SHIELDING GASES FOR GMA & GTA WELDING

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The function of shielding gases in GTAW (GAS TUNGSTEN ARC WELDING) and GMAW (GAS METAL ARC WELDING) processes and their applications, alongwith brief introduction have been discussed here to enable the user to critically assess the shielding gas requirements for given application and the key areas the emphasis are to be made for higher productivities.

INTRODUCTION

It is often considered that the function of a shielding gas is merely to displace the air from the weld zone and thus prevent weld contamination from Nitrogen. Oxygen and water vapour, which may cause variety of defects and put impurities into the deposited weld metal, in fact, the gas not only, provides a protective blanket over the weld area but also effects arc stability, Weld bead shape, weld mechanical properties process efficiency and fume formation.

Function of Shielding Gas

The principal functions of the gas can be considered under the following heading.

a. Physical characteristics

b. Shielding Efficiency

c. Arc Stability

d. Weld Geometry

e. Weld metal property

Physical Characteristics

Six gases i.e. Argon (A) Heliumn (He) Carbon-di-oxide (CO_2). Hydrogen (H_2), Nitrogen (N_2) and Oxygen (O_2) are the principal shielding gases. Selecting the best shielding gas or mixture for a given job initially depends upon the welding process. Certain gases are not compatible with certain mode of melten metal transfer through welding arc. For example, spray transfer or free light transfer of freelight transfer will not occur with a sheilding gas of pure CO_2 or pure Helium. Spray transfer requires a larger amount of Argon in shielding gas usually above 75 to 80%.

A deeper understanding of the physical characteristics of the shielding gas will help to guide the proper selection of the gas/gas mixture.

Material	Gas	Compatibility
Plain carbon steel and	Argon & helium	No reaction
low alloy steel	CO_2 and oxygen	Slight oxidation of alloying elements
	Hydrogen	Porosity and HICC risk
	Nitrogen	Porosity and loss of toughness
Austenitic stainless Steel		
	Argon, helium	No reaction
	H_2	Reduces Oxide
	O_2	Oxidising
	CO_2	May cause carbon pick up
Aluminium and alloys	Argon helium	No reaction
	H_2	Gross prorsity
	O_2	Oxidising
Copper	Argon helium N_2	No reaction
	H_2	Porosity
Nickel	Argon helium	No reaction
	N_2	Porosity
Titanium	Argon helium	No reaction
	C_2, N_2, H_2	Embrittlement

Fig. 1 Shielding Gas / Material Chemical / Physical Compatibility

Element	First Ionisation Potential (Electron Volts)
Argon	15.75
Helium	24.58
Hydrogen	13.59
Nitrogen	14.54
Oxygen	13.61
Carbon dioxide	---

Fig. 2 : Important Physical Constants of Shielding Gases.

Ionization Potential

Ionisation potential can be defined as the voltage needed to remove an electron from an atom of the shielding gas, turning the atom into an ion. A cloud of ions in an electrically charged gas is called plasma.

For example, Argon requires a low ionization potential of 15.75 electron volts to remove the first electron from the Argon atom and only 27.6 ev to remove the second electron. By virtue of this, Argon easily forms a plasma, which works like an electrically charged path that encourages the welding current to travel from the electrode to the work piece. Helium, on the other hand, requires 24.50 (ev) to remove one electrode from one atom and 54.4 (ev) to remove the remaining electron from the atom. Thus, Helium shield welding produces a less stable arc which make the weld puddle difficult to control compare to Argon or Argon mixture.

Higher ionization potential, higher the voltage requires for initiating the arc. The higher arc voltage of Helium gives an intensive arc with higher heat input and high fluidity of the weld puddle and thus produces welds of good integrity.

Thermal Conductivity

The Thernal Conductivity of gas is defined as the ability of a gas to conduct heat. A gas with good thermal conductivity helps to conduct heat to the work piece. The degree of the conductivity influences the shape of the bead and the conduction of the metal next to the weld in the heat effected zone.

