible (Fig. 3).
- The best way to protect oneself from magnetic fields from a power source is to have the power source several metres away.

Working environment

Welders and cutting operators are members of an occupational group, which is exposed to a number of different environmental problems.

- Electricity
- Electromagnetic fields
- UV, IR and visible light radiation
- Thermal radiation
- Welding fumes and gases
- Fire and spatter
- Noise
- Ergonomics
- Machine safety
- Laser safety

Electricity

Human beings are extremely sensitive to current that passes through their bodies. Currents of just 20 or 30mA can cause serious physical injury. The effects that

result from the current through the human body also depend on the duration of the route the current takes through the body and the frequency of the current. The choice of the type of current (alternating or direct) during arc welding is important, as risks associated with alternating (AC) are as much as four times greater than those associated with direct current (DC). Special care is required when welding in confined spaces.

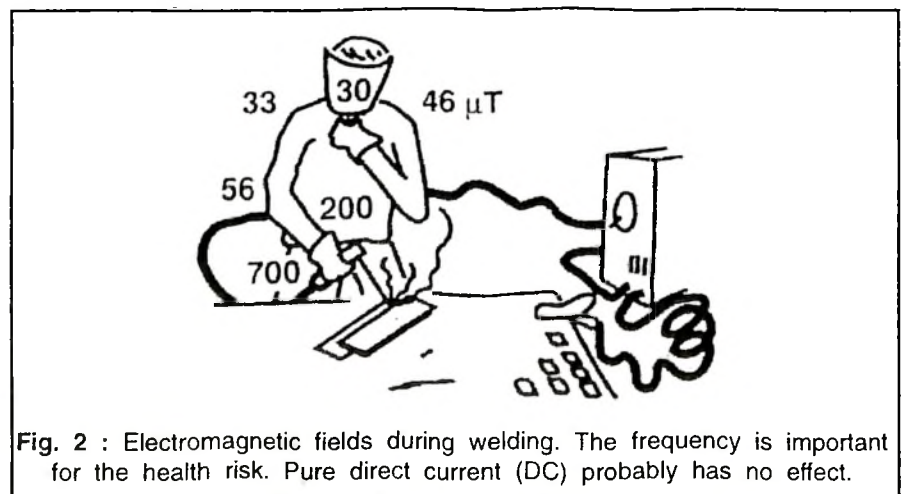


Fig. 2 : Electromagnetic fields during welding. The frequency is important for the health risk. Pure direct current (DC) probably has no effect.

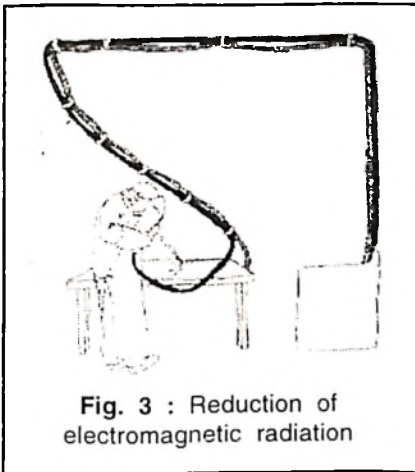


Fig. 3 : Reduction of electromagnetic radiation

- Welding with direct current is preferable to welding with alternating current.

UV, IR, visible light and thermal radiation

Electrical arcs – and molten pools to some degree – give off powerful radiation within the ultraviolet (UV), visible and infrared (IR) wavelengths. This radiation can also be reflected by certain surfaces. Moreover, the flames from a gas/oxygen mixture can emit visible and infrared radiation.

UV radiation is most dangerous for the eyes. It causes what is known as welding flash (a temporary injury to the cornea). Visible light can have a dazzling effect and temporary effect on the vision while the IR radiation can cause damage to the retina and the lens (cataracts). The UV radiation can also damage unprotected skin. The damage resembles stinging sunburn.

Appropriate preventive actions as illustrated in Fig.4 can be :

- A welding screen or welding helmet with a glass visor, which is regulated by liquid crystals or a fixed, standardised glass visor.
- A welding helmet with a window and side guards for use during slag removal.
- Welding overalls or some other protective clothing with a leather apron.
- Leather gauntlets, without rivets or other metal components on both hands.

The thermal radiation is a major problem at welding workshops. This applies in particular when welding is performed at increased working temperatures ie when preheated objects are welded. The measures to reduce the exposure are obvious. The workplace should be well ventilated. The object should have effective thermal insulation. The welder should not be obliged to adopt uncomfortable working positions or to use heavy equipment. Suitable protective equipment, such as heat-insulated gloves, should always be used.

