Environmental implications of using HFC-134a as a replacement for sulphur hexafluoride in the magnesium industry

N.J. Ricketts and R.Esdaile

HFC-134a alternative to SF_6

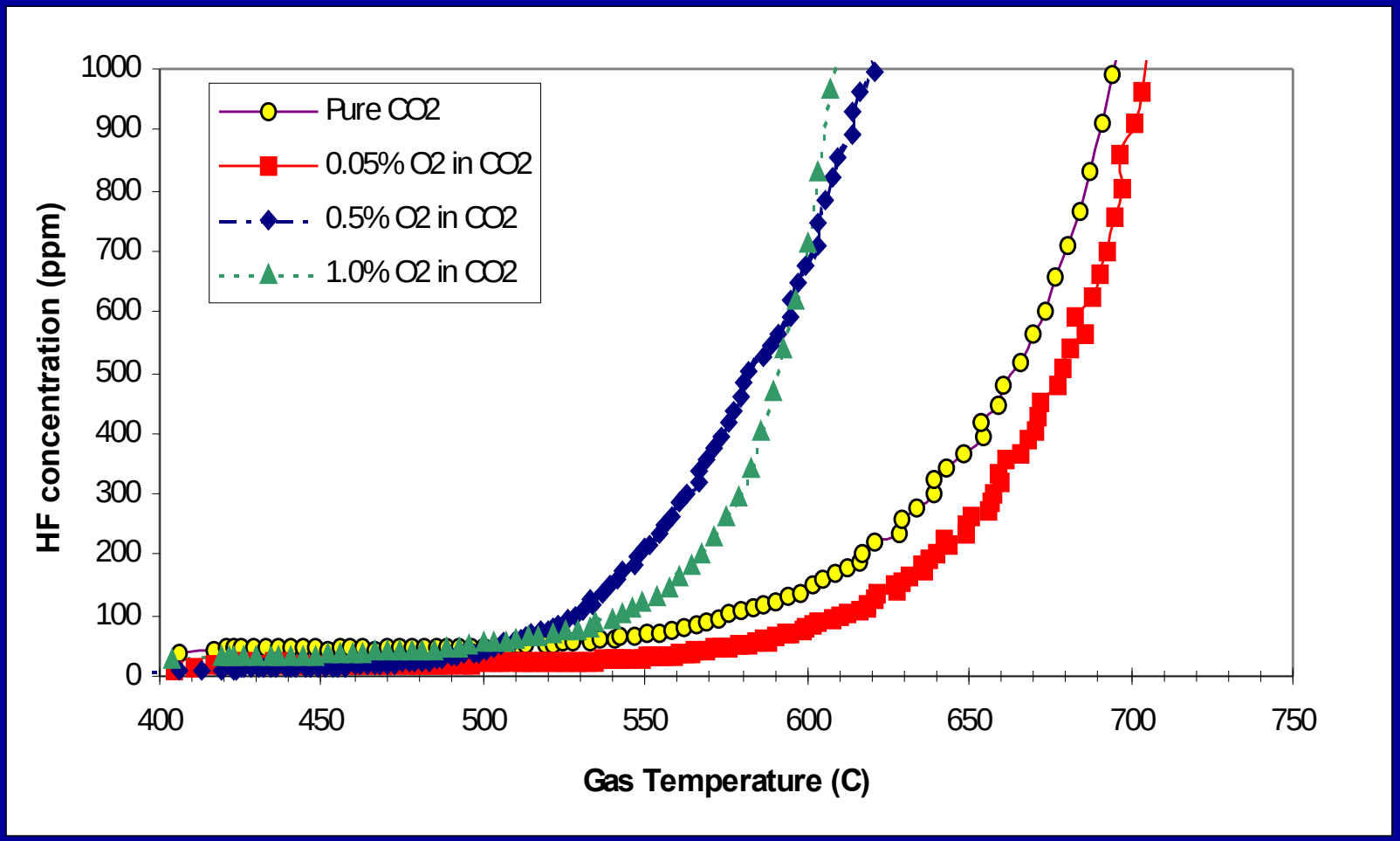
- HFC-134a selected as promising:
  - cheap ($US5/kg compared to $US13/kg for SF_6)
  - low GWP (1300 compared to 23900 for SF_6)
  - readily available from many suppliers (R134a)
  - non-toxic, simple chemical