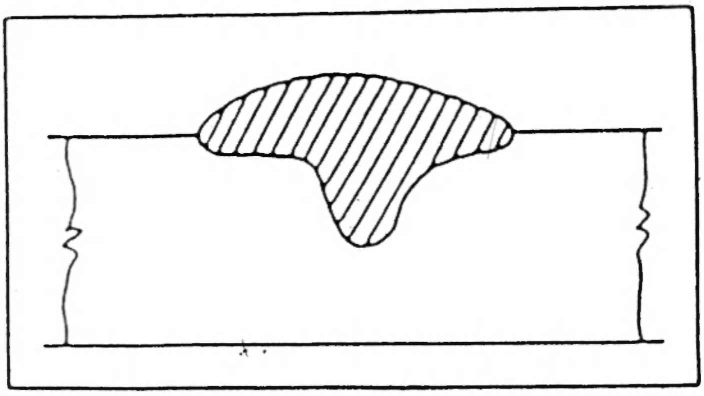

Fig. 4 : 'Finger' or 'Wine Glass' Penetration profile

Helium for example, has excellent thermal conductivity. In GTAW or as an additive in GMAW with Helium, the arc column broadens due to heat and spreads the heat to make a wide, smooth bead Argon on the other hand, has lower thermal conductivity which makes the arc column narrower resulting in narrower weld bead. But since the heat is concentrated in the narrowed arc column, the Argon Shielded Arc "digs in" more and produces deeper weld with "finger" shaped root.

Carbon-di-oxide with its thermal conductivity in between that of Argon & Helium produces a weld bead between this two shapes.

Gas Density

Density is the weight per unit volume to the gas. A heavier shielding gas will provide better coverage at an equal flow rate than a lighter or low density gas. For example, Argon which is $1\frac{1}{2}$ times heavier than air and 10 times heavier than Helium requires one half to one third the flow rate of Helium to do the same work.

The density of Helium is 0.178 KG per cum at 30°F and 14.7 PSI in comparison with 1.3 kg per cum in case of air under the same condition. Hence, flowrate of Helium must be two to three times higher. One exception is during overhead welding, where the tendency of helium to rise helps in good shielding of the arc.

Gas	Density (Kg/m^3)
Argon	1.784
Helium	0.178
Hydrogen	0.083
Nitrogen	1.161
Oxygen	1.326
Carbon dioxide	1.977

Fig. 5 : Density of Common Shielding Gases

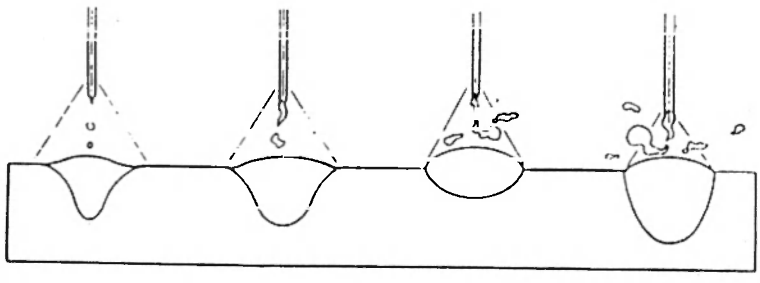

Fig. 3 : Bead Control and penetration Pattern for Various Shielding Gases.

Dew Point

Dew point of gas is a temperature at which the moisture in the gas would condence out as water vapour on a mirror at that temperature in front of the gas following from the cylinder. Therefore, the dew point of the gas is equivalent to stating how much moisture it has in it. It's measure of its purity. Shielding gases for welding must be very dry because of any moisture in the gas will turn into hydrogen and oxygen when it passes through the welding Arc. The hydrogen specially can be very destructive

Dew point	% moisture
$0^{o}F$	0.059
$-20^{o}F$	0.021
$-40^{o}F$	0.0065
$-60^{o}F$	0.0048
$-80^{o}F$	0 0030

