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Megtec™

EVALUATION OF AN ALTERNATIVE FURNACE COOLING MEDIUM FOR ENHANCED OPERATIONAL SAFETY

Kgomotso Maluleke

Technical Sales Engineer – Base Metals

Agenda

Introduction and Background

Study Objectives

Cooling Efficiency Tests

Explosion Tests

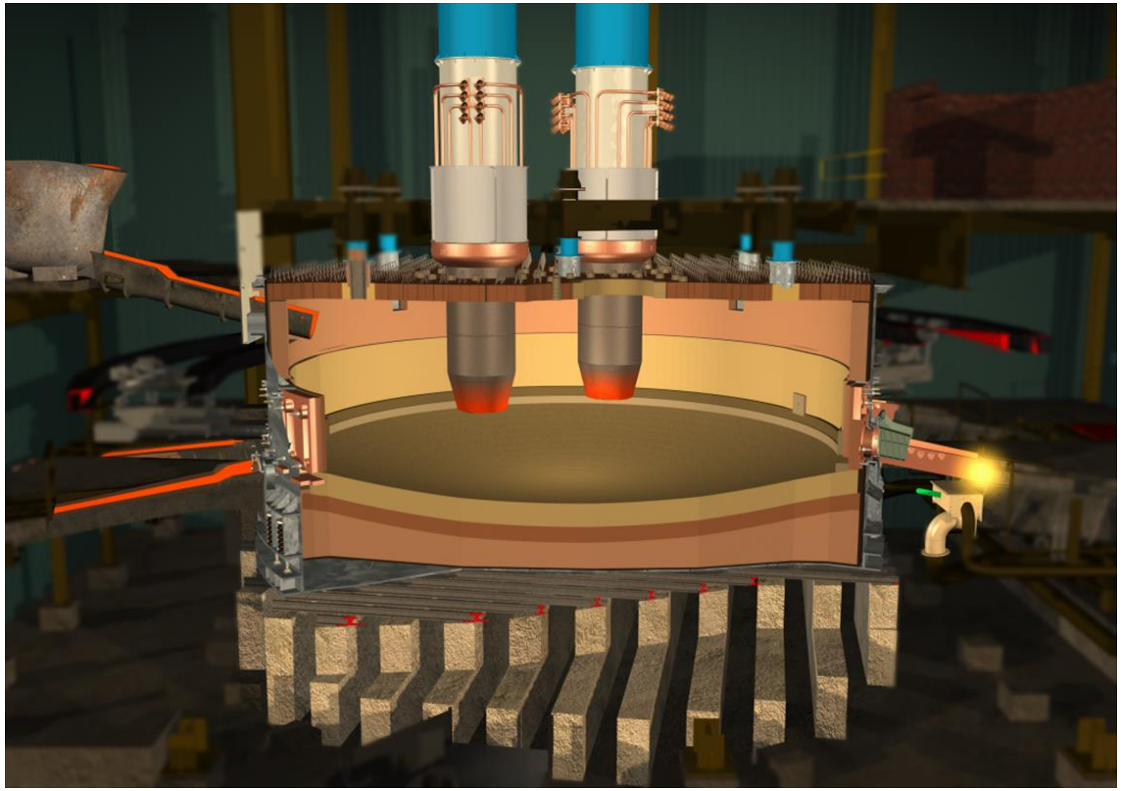
Study Conclusions

Acknowledgements

Background

FURNACE COOLING ELEMENTS

- Rising heat loads in slag & taphole zones
- Cooling stabilises refractory & forms freeze-lining
- **Enables higher intensity & longer campaign life**
- Copper/steel cooling elements are commonly used
- **Water is the standard cooling medium**