chemical name	1,1,1,2-tetra-fluoroethane
chemical formula	CF_3CH_2F

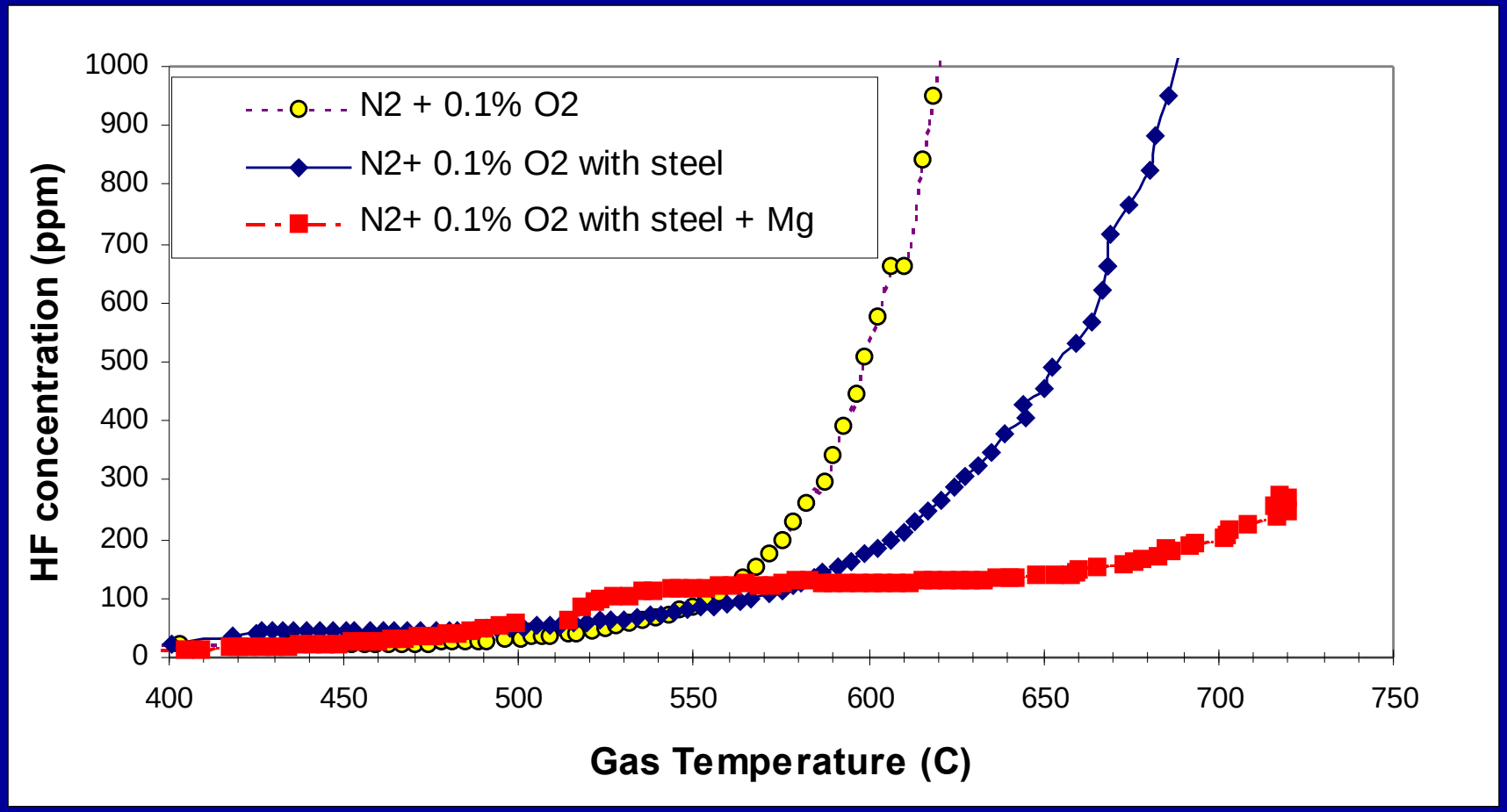
AMCover key features

- Diluent gas is just as important in the system as the active gas
- AMCover does not use dry air
- Grade of diluent gas is also important
- Steel surfaces and molten magnesium surfaces are also important