Welding fumes and gases

This matter, which is causing more worry than any other risk in welding,

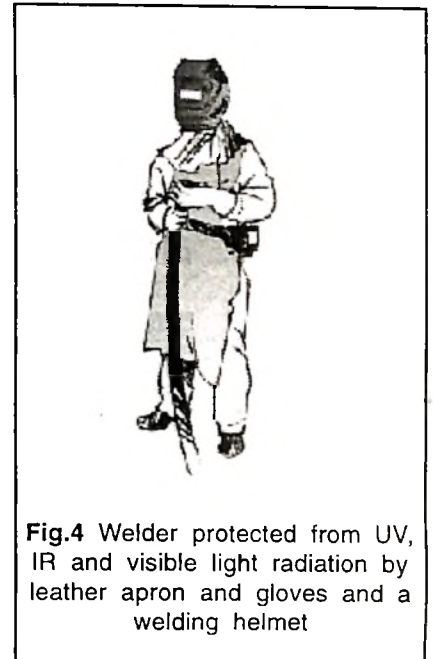


Fig.4 Welder protected from UV, IR and visible light radiation by leather apron and gloves and a welding helmet

has for many years been and still is a major concern for welders and many research institutes and suppliers of welding consumables have dealt with it. There are several substances such as hexavalent chrome, manganese, nickel, lead, iron oxides, zinc, fluorides, ozone, nitrous gases and carbon monoxide, which can cause different diseases or have other negative effects. The IAW Commission 8, which is the main body for discussions, exchange of experiences and findings, standardisation and producing lists with recommended practices, has indeed contributed to a safe and improved working environment. By applying the recommended preventive actions with ie spot extraction, ample general ventilation and in some

to be continued from page 38....



Pipe Cutting and Beveling Machines

Why Use Mathey Dearman Cutting and Beveling Machines?



Hand Cutting
Time : 30 minutes
(includes Measuring, Cutting and regrinding)

Result:
Excessive amount of time to cut the pipe
Inaccurate uneven cut requiring grinding
Extended fit-up time
Uneven weld gap



Machine Cutting
Time : 6 minutes
A CLEAN PRECISE CUT

Result: Perfection

Better.

Faster.



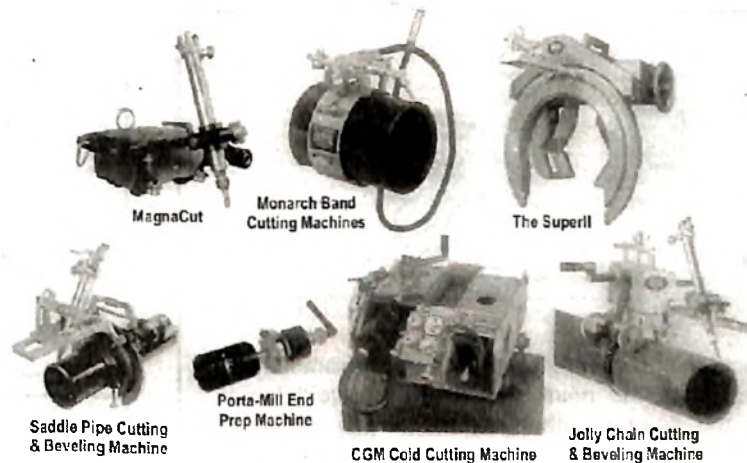
Cheaper.

Mathey Dearman goes one step beyond.

Companies in the world today are faced with the task of finding ways to do things faster, more accurately, less expensively and in a shorter period of time to compete in the market place. Equipment such as automatic welding machines, welding and cutting robots and lasers for cutting and welding were invented to improve welder productivity and accuracy. These pieces of equipment cost thousands of dollars and require many hours of operator training.

The less experienced welder as well as the journeyman welder will improve their productivity, cutting accuracy and cut quality, while reducing grinding time with Mathey Dearman Cutting and beveling equipment. Mathey Dearman equipment requires little or no training of the person operating the equipment. The equipment is designed to operate under the most adverse conditions such as arctic cold and the heat of the desert.

Mathey Dearman goes one step beyond other companies as it offers seven (7) ways to cut and bevel pipe in an attempt to fill every facet of the customer's cutting and beveling needs. ...



Let Mathey Dearman Help You Select the Right Cutting and Beveling Equipment for Your Project.

Please fill out the following questionnaire so that the cutting & clamping experts at Mathey Dearman, Inc. can help you select the right equipment.



Company Name _____
 Your Name _____ Title _____
 Address _____ City / State _____ Zip Code _____
 Phone # (_____) _____ Fax # (_____) _____ Email _____

- Briefly describe what you are trying to accomplish. _____
- How is the pipe currently being cut or beveled? _____
- Please Check (✓) boxes which apply to your application and indicate the number of cut or bevels made a day, month or year.