Fig. 6 : Relation of Dew Point with % Moisture Content in Shielding Gases

The expression other than dew point most commonly used for dry gases is parts per million or p.p.m. For example the gas with a dew point of $80^{o}F$ would have only 30 ppm water vapour or moisture. Argon used as shielding gas in GTA welding should have a minium purities of 99.996% with maximum of 10 ppm and in case of Helium, the moisture content should be less than 15 ppm. At this purity levels differences in the kind and amount of impurities usually cannot be detected during welding Steels and copper alloys have high tolerances for relatively large amounts of contaminations. Aluminium and magnesium alloys are sensitive of purity level and still others such as titanium and zrconium have extremely low tolerances for foreign constitutents in the inert gases. Higher purity standards are to be maintained to ensure that shielding gases will be more than adequate for most severe applications. Carbon-di-oxide used for welding should be produced to a dew point of $40^{o}F$ maximum or less than about 120 ppm moisture. Because CO_2 Shielding is used only for GMA welding of steels, a relatively low purity level is adequate. However the "soda fountain" variety of CO_2 should not be used for welding since it can cause porosity or poor weld metal mechanical properties.

Shielding Efficiency

The chemical and physical properties of a gas will govern its shielding efficiency. The shielding gas should prevent the undesired reactions occurring between the weld metal and the surrounding atmosphere. In GTAW process, it is also required to protect the tungsten electrode from contamination also to prevent adverse reaction between the tip of consumable, metal droplets and the arc environment.

The common reactive gases which may pose problems are Oxygen, Nitrogen and Hydrogen. Most of the metal from oxides when heated in an oxidising atmosphere whereas Nitrogen may form insoluble Nitrides with the reactive metals (Ti, Ta, V & Nb) and soluble compounds with some common metals (Fe, Mn, & Cr,) Hydrogen is soluble in most of the metals but does form compounds with more reactive metals such as (Ti, Zr, & Nb etc.). In the weld pool the gas metal reactions may result in the solution of very high levels of Hydrogen and Nitrogen, but due to the low solubility of these gases in the solid materials, the excess gas evolves during solidification. If the gas bubbles are nucleated during solidification, these are normally trapped to form porosity. This effect will depend on the solubility of the gas in the metal being joined. The risk of porosity is indicated by the equilibrium solubility curve.

It is often found that the amount of gas dissolved is often greater than the

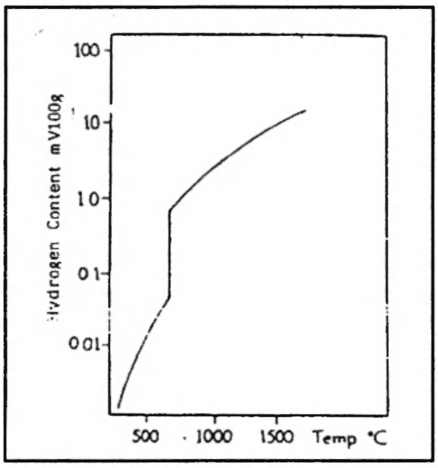

Fig. 7 : Equilibrium Solubility of Hydrogen

expected under equilibrium conditions for non arc melting. In addition, the solution of gas may be influenced by alloying elements within the material or other gases in the arc (e.g. oxygen and hydrogen have a significant influence on the solubility of Nitrogen in steel).

Oxidising effects are also responsible for loss of alloying additions and the formation of oxides inclusions while it is observed that some oxygen is beneficial for the stability of the arc while presence of oxygen in excess may lead to a deterioration in weld metal. The viscosity and the density of the shielding gas will determine the ability to maintain a lamillar gas flow to achieve the efficient gas coverage, while turbulence in the shielding gas flow is undesirable which leads to increase amount of entertainment of contaminants.

ARC Stability

In GMAW process, the potential stability of the arc is indicated by the dissociation potential and ionisation potential of shielding gas. The lower ionisation potential indicates the possibility of improved Arc Stabilities. The ionisation is maitained by high temperature in the core of the arc and thus in turn is affected by the thermal conductivity of the gas. High thermal conductivity may result in reduction in arc core diameter and an increase may result in reduction in arc core diameter and an increase in voltage. For example, the overall arc voltage in Helium shielded arc may be double than in an equivalent Argon shielded arc at 300 Amps.

