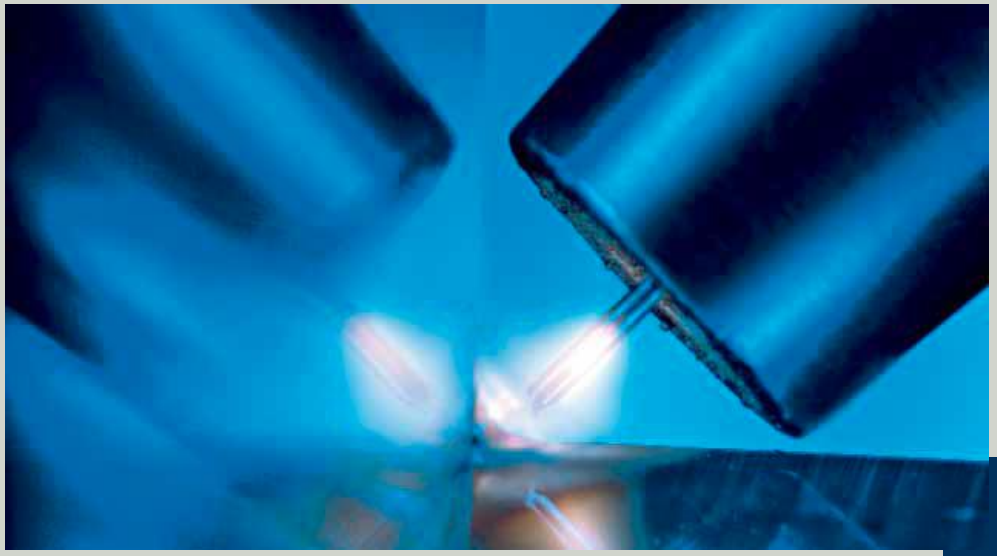


Complex Properties of Shielding Gases

LeadIng.

THE LINDE GROUP

Ioannis Maitos, Application Engineer,
Linde Hellas

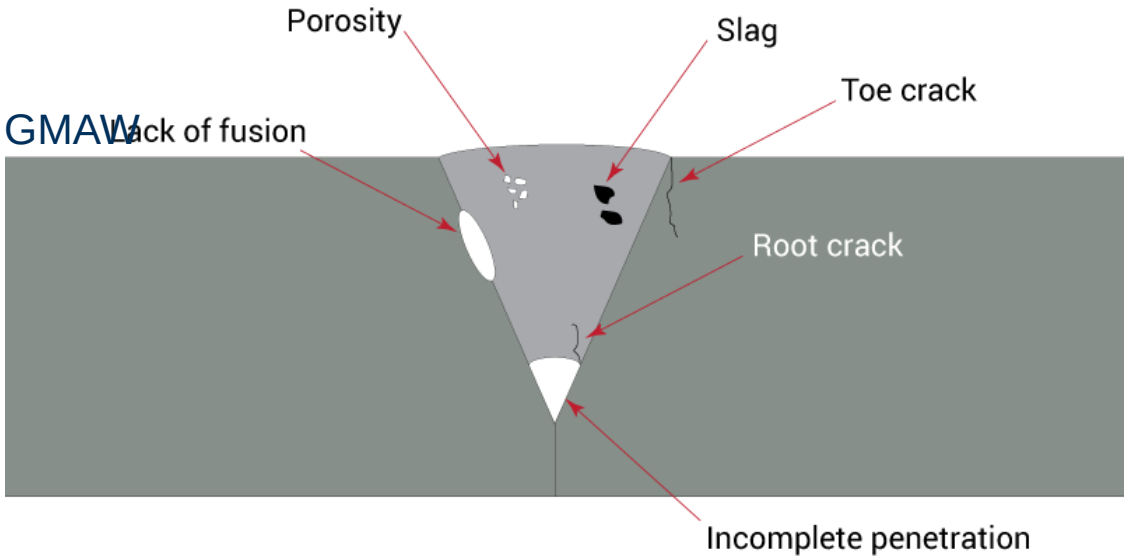
Athens, November 2016

Introduction

Cures for typical weld defects usually suggest modification of welding parameters

- ✓ Travel speed
- ✓ Welding current
- ✓ Arc length
- ✓ Material transfer mode in GMAW

etc



What about selecting the appropriate shielding gas?