Background

COOLING MEDIUMS - WATER

Advantages of water

- Abundant
- Low cost
- Exceptional heat transfer properties

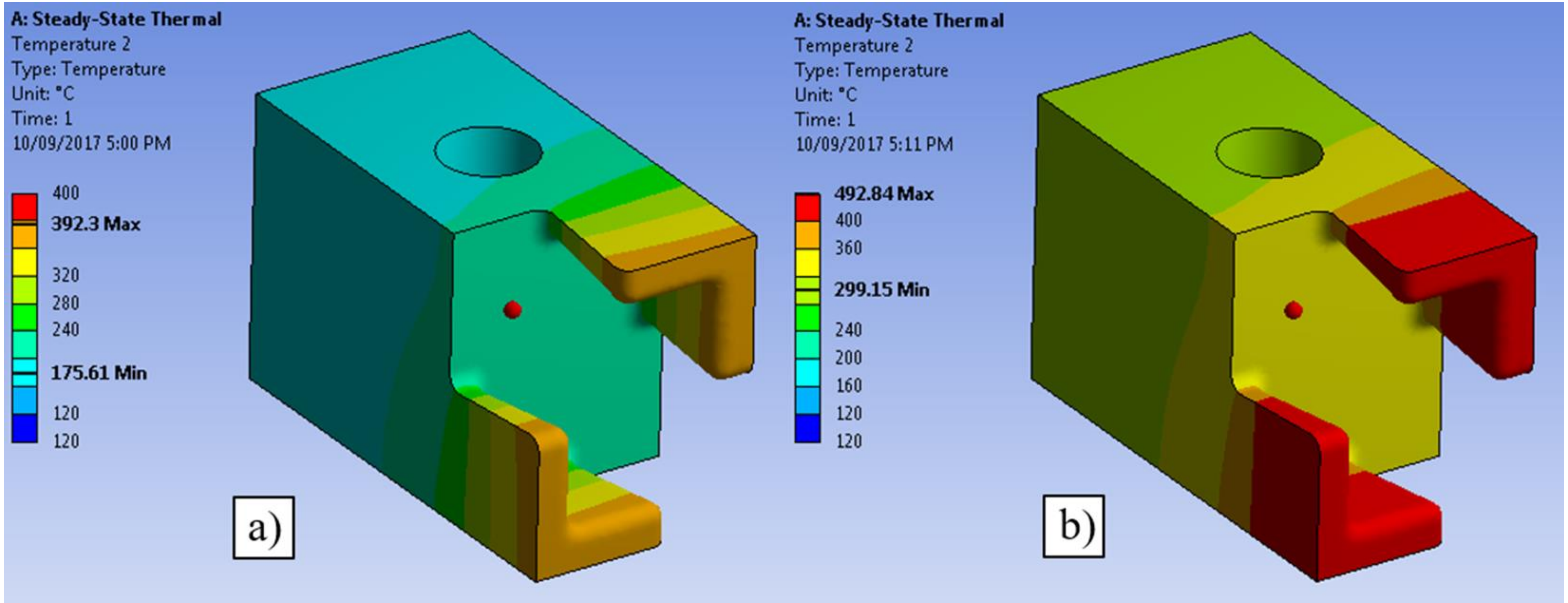
Disadvantages of water

- Imposes risk in the vicinity of molten material
- Boiling liquid expanding vapour explosions (BLEVEs)
- Equipment damage
- Physical injuries and fatalities

MEGTec™ - Alternative Cooling Medium

WHY MONO-ETHYLENE GLYCOL?