Please List Pipe Size in (in./mm)	Schedule					Type Material			Type of Cutting				Contour or Miter Cutting the End of the Pipe	Double Cut or Bevel	Number of Cuts Per		
						Ferrous	Stainless or Alloy Steel	Other Non-Ferrous Material	Oxy / Fuel	Plasma	Cold Cutting	End Prep			Day	Month	Year
Example: 6"/152mm	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		<input checked="" type="checkbox"/>			<input checked="" type="checkbox"/>					10		
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>												
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	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>												

- What is your current hourly shop rate? _____
- Type of Material: Seamless Pipe Pipe with Seam Spiral Welded Pipe Plate .
If pipe has Seam or is spiral welded, please list the height _____ and width _____ of the weld. _____
- Pipe condition: Rusty Coated / Dirty Heavily Scarred Out of Round New Painted
- Clearance around pipe: 0"-6" (0-152mm) 6"-8" (152-203mm) 10"-12" (256-305mm)
Clearance is no problem Other (Please list and specify whether inches or millimeters.) _____
- Clearance along pipe Outside Diameter : 0"-6" (0-152mm) 6"-8" (152-203mm) 10"-12" (256-305mm)
Clearance is no problem Other (Please list and specify whether inches or millimeters.) _____
- What is most important to you? (Please indicate the order of priority with (1) most important and (7) the least important.)
Versatility Weight Ease of Use Minimum Set-up Efficiency Accuracy Cost
- What is the barrel diameter of the Oxy-fuel or plasma torch with which you are working? 1.3/16" (30mm)
1.3/8" (35mm) Other (Please list and specify whether inches or millimeters.) _____
- Are you cutting these parts to make a code weld? Yes No
If for a code weld, please specify whether for : ANSI AWS ASME Other (Please list.) _____
- What types of power are available: 110vdc 110vac 230vac Air Pressure: 100psi or 200psi Hydraulic None
- This inquiry is for: Immediate Purchase Future Project General Information
- Would you like a factory representative to visit you to discuss the project or demonstrate the equipment? Yes No
- What is the best time to call? _____
- Would you like to be kept informed about new products? Email Fax Mail



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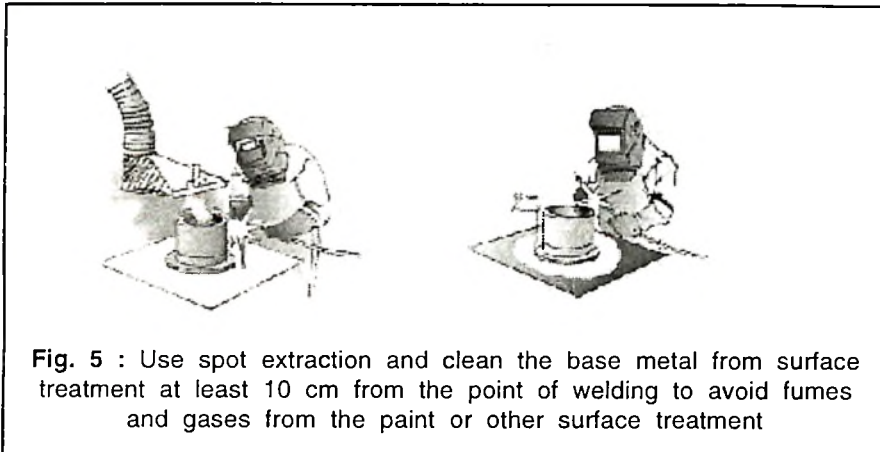


Fig. 5 : Use spot extraction and clean the base metal from surface treatment at least 10 cm from the point of welding to avoid fumes and gases from the paint or other surface treatment


 SAFETY DATA SHEET The Safety Data Sheet complies with European Community Directive 93/112/EEC, (CEC No. 1/91) and ISO 116 47 1993/03		Page 1(2) Part number: S 2402 Date: Jan 28, 1999 Product: UK 6515
1. PRODUCT AND COMPANY IDENTIFICATION Product identifier: Easy Stainless Steel Electrode Application and the: All welding Trade name/Synonym: TP 6211 Classification: AWS A5A 14-07 ER308L EN 506 (EN44) E 308L EN 506 (EN44) E 308L (EN 506) EN 506 (EN44) NFAR 300 HZ 13B Other numbers: EN 506 (EN44) E 308L Manufacturer/Supplier: Esab AB, Box 8004 SE-771 88 Grönberg, Sweden		
2. COMPOSITION INFORMATION ON INGREDIENTS This product is a preparation of base wire with surface coating. The following components are defined in accordance with paragraph 2 (a) of the Commission Directive 1977/249/EEC Annex (1)X threshold limit values according to ACGIH, 1976.		
3. FIRE FIGHTING MEASURES No specific fire-fighting measures. 4. ACCIDENTAL RELEASE MEASURES Personal protection: refer to section 8 Environmental precautions: refer to section 12 Methods for cleaning up: refer to section 12 5. HANDLING AND STORAGE Handling: Avoid exposure to welding fumes, radiation, spatter, electrical shock, heated materials and dust. Do not ingest. Handle with care to avoid sharp and cut. Spooled wire can spring. Storage: Keep separate from chemical substances like acids which could cause chemical reactions.		

