

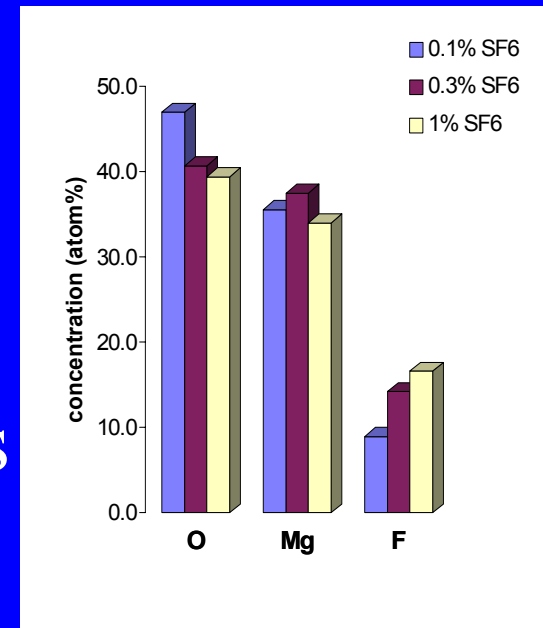
Hydrofluorocarbons As Magnesium Cover Gases

Nigel Ricketts & Simon Cashion
CRC for Cast Metals Manufacturing



HFCs as Mg cover gases

- SF_6 is basically a source of fluorine
- Most sources of fluorine are toxic
- SF_6 is a stable molecule, makes it a potent greenhouse gas
- A less stable form of fluorine may also work



Concentration of film elements for various levels of SF_6 in the cover gas



Sources of fluorine

- Preferably gaseous for easy delivery
- Needs to be cheaper than SF₆
- Safe, non-toxic
- Widely available
- Must protect magnesium

▶ TOUGH ASK



HFCs as a source of fluorine

- Widely available
- Lower GWPs than SF₆
- At least one is cheaper
- Safe, non-toxic
- Do protect molten magnesium



HFC-134a attributes

- GWP of 1,300 (SF_6 23,900)
- One-third of the cost of SF_6
- Non-toxic
- Widely available, many suppliers



HFC-134a

1,1,1,2-tetrafluoroethane



HFC-134a protection



Pure Mg protected with
HFC-134a

- Provides good protection in a melting furnace
- Simple gas delivery system but needs to be tailored to application
- Once surface film is formed, it is very stable

Other applications tested

Squeeze casting



Ingot casting



Sand casting



Investment casting



High-pressure die casting



AZ91D removed from protective atmosphere

Melted and held for 3 hours under 0.75% SF₆ in dry air



0 secs



30 secs



60 secs



120 secs



Melted & held for 3 hours under 0.75% HFC-134a in dry air



RESIDUAL MELT PROTECTION EFFECT

Environmental benefits

- HFC-134a has a GWP of 18 times less than SF₆ - even further savings are possible as HFC-134a is more protective than SF₆
- HFC-134a is cheaper than SF₆, providing impetus to change over
- Global switch from SF₆ to HFC-134a could potentially save >5m tonnes CO₂ equivalent



Future use of HFC-134a

- Test work with third parties nearing finalisation
- Licence packages being prepared
- Aim is to make available to the whole magnesium industry
- Research will be on-going



Making the switch

- Switching from SF₆ to HFC-134a is not simple process
- The key to success is the way the gas is distributed inside the furnace
- There are also materials issues to be dealt with for some applications
- Talk to CAST if interested in making the switch



Conclusions

- HFC-134a appears to be a viable option for most current magnesium protection applications where SF₆ is used, but expertise is needed to make the switch
- Switching from SF₆ to HFC-134a should result in significant environmental benefits and possible cost savings