Arc stiffness - Another phenomenon related to Arc Stability, is indicated by the force generated between the electrode and work the piece which is also effected by the shielding gas (For example, the arc force at the centre of the arc is much less in case of Helium rich gas mixture, which effects stability of the arc in lower welding current). In GMAW process the arc root behaviour at the electrode end has a significant effect on process stability. It was observed that a fractional addition of oxidising gas to the inert shield reduces the wondering of the arc root and improve the stability. CO_2 additions of more than 15 to 20% in Argon tends to increase the level of spatters and decrease the arc stability in lower current range.

Weld Geometry

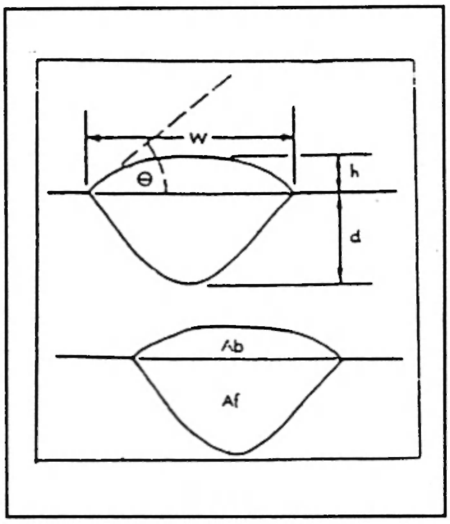

Fig. 8 : Weld Bead Geometry

$$\text{Dilution} = \frac{AF}{Ab + Af} \times 100\%$$

W - Width, h - Height of reinforcement

d- depth θ- Wetting angle

Ab - Reinforcement area

Af - Plate fusion area

The weld bead geometry may be defined as shown in Fig (8). The shielding gas has a pronounced effect on the bead geometry in both GTAW and GMAW processes. The total fused area is increased at equivalent current by using gases which increase the arc energy although the shape of the dilution and the reinforcements is influenced by the type of Shielding gas and the material used (e.g. an addition of He, H_2, O_2 and CO_2 to Argon).

Argon produces a pronounced finger or wine glass penetration profile whereas Helium/Argon mixture would produce a much more rounded weld bead with increased depth. The profile of the reinforcement of the weld can also be improved with correct shielding gas selection. Weld beads with lower levels of reinforcement can give substantial wire savings and are especially important with expensive consumables such as Low alloy steel. Stainless steels and Aluminium.

Weld Metal Properties

Although the weld metal properties are controlled by the chemical composition of consumables, the shielding gas influences the ultimate strength of the joint to large extent in the following ways.

- Control of porosity.
- Control of fusion characteristics & alloying element recovery.
- Control on Microstructure.

Porosity

Causes a loss in cross sectional area which may limit the joint property. Porosity can be controlled by selection an appropriate shielding gas and ensuring that suffucient purity of the gas mixture used for shielding is maintained.

Fusion characteristics & alloying element recovery

Fusion defects may be minimized by selecting a gas which gives improved tolerance to other process variables and an increased heat input. Alloying elements are also lost during metal transfer in GMAW process. Not only the reactive metals (e.g. Ti and Zr.) be affected, but also the level of elements which significantly affect the weld metal property may also be reduced. The final recovery of the alloying elements will depend on the oxidising potential of the gas and the shielding medium when determining the consumable composition for maximum recovery.

Microstructure

The final weld metal micro-structure may also be influenced by the shielding gas as a result of its effect on weld metal composition. For example, it is found that with the ferritic steels, an improvement in toughness may be produced by increasing the oxidising potential of GMA Shielding Gas. It is believed that this is due to the nucleation of fine grained acicular ferrite. Excessive of oxide inclusion levels may be generated if CO_2 and O_2 levels are increased abnormally and this will result in a deterioration in weld metal toughness due to "decohesion effects"

Application of Gases

GTA WELDING

Argon : Argon is most commonly used shielding gas for TIG welding. Most is used for joining Aluminium and Stainless Steel. Argon is preferred for manual welding. Because it is easy to use. It offers the operators greater manipulative flexibilities because of its lower arc voltage characteristics. In addition, Argon provides superior Arc starting. For AC welding applications, Argon is better than Helium because of superior cleaning action, weld appearance and weld quality. Argon is also used for mechanized TIG welding.