Fig. 6 Safety Data Sheet

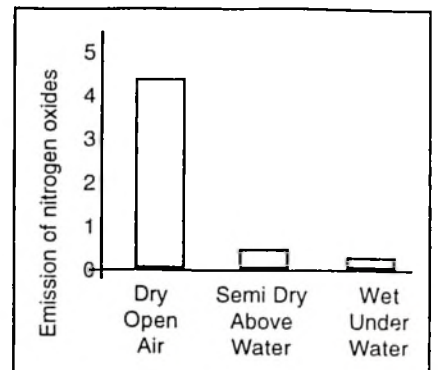
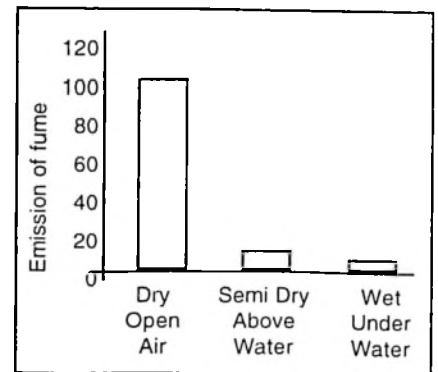


Fig. 7 Relationship between emission of fumes and oxides of nitrogen gases when plasma cutting of stainless in open air, above water (60mm) and under water (75mm)

cases breathing protection the risks are minimised or completely eliminated (Fig. 5).

Most harmful substances have occupational exposure limits (OEL), which are regularly revised. OEL specifies the average concentration, which does not normally represent a health risk during eight hours of work a day. A maximum exposure limit or short-term limit value is also specified for certain substances. Material Safety Data Sheets (MDS) are also available (Fig. 6). On these the manufacturer has 16 points, in

which to provide a detailed description of ways of protecting oneself from injury, for example.

Cutting fumes and gases

The cutting process generates a lot of fumes and gases, which requires precautionary measures. Fig.7 shows the difference in exposure to these with different set-ups when plasma cutting stainless.

In addition plasma cutting in open air is a very noisy process 125 dB (A), which level exceeds N-85 – an

allowable noise level for 8 hours daily exposure without damaged hearing. Cutting under water reduces the noise below N-85.

Fire and spatter

In some cases, the spatter produced by welding and cutting can cause discomfort and even burns. One example is when large drops of spatter fall into wooden clogs. The risks increase in connection with overhead welding or if the welding is performed in confined spaces, where the welder may even have to



Fig. 8 : It is important to protect fire sensitive things where there is a risk of fire when welding

lie down to obtain better access to the object he is welding.

Welding is still a major cause of fires, which are mostly result of lack of knowledge, carelessness and insufficient protection. Continuous training and information about effective protection programmes are essential in this context (Fig. 8).

Noise

The noise level in welding shops is high caused by MIG/MAG welding (<80dB), straightening (~40dB), heavy grinding (~110dB) and other applied manufacturing processes (Fig. 9).

Precautionary measures are recommended. Appropriate ones can be eg

- Use of ear protectors
- Screen off of noisy use of ear work
- Use of quieter tools

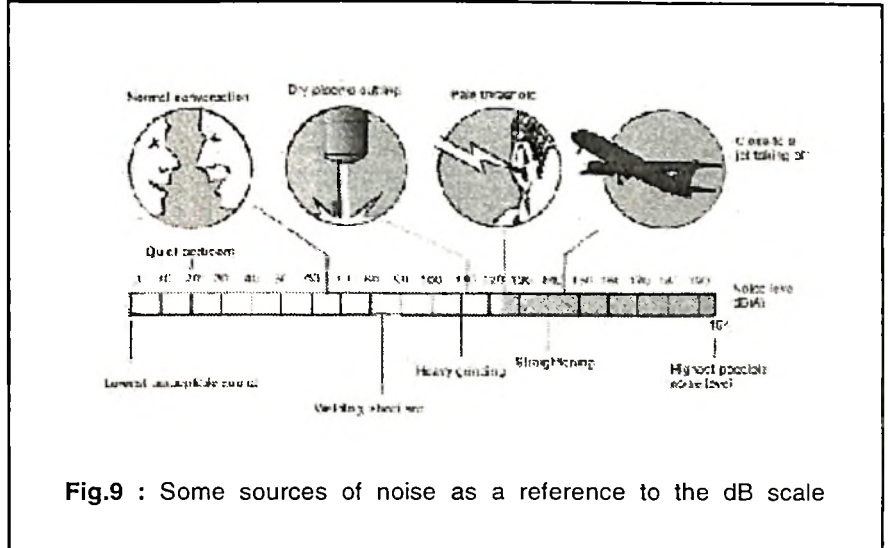


Fig.9 : Some sources of noise as a reference to the dB scale

- Elimination or minimised use of grinding

Ergonomics

When welding heavy material and during assembly welding the loads are very static. The welding times are longer and the weight of the equipment is greater. In addition, the working position in this case is dependent on the position of the weld joint. Overhead is unsuitable from an ergonomic angle. To reduce the burden a load reducing counter balanced arm can be used (Fig. 10). Lifting the hoses off the floor also protects them from wear and tear, as well as facilitating wire feed.