4 m/s Bulk Velocity



70% MEG + 30% Water (MEG70)
T_{cu} = 392°C < 400°C
↑Cp, ↓μ, ↑k

Ionic Liquid
T_{cu} = 493°C

Study Objectives

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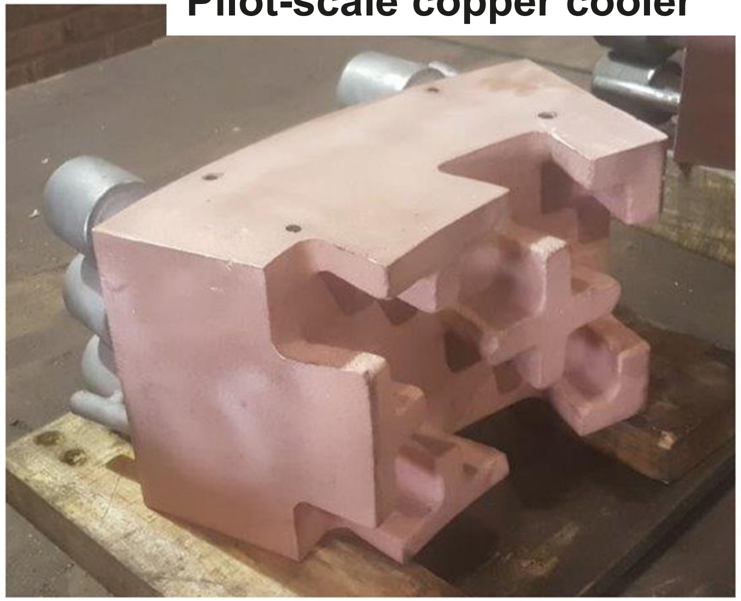
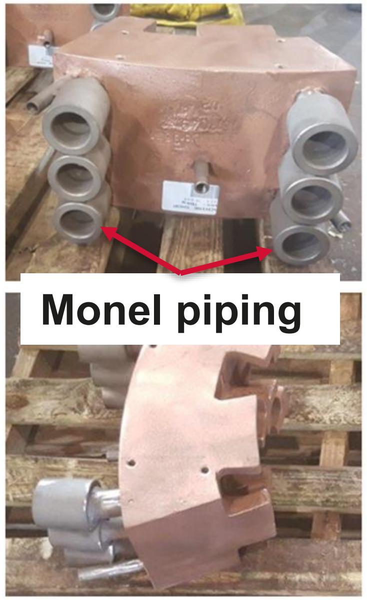
WHAT ARE WE TRYING TO ACHIEVE?

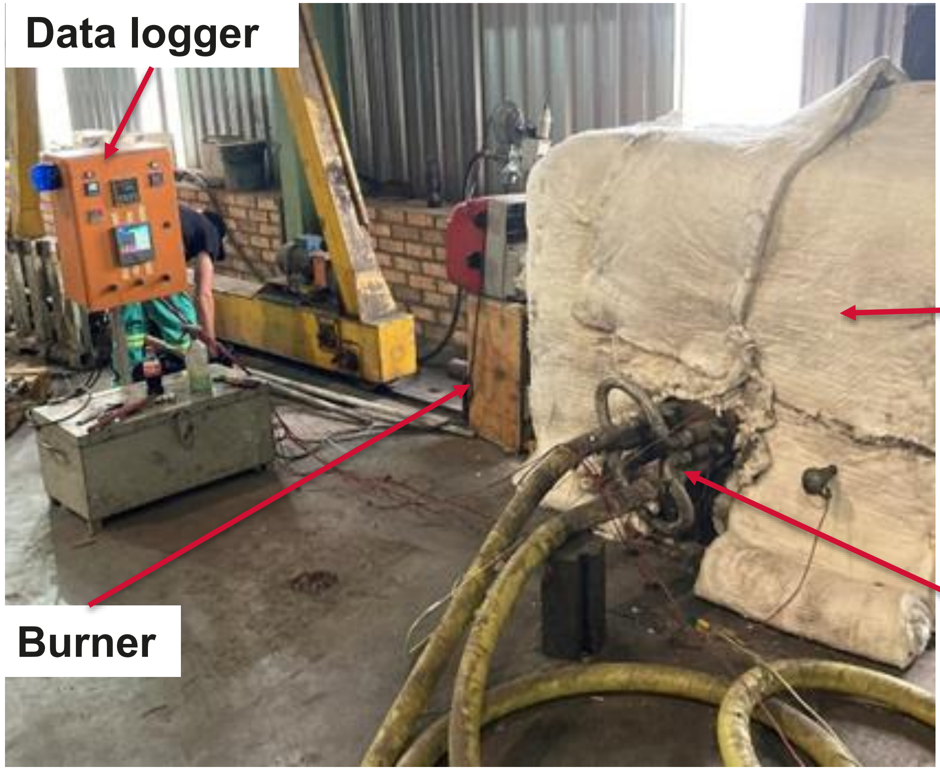
- Validate FEA predictions for MEG cooling performance.
- Measure thermal, flow, and material behaviour under furnace conditions.
- Compare safety and stability against conventional water cooling.
- Support industry adoption of safer cooling technologies.