Helium : Helium is used primarily for high speed machanized TIG welding of light gauge material such as tube mills and for TIG welding of high con-ducitivity and refractory alloys. Helium is mostly used in (DCSP) mechanized TIG welding of aluminium in a number of areas in space applications. Such welds are deeply penetrated and of high integrated quality. These weld joints must be carefully cleaned prior to welding and it is advisible to use solid state control equipment to control the short buried Arc.

Argon - Helium Mixture

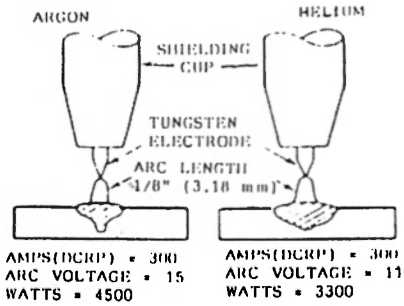

Fig. 9 : Increase of Heat Input with Different Shielding Gases

These mixtures are used to increase the voltage and heat input of TIG Arc while maintaining the favourable characteristics of Argon. Helium-rich mixtures are preferred in order to achieve significant benefit from the Helium. The most commonly used mixture contains 75% helium. Fig. (9) shows the substaintiai increase in heat input and weld penetration. Additions helium less than 50% have little influence on the arc characteristics. The commonly used mixture of Helium / Argon is in the proportion of 75% and 25%. The speed and quality of AC welding in Aluminium can be improved with this type of mixture with cleaning actions almost as good as with pure Argon. These mixture is sometimes used for manual welding of Aluminium pipe and mechanized welding of butt joints in Aluminium sheet and plate. It is also used for hot wire TIG applications to increase the deposition rate. To maintain the good Arc behaviour of Argon and as well as to achieve the heat input characteristics of Helium, a mixture of (90/10%) Argon & Helium is used occasionally for DC manual TIG Welding.

Argon- Hydrogen Mixture

Argon Hydrogen mixtures are employed in special cases, such as mechanized welding of light gauge stainless steel. Increased speeds can be achieved in almost direct proportion to the amount of Hydrogen added to Argon.

However, the amount of Hydrogen that can be added vaies with the metal thickness and type of joint on each particular application. Excessive Hydrogen will cause porosity. Hydrogen concentrations of 33% can be used on all thickness of stainless steel provide the gap between the weld joint is within 0.010 to 0.020 inch in the fabricating Industry. The most popular mixture is Argon + 15% Hydrogen. This mixture is most often used for welding tight butt joints in stainless steel upto 0.062 inch thick at a speed which can be as high as 50% faster than Pure Argon. This mixture is also used for welding of Stainless Steel beer - barrels and tube-type sheet welds in a variety of stainless steels and nickel alloys. A hydrogen content of 5%, is sometimes preferred for normal welding to obtain clear appearing weld.

Helium - Hydrogen Mixture

Since hydrogen addition in Argon improves the performance of Argon one would expect that He - H_2 mixture should be advantageous too. Although H_2 increases the voltage gradient of the arc, no significant speed increases have been observed for mixtures containing substantial quantity of Hydrogen. A 5% H_2 mixture, however, is used in several stainless steel tube mills primarily to obtain an oxide free weld surface.

Nitrogen mixtures

Because of its low cost, relatively inert behaviour, and greater conductivities, attempts have been made to utilize nitrogen as shielding gas. The success have been achieved for DCSP TIG welding of copper and copper alloys with Nitrogen shield. On some grade of austenitic stainless steel. N_2 upto 15% addition in Argon can be used but the welding speed will fall substantially.

GMA Welding

CARBON - DI-OXIDE (CO_2)

When CO_2 is used as shielding gas for dip and globular transfer i.e. the limiting current upto 250 Amps, a good steady arc is obtained with good fusion characteristics. At higher current, MAG welding accomplished by a non axial type of globular metal transfer produces a great deal of spatter. To reduce the spatter, buried Arc Technique is used where the welding wire is captured in the deep weld pool post. Argon and O_2 or Argon & CO_2 mixtures exhibit less spatter. To achieve the best weld quality with CO_2, highly deoxidized consumables should be used.