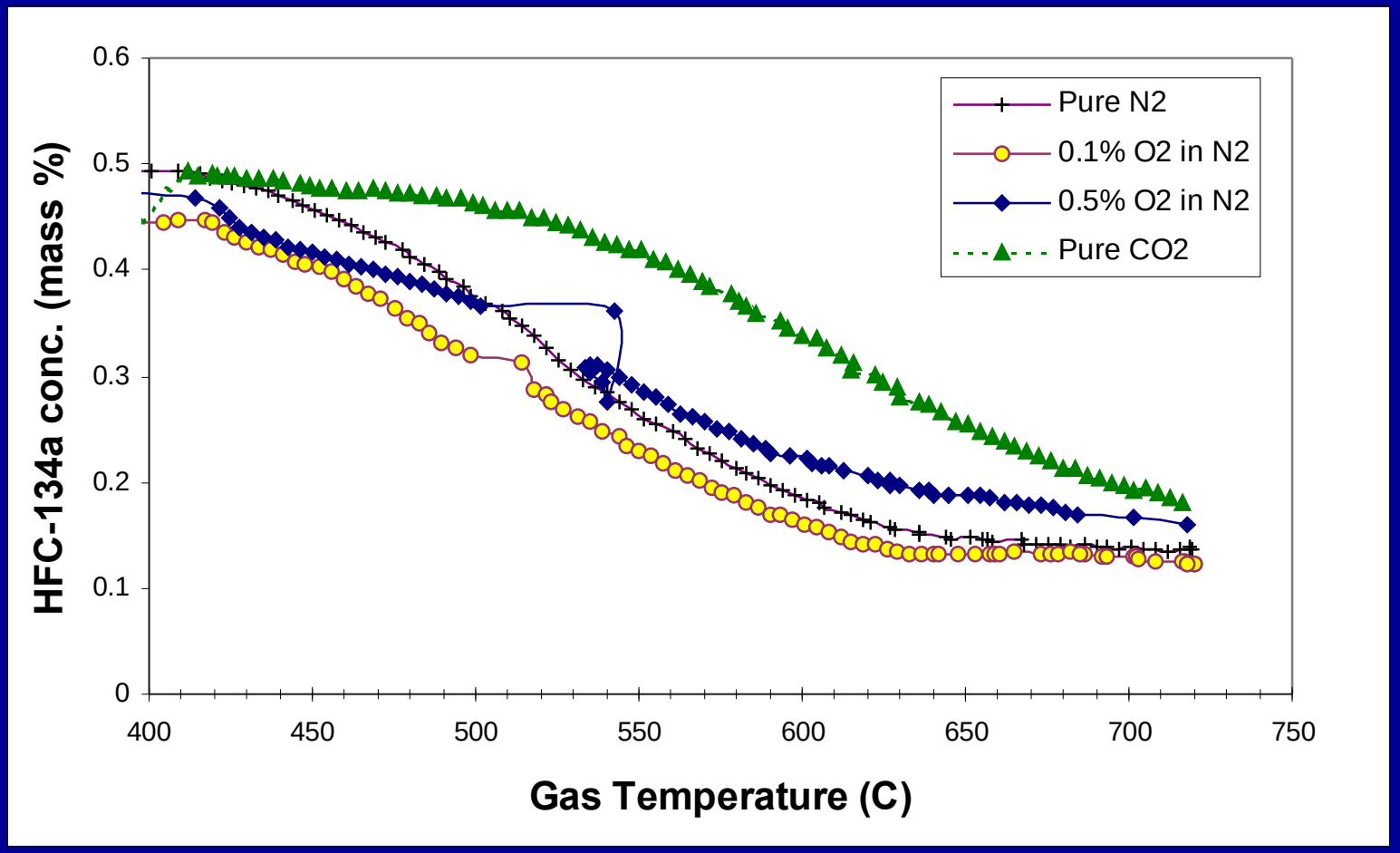
Effect of diluent gas grade



Effect of steel and Mg surfaces



Residual HFC-134a



Current status

- AMCover™ is a viable replacement for SF_6
  - ✓ Cost-effective (much cheaper than SF_6)
  - ✓ Superior performance
  - ✓ Minimal capital investment needed
  - ✓ Applicable to a wide range of processes
  - ✓ Significant reduction in greenhouse gas emissions, >95%
  - ✓ Manageable levels of decomposition products
- Commercialisation now occurring in Australia, Europe and North America

Alternatives

- SF_6
- SO_2
- AMCover (HFC-134a blend)
- Novec 612
- HFE-7100

Do we have all the data on the alternatives?

How to compare GHG impact?