It is also a good thing if the workpiece is placed in a positioner and is positioned to ensure the best accessibility and height. Most of the risks associated with welding and mechanising these processes can eliminate cutting.

Machine safety

The moment we begin working with machines with moving parts, like robots or cutting machines, we must be aware of the possible risk of personal injuries. The machine directive prescribes that best available technology for the safety is applied and that a risk analysis is made and documented before the work station is put in operation. Otherwise one cannot CE-mark the station.

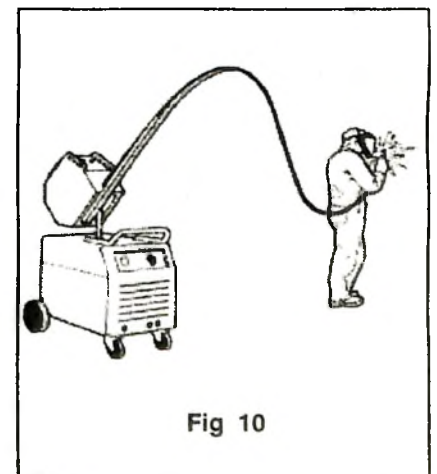


Fig 10

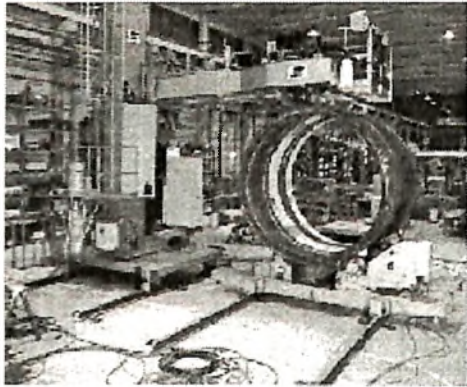


Fig. 11 : Railbound column & boom and roller bed for welding of cylindrical objects



Fig. 12 : The shielding must provide constant protection from leakage radiation and from danger in the unlikely event of a breakout of the laser beam

Fig. 11 shows an advanced welding station requiring careful planning.

Laser safety

The direct laser beam and indirect, reflected radiation constitute a special risk. Special requirements must be met and special actions must be taken to protect the operators such as protective screens (Fig. 12), protective clothing and laser goggles. The people, who are involved in maintenance and settings, must be given special training.

Sustainability

Our environmental awareness has increased significantly in recent years and we are all caring about a sustainable environment through different actions. Companies are as well giving higher attention and priority to environmental issues not only to meet the increasing legal

requirements but also to improve their profitability by

- Improving the energy efficiency
- Reducing the energy consumption
- Using renewable energy sources
- Reducing waste
- Elimination of non-products eg packaging
- Labelling items in products to simplify a safe recycling and disposal of it
- Starting reusing items in scrapped products
- Reducing the environmental impacts of products by applying LCA – Design For Environment (DFE)

To know your own position you have and progress you make one has to start

- Measuring

- Monitoring
- Screening
- Comparing
- Benchmarking

A prerequisite for a success with an environmental mission is the commitment and involvement by the top management. Few examples will be described.

Energy efficiency

By careful choosing of a welding power source you can reduce your energy consumption (Fig. 13) due to the different efficiencies they have.

Open circuit losses amounting to about 1kW for a converter to be compared with 300-400W for a rectifier resp 50W for an inverter.

Energy consumption

It has proven very beneficial to benchmark manufacturing units to find the highest potential for

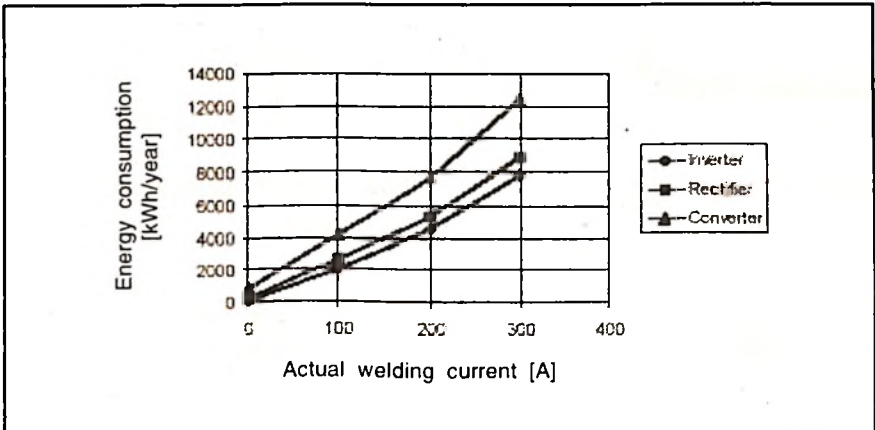


Fig. 13 : Energy consumption per year at an arc factor of 35% as a function of welding current for an inverter, rectifier and converter with electrical efficiencies $\eta = 0,85, 0,75$ resp $0,55$

Waste reduction – non-product output

Although the amount of waste is reduced in the same accounted factories the waste cost is increasing, which trend is expected to continue (Fig. 15).