Role of Shielding Gas

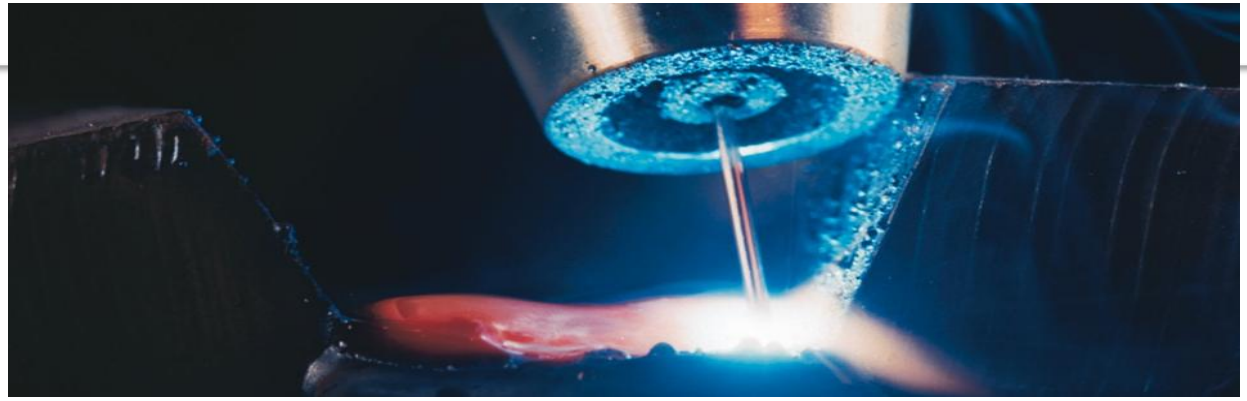
THE LINDE GROUP

Shielding Gas does NOT ONLY shield the weld from the atmosphere.

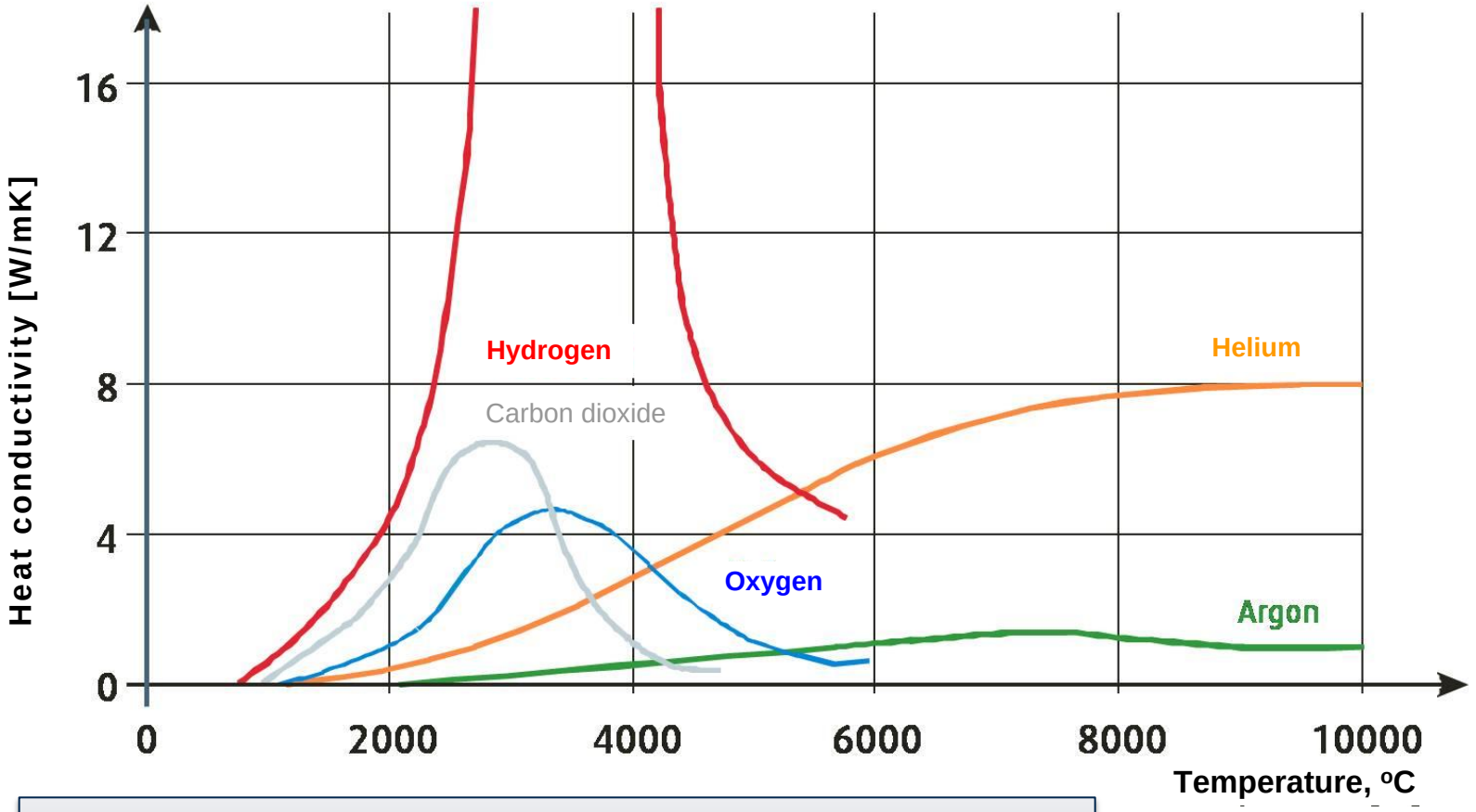
It also does:

- Influence the arc (electric, thermal)
- Influence the viscosity and the surface tension of the molten pool and the droplet
- Influence the wetting properties
- React metallurgical with the filler and the pool
- Control penetration, geometry and surface of the weld
- Influence pollutant emission

etc



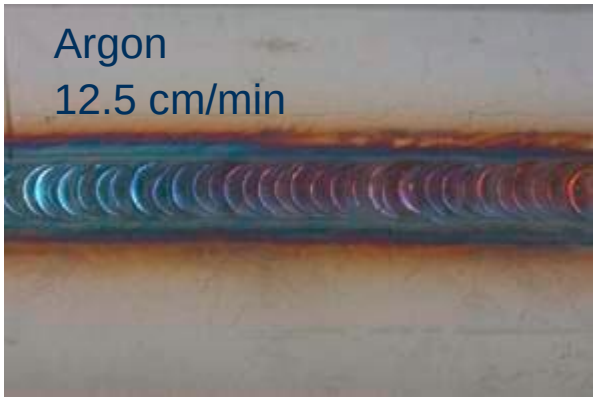
Heat Conductivity

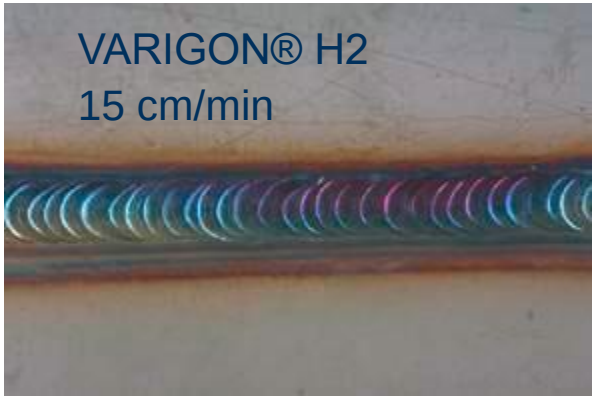


<u>Increase of thermal conductivity of the welding gases</u>:
- increase of weld pool temperature (improve degassing)
- higher welding speed
- deeper penetration