CO_2 as a shielding gas is also used in conjuction with flux cored wires. This process of welding commonly known as FCAW process and allows the advantages of reduced spatter, easier weld puddle control, lower smoke and generally better all round performance.

Argon :

On ferrous metal, Argon alone does not exhibit adequate arc stability during welding. This causes poor shaped beads and undercuts. Addition of CO_2 or O_2 to Argon overcomes this difficulty.

Argon - Oxygen Mixtures :

1 to 2% Oxygen mixture in Argon provides better welding of the arc, improves the drop rate of the globules and provides good weld bead coalescence and appearance of the weld bead. It is sometimes preferred for apray welding of stainless steel at high speeds. In case of alloy steel welding, the corrosion resistance and mechanical properties of the welds are found to be better than welding with higher content of O_2 in Argon. 2% Oxygen mixtures are sometime used for spray welding of carbon steel when weld surface is oxidized and to minimize the slag information 3 to 5% O_2 in Argon mixture are normally used fro spray Arc welding of mild steel. These mixtures generally give the best all round arc stability 6 to 12% O_2 in Argon mixtures are also used by some fabricators. The higher oxygen potential of these mixtures increases suface slag and requires higher alloy content wire to ensure sound welds with adquate mechanical properties.

Argon - Carbon Dioxide Mixtures :

Small additions or carbon dioxide to Argon produce about the same effect of MIG welding as with Argon & O_2 mixture. These type of gas mixture can be classified into three categories.

Low CO_2 Content (1 to 4%) in Argon

This mixture is characterised to produce a weld distinctive fingure type penetration profile. This mixture gives stable low spatter arc and allows pulsed Arc technique although the Pulse Arc welding are a suitable to the positional welding of thin sheet by dip transfer technique which gives low heat input and more risk of fusion defects on thicker material. In addition, the application of these mixture for multipass spray transfer welding of thicker sections is limited since the formation of porosity were also observed. This phenomenon occurs due to entrapment of Argon and the solution of Nitrogen in weld puddle, which can be minimized by increasing the percentage of CO_2 content in gas and as well as the welding current..

Medium content of CO_2 (5 to 15%) in Argon

This mixture gives improve plate fusion reducing the chance of fusion defects with higher and improved weld bead profile. With the higher content of CO_2 the heat input also increases resulting in deeper penetration. The fluid weld pool will allow any entrapped gas to rise to the surface before the freezing occurs, and thereby reducing the possibilities of porosity.

Higher Content of CO_2 (16 to 30%) in Argon

For shielding gases containing 16% to 20% CO_2 the arc will behave same as 15% CO_2 in Argon with slightly increase in spatter generation. However 21% to 30% CO_2 in Argon will perform in a similar manner to pure CO_2 and the problems related to homogenous mixture of Argon & CO_2 will also effect the weld quality considerably. Argon & CO_2/O_2 mixtures usually exhibit better weld profiles and lower level of reinforcement as the weld pool is more fluid. The additional O_2 helps to reduce the size of droplet and improves the stability of the transfer.

Helium - Argon - Carbon-di-Oxide Mixtures

90% Argon and balance Helium with littel addition of CO_2 is now a days becoming popular for welding of stainless steel. The lower CO_2 level is required to avoid carbon pick up and ensure corrosion resistance, especially in multipass welds. The lower level of CO_2 provides good arc stabilities and develops slightly more penetration than a like amount of O_2 in the mixture. The high percentage of Helium increases the Arc voltage during the welding and provides additionals heat input to overcome the sluggish nature of the weld puddle in stainless steel. For welding high-strength steel, a mixture of 61% He, 35% Ar and 4% CO_2 is proven to be most efficient. This mixture can be used for all positional welding and can reduce the requirement of the operators' skill for out-of-position welding. By increasing the percentage of Helium the control of out-of-position weaved weld beads becomes more difficult because the puddle are more fluid in nature.

Argon - Helium - Oxygen Mixture

In order to reduce porosity. He-Ar-O_2 mixtures are occasionally used for spray welding and surfacing. In case of high alloy stainless steel these mixtures improve the fluidily of the puddle and bead shape.