The latest approach to non-product output (NPO) for accounting waste is to include all material not contributing to the use of the product as illustrated below (Fig. 16). Typically NPO makes up 30-50% of total output by mass and causes 5-15% of total cost to go down the drain.

improvements. Not only the energy consumption has been reduced by careful planning of the sequence for manufacturing of welding consumables but partly also by

reducing the cost for energy (Fig. 14).
The annual savings between 1996 and 1997 amount to US\$ 1,5 million.

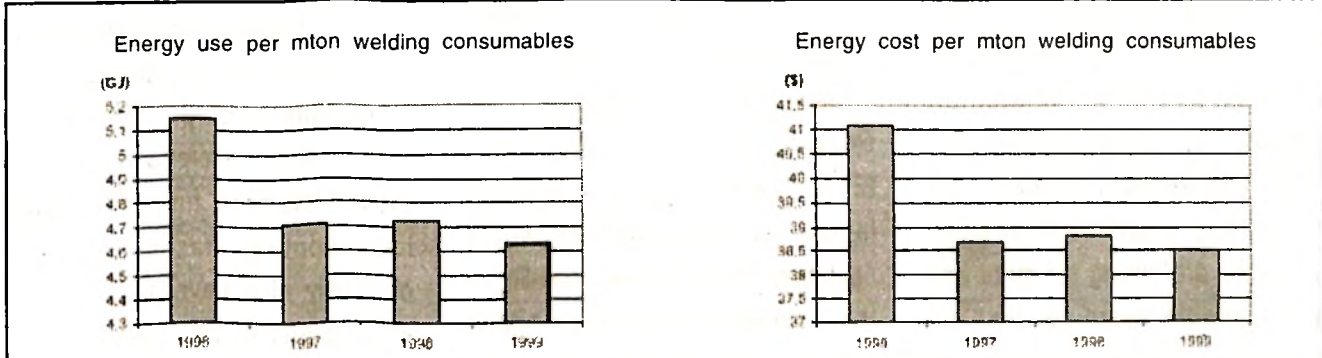


Fig. 14 : Average energy use and cost per metric ton manufactured volume of consumables for 14 factories

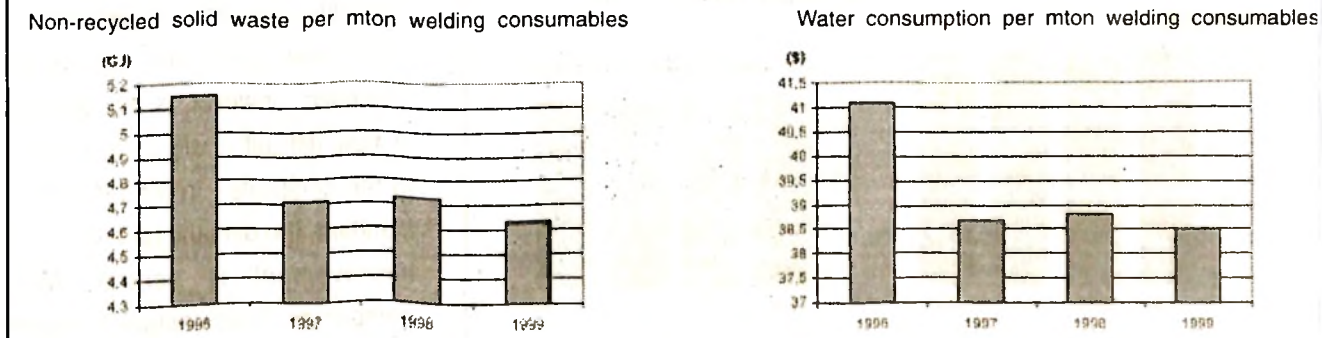


Fig. 15 : Average amount of solid waste and cost per metric ton to dispose of.