Hydrogen and Helium:
Boosting the heat transfer efficiency

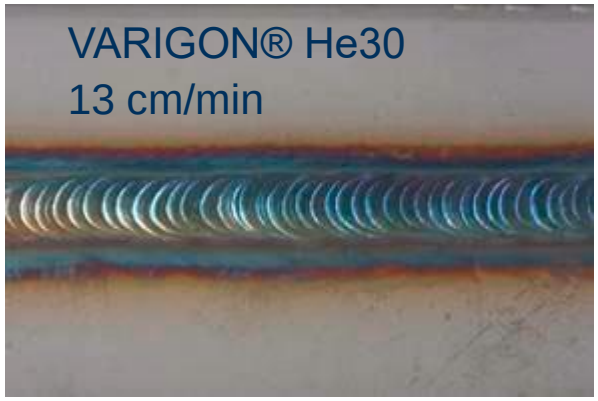
THE LINDE GROUP

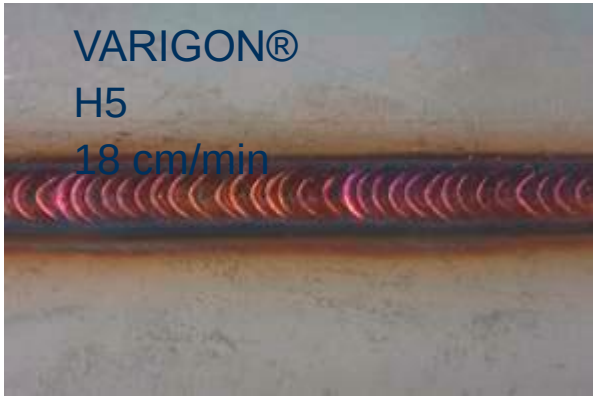




Annealing colors
250°C

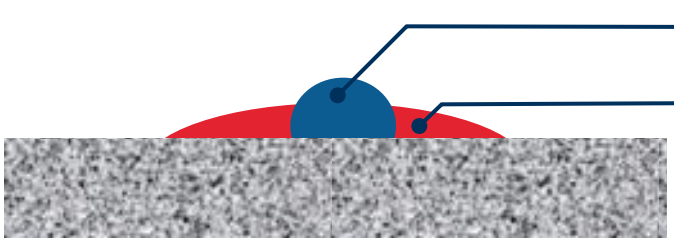
1200°C





TIG manual fillet weld on 4.0 mm thick 304, filler ER 308 L Si, Ø 2.0 mm

Wetting properties & “Preheating Effect”

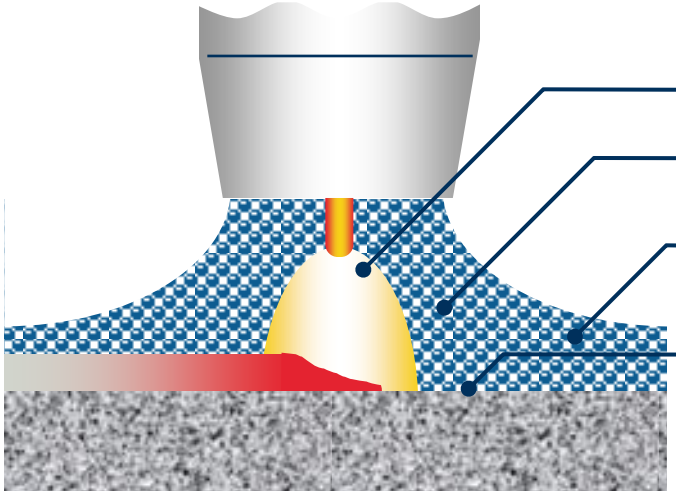


wetting

Reduction of surface tension and viscosity

O_2 and CO_2 : by oxidation

He : by higher temperature



„Preheating effect“

Dissociation $CO_2 <=> CO + ½ O_2$ endothermic

Recombination exothermic

Thermal conductivity $\frac{\lambda \text{ He}}{\lambda \text{ Ar}} \approx \frac{8}{1}$

Coefficient of heat transfer $\frac{\alpha \text{ He}}{\alpha \text{ Ar}} \approx \frac{5}{1}$

Chemical reactivity of welding gases

THE LINDE GROUP

Chemical reactions in GMAW of low alloyed steel:

$$CO_2 \rightleftharpoons CO + \tfrac{1}{2} O_2$$

$$\{O\} + (C, Fe, Mn, Si\ u.a.) \rightleftharpoons (SiO_2, MnO, FeO, u.a.) + \{CO, OH\}$$

Slag formation

Oxidation

Porosity formation

- metal oxides can improve arc stability
- Shielding gas influences the loss of alloying elements and pick-up of nitrogen, oxygen and carbon

Metal transfer in GMAW

THE LINDE GROUP

Shielding gas composition strongly influences the type of metal transfer

(short circuit, globular, spray arc,…)

Example:
Reducing CO2 concentration

Mixture	Transition current range
Ar + 18% CO2	260 - 280 A
Ar + 10% CO2	240 - 250 A
Ar + 5% CO2 4% + O2	220 - 230 A

Conclusion:

THE LINDE GROUP

- In-depth understanding of the “internal properties” of the gas components and their interaction in specialized mixtures leads to an accurate selection of shielding gas having eventually a major impact on the quality and the productivity.

Thank you for your attention.

LeadIng.

THE LINDE GROUP