- GWP values
  - What time frame to use?
  - Are they known over the time frame of interest?
- Level of thermal decomposition during passage through furnace
- High GWP decomposition products?
- Should be on basis of GHG emissions per mass of parts

GHG emissions

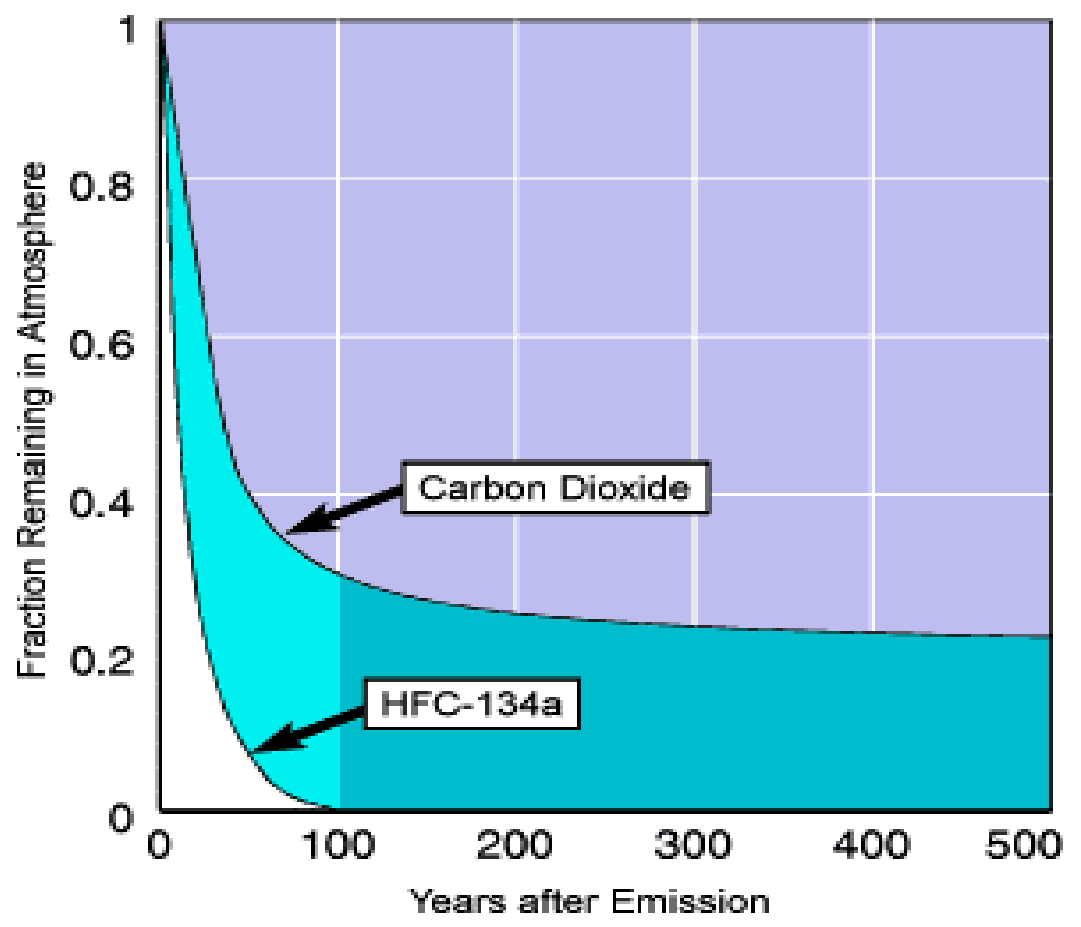
- From cover gas
  - Active gas
  - Diluent gas
  - During production of these gases too
- From furnace operation
- From post-casting handling
- Needs to include recycle streams

GWP Values for HFC-134a

- Well known and well studied chemical
- Half-life of about 14 years (SF_6 3200)

GWP for HFC-134a and SF_6 at Time Horizons of:		
20 years	100 years	500 years
3400 16300	1300 23900	420 34900

Relative to CO_2



Compared to SF_6

- SF_6 has half-life of 3200 years
- Comparing HFC-134a as a replacement for SF_6 over 100 years does not seem to make a lot of sense
- Using 100-year time horizon compared to CO_2 does not make complete sense as CO_2 effect lasts longer than 100 years

CONCLUSIONS

- Use of 100-year GWP information of the active component of a cover gas mixture to compare cover gas alternatives only provides one small amount of the whole picture
- The use of AMCover™ will eliminate >95% of the greenhouse gas emissions currently produced by SF_6 use and should return a significant operating cost saving as well