Argon - Nitrogen Mixture

During the experimental Stage, small amount of Nitrogen were added to Argon & Oxygen mixture to achieve a completely austenitic microstructure in welds made with 347 type of filler metal. Concentration of N_2 was between 1 to 1.5%. It was observed that the welds were sound although considerable smoke evolved during welding. Additional of 2% N_2 in Argon rich mixtures produced porosity in mild steel welding and more than 0.4% can cause porosity in common steel welding. MIG welding of copper & its alloys with Argon Nitrogen mixtures resulted in higher spatter generations.

Argon - Chlorine Mixtures

Chlorine is normally bubbled through the molten Alluminium to remove hydrogen from the ingots or castings. Since this degassing operation is successfully used, it was thought-that chlorine might remove hydrogen from aluminium weld metal to eliminate porosity but this gas mixture was not able to deliver consistent quality welding.

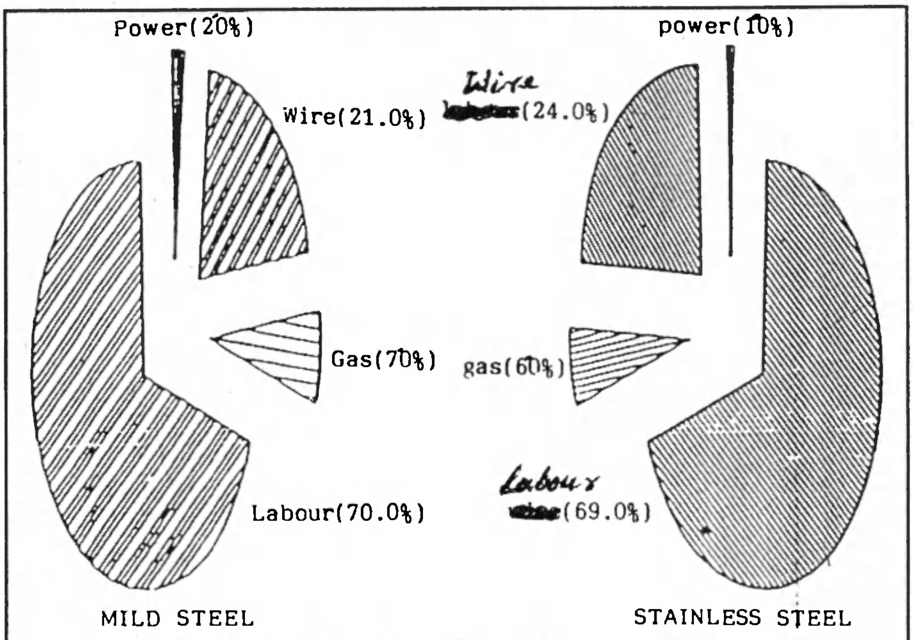

Fig. 10 : Cost Comparision of Process Components Per Metre of Weld

Gas	Applications	Features
Argon	GTAW, all metals GMAW spray/pulse aluminium nickel, copper alloys	Stable arc performance Poor wetting characteristics in GMAW Efficient shielding with Low cost
Helium	GTAW, all metals especially copper & aluminium GMAW, high current spray aluminium	High heat input Increased arc voltage
Argon + 25 to 80% He	GTAW, aluminium, copper stainless steel GMAW aluminium & copper	Compromise between pure Argon & pure He. Lower He contents normally used for GTAW
Argon + 0. 5 to 15% H_2	GTAW austenitic Stainless Steels some Copper nickel alloys	Improved heat input edge wetting and weld lead profile.
CO_2	GMAW, plain carbon and low alloy steels	Low cost gas. Good fusion characteristics/shielding efficiency but stability and spatter levels poor. Normally used for dip transfer only.
Argon + 1 to 7% CO_2 + + upto 3% O_2	GMAW, plain carbon and low alloy steels. Spray transfer.	Low heat input, stable arc. Finger penetration. Spray transfer and dip on thin sections. Low CO_2 levels may be used on stainless steels but carbon pickup may be a problem.
Argon + 8 to 15% CO_2 + upto 3% O2	GMAW plan carbon and low alloy steels. General purpose	Good arc stability for dip+spray pulse and FCAW. Satisfactory fusion & bead profile.
Argon + 16 to 25% CO_2	GMAW plain carbon and low alloy steels. Dip transfer/FCAW	Improved fusion characteristics for dip
Argon + 1 to 8% O_2	GMAW dip and spray & pulse, plain carbon and stainless steel	Low O2 mixtures suitable for spray and pulse but surface oxidation and poor weld profile often occur with stainless steel. No carbon pick up.
Helium + 10 to 20% Argon + Oxygen + CO_2	GMAW Dip transfer stainless steel	Good fusion characteristics, high short circuit frequency. Not suitable for Spray / pulse transfer.
Argon + 30 to 40% He + CO_2 + O_2	GMAW DIP, Spray and pulse welding of stainless steels	Improve performance in spray and pulse transfer. Good bead profile. Restrict CO_2 level for minimum carbon pickup
Argon + 30 to 40% He + up to 1% O_2	GMAW dip, spray and pulse welding of stainless steels	General purpose mixture with low surface oxidation and carbon pickup

Gas Mixtures Available and Their Application - At a glance

Influencing Factors in Selecting Shielding Gas