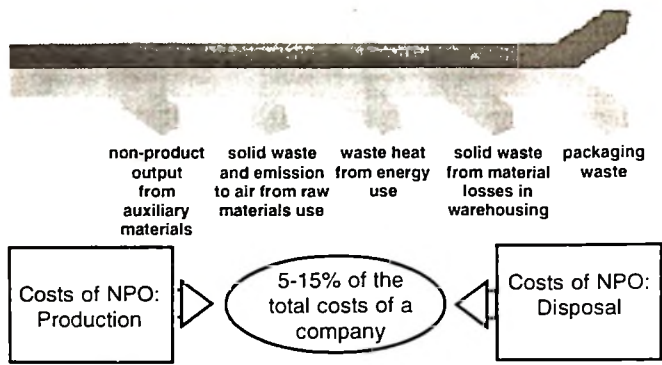


Fig. 16: There is a great potential for cost saving by reducing amount of waste

Packaging material

Welding companies at least in Europe are becoming more concerned about the amount of packaging material due to the time to open the packages and to handle the packaging waste. For the manufacturer of consumables the cost is the second highest after raw materials. The negative trend in Fig. 7 is addressed but there are contradictory requirements to meet. Authorities are asking for more and till readable warning text on

packages, eg about content of Mn in Italy.

The European Commission is considering scrapping recycling targets for packaging wastes and replacing them with an absolute limit. On the amount of packaging going to landfill, a European Union industry organisation, the European Recovery and Recycling Association (ERRA) said in December 1999 that landfill diversion targets would contribute more to sustainability of the packaging chain than higher

recycling targets. Such a change of the packaging law will definitely have an impact on our business.

Environment management system ISO 14001

Two years ago no company in the world demanded of their suppliers to implement Environmental Management Systems. About a year ago, pioneers like IBM and Volvo went down this path. This autumn they are followed by some of the largest companies in the world. This will have a significant impact on the pace of EMS.

Implementations, especially in North America where less than 550 ISO 14001 certificates have been issued, General Motors alone have about 5000 suppliers that could be forced to implement EMS's. Those who wish to remain preferred partners to their customers had better start implementing fast. This will obviously also have an impact on welding and cutting business

In a few years time ISO 14001 certificates are likely to become as common as quality certificates. A big difference, however, is the question of how difficult it will be to hold on to the certificate? In the ISO 14001 standard, the demand for continuous improvement is central. Most companies have included targets regarding suppliers in their EMS's.

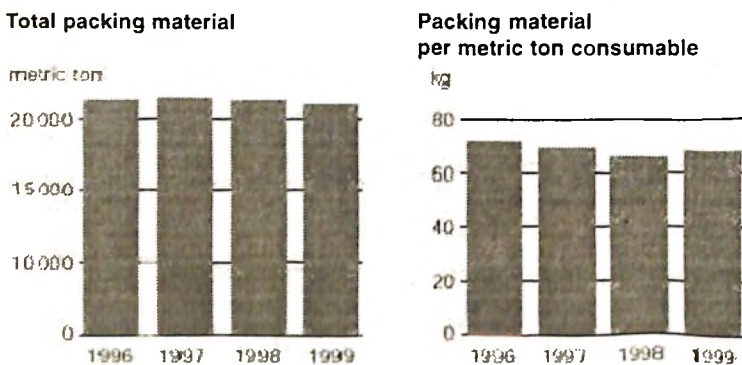


Fig. 17: Packaging material for consumables

A typical target for the first certification period would be to evaluate suppliers and encourage them to implement EMS's.

The problem is that the standard is now three years old and the certification period is also three years. This means that in the next year more than two thousands of companies will have to set new sharper targets regarding their suppliers' environmental performance. Ford is asking the suppliers to have at least one of their manufacturing sites ISO 14001 certified before the end of 2001 and all units by July 1, 2003.

EM's Worldwide Purchasing, who wish to have their vendors' implementation of EMS accomplished by the end of 2002, will also accept a registration to the European Union Eco-Audit Scheme (EMAS) as demonstration of EMS implementation. GM also will accept a written declaration by a responsible executive that a site is operating under an EMS that is in conformance with ISO 14001.

This requirement of certified implementation of EMS will definitely get the development (Fig.18) of ISO14001 certification to sky rocket and we in the welding business must immediately start implementation of EMS if we have not made it.

