Cooperative Studies of Magnesium Melt Protection Technologies

Jeremy Scharfenberg, ICF International

Alternative Cover Gases in Ingot and Die Casting Applications
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Mg Measurement Study Details

- Strong support from Partners and suppliers
- Careful coordination of numerous parties

Process:	Die Casting	Ingot Casting
Where:	Lunt Manufacturing	AMACOR
When:	August 2006	December 2009
Who:	AML (HFC-134a) 3M (Novec 612) Polycontrols (SO_2)	3M (Novec 612) Polycontrols (SO_2)

Study Parameters

Process:	Die Casting	Ingot Casting
Machine:	Cold Chamber	Belt Caster
Analytics:	Extractive FTIR and QMS	Extractive FTIR and QMS
Gases:	HFC-134a Novec 612 SO_2 SF_6	Novec 612 SO_2 SF_6

Study Objectives

Four Objectives:

1. Estimate cover gas destruction in the crucible / casting hood head-space
2. Monitor the production of byproducts
3. Estimate relative GHG emission reduction potential of alternative technologies compared to SF_6
4. Identify potential occupational exposure concerns

Study Implementation

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Global Warming Potential

The climate impact of a given substance (e.g., cover gas) may be determined by understanding the mass of actual emissions and the GWP of the gases

Some gases are reacted or transformed in the crucible

100 year GWP – relative to CO_2:

Chemical	GWP Value
CO_2	1
SF_6	23,900
HFC-134a	1,300
Novec 612	~1 (estimated)
SO_2	0

Climate Impacts / Potential Benefits

Average Amount of Destruction*:

Cover Gas	Die	Ingot
SF_6	32%	2%
HFC-134a	79%	NA
Novec 612	77%	4%
SO_2	33%	6%

*Within the crucible head-space and across multiple cover gas concentrations; values are corrected for dilution

Results Summary
Relative Climate Benefit

Melt Protection:

HFC-134a, Novec 612, and SO_2 displayed melt protection characteristics similar to SF_6

Global Warming Potential Comparison:

Cover Gas	Die	Ingot
SF_6	100	100
HFC-134a	3	NA
Novec 612	2	1
SO_2	0	0

GHG emissions normalized to an SF_6 value of 100

Results Summary
Reaction Byproducts

Die Casting Crucible (head-space):

Melt Protection	Detected Byproducts
HFC-134a	CO, HF, COF_2, CH_2O
Novec 612	CO, HF, COF_2, CH_2O, C_2F_6, C_3F_8, CHF_3
SO_2	None detected*
SF_6	HF, SO_2

*H_2SO_4 and SO_3 were below detectable limits.

Results Summary
Reaction Byproducts

Ingot Casting Hood (head-space):

Melt Protection	Detected Byproducts
HFC-134a	NA
Novec 612	None detected*
SO_2	None detected*
SF_6	None detected*

*below detectable limits (BDL).

Results Summary
Exposure Hazards

Die Casting:

- HFC-134a and Novec 612 byproducts such as HF, CH_2O, and COF_2 were not detectable during continuous monitoring of ambient air at the part drop station
- SO_2 concentrations at the crucible were well below the permissible exposure limit (PEL)*

* A single measurement did approach the SO_2 PEL of 2 ppm when the ingot door was open for a prolonged period due to an ingot loading malfunction

Results Summary
Exposure Hazards

Ingot Casting:

- Novec 612 byproducts such as HF, CH_2O, and COF_2 were not detectable during continuous monitoring of ambient air above the casting hood
- SO_2 concentrations above the casting hood were at the permissible exposure limit (PEL)

THANK YOU

Details on these studies are available at:
www.epa.gov/magnesium-sf6/index.html