The following factors influence the selection of most economical shielding gas :

¤ Relative performance i.e. weld speed, spatter, smoke & productivity.

¤ The relative cost of the shielding gas.

¤ The type of the application and utilization i.e. manifold system, Bulk storage system etc.

In most of the circumstances, the total operating cost should determine the gas selection not the initial cost of gas itself. This is particularly true for welding in mechanized application and robotic where optimum productivity is the essence and can be easily achieved. For example, a mixture of 75% He & 25% Argon can be used in aluminium pipe welding applications to achieve optimum weld quality, inspite of the higher cost for the Helium mixture as compared to Pure Argon.

In GMA welding of low alloy and mild steel the initial gas cost can apparently be a factor in the choice between CO_2 and Argon & CO_2 mixture. While the comparative like to like cost of Argon/CO_2 mixture may initially appear to be on the higher side than that of CO_2 but the operating advantages and the indirect benefits of Argon CO_2 mixtures generate demonstrable savings in the total welding cost that can

easily off set the price difference. Some of these advantages are as follows.

¤ Minimization of spatter : The nature of Argon base mixtures is such that weld spatter is substantialy less than that encountered with CO_2.

¤ Duty cycle increases : The operator is able to weld for longer periods of time before stopping to clean spatter from nozzle and contact tip. This enchances the longer life of the semi-consumable components such as nozzle tip etc.

¤ Post-weld clean up time is reduced due to minimal spatter on the work piece. This is particularly important where the customer needs a smooth,painted surface, for example, Automobile, Heavy Engineering Industries.

¤ Interpass clean up time is reduced, due to reduction of slag deposit and spatter on the previous weld bead. This increases the duty cycle and production output.

¤ In some circumstances, a less expensive filler wire with less amount of deoxidizers may be utilised with Argon base mixtures.

¤ While welding with CO_2 shielding, due to the tendency of overweld, the weld bead becomes more growing resulting in a peaky weld. Argon base mixtures allow a reduction in the growing effect, thus lower consumption of weld metal per inch of weld and correspondingly faster travel speeds. This is particularly noticeable while welding of sheet metals upto 1/2 inch thickness.

¤ Due to less spatter loss, the deposition efficiency of the wire increases-resulting in lower cost of deposited weld metal.

¤ The Arc formed in CO_2 shielding generate more heat than that of Argon mixtures. This hotter Arc tends to create burn through while a gap is observed due to poor fitment of the plates to be welded. With Argon mixture it is easier to bridge the gaps and weld over poor-fit-up in the weld plates.

CONCLUSION

Shielding Gas selection is a Key variable for achieving better welding perfirmance. Since there are a large number of Shielding gases available, choice of optimum gas mixture is best undertaken by means of careful monitored comparative studies which allow the practical features and cost factor to be accurately assessed for better quality and productivity.

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