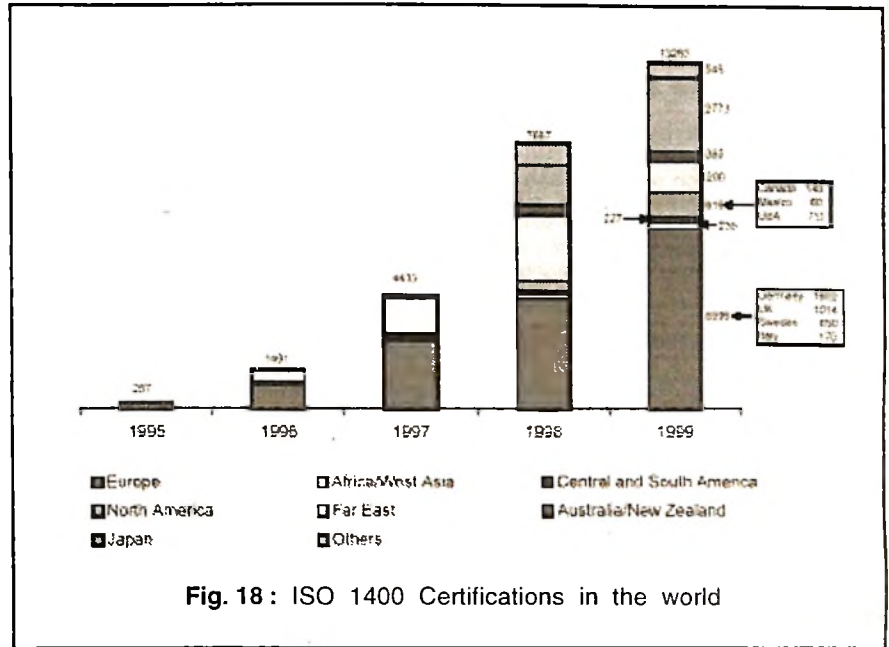


Fig. 18 : ISO 1400 Certifications in the world

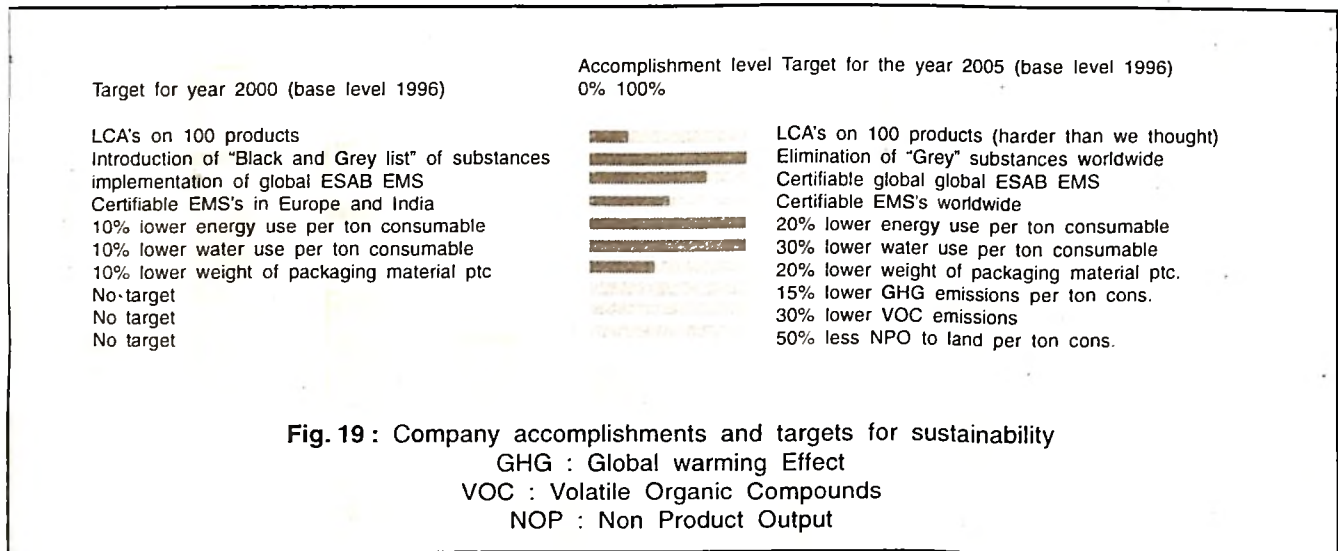
Environmental reporting

The number of issued environmental annual reports by companies is growing fast, but we have so far not seen many in our business. The core messages in these reports to the stakeholders, customers, employees, shareholders and society cover environmental impacts caused by the company, environmental exposures and liabilities, environmental related investment. The report is a means to environmental improvement and greater accountability, not an end in itself.

There is a growing focus on verification of environmental benchmarking, environmental performance indicators, full cost accounting and sustainability. The

more developed companies from environmental point of view are introducing the Triple Bottom Line organisations, both governmental and others, are starting to use a combination of environmental, economic and social aspects as criteria for sustainable development. In summary it means that the society depends on the economy and the economy depends on the global ecosystem, whose health represents the ultimate bottom line.

We are not yet there with our reports, but we need to start now issuing basic environmental reports and gradually develop these to include the triple bottom line approach and set objectives for sustainability to get things done.



CONCLUSION

We must continue working relentlessly for an improved working environment and increased safety to attract young people to the welding and cutting business which is estimated to employ about two and half million welders in the world. The total number of employees is many times greater.

We are all interested in a sustainable environment and we can contribute. In addition there is a great cost saving potential and a business opportunity to grasp.

We in IIW have a mission to advise and help the welding business to enter the right track.

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PCN NDT, CSWIP WELDING INSPECTOR & BGAS PAINTING INSPECTOR COURSES & EXAMS

Venue & Dates in 2001 :

MUMBAI : 15-19 October, 2001
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CHENNAI : 10-14 December, 2001
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