Experimental Setup

COOLING EFFICIENCY TESTS



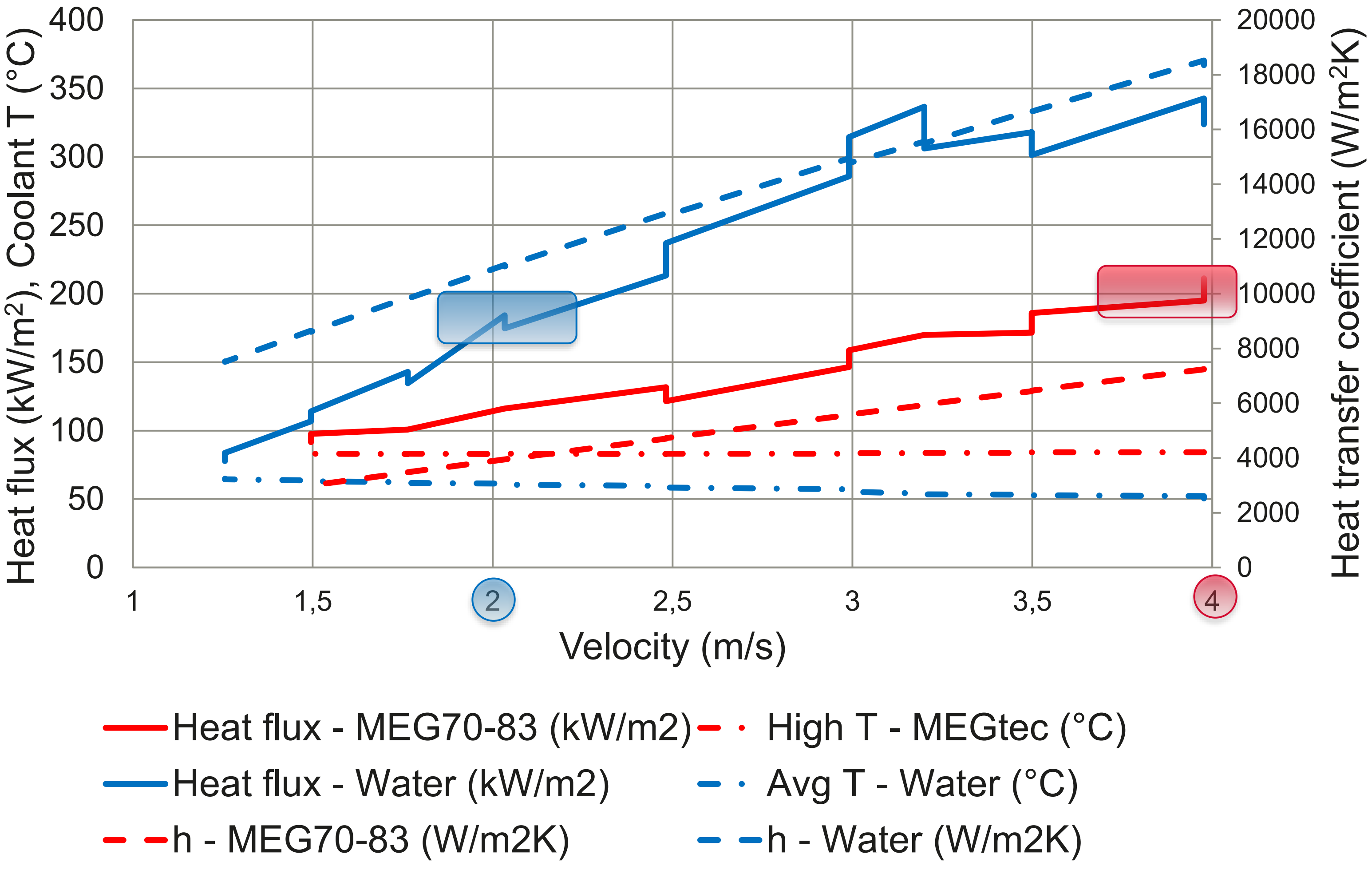




- 900°C hot box
- Water (baseline) temp = 58°C
- MEG 70 temps = 68°C to 83°C
- $8m^3/h$ (8m/s) to $2.5m^3/h$ (1.25m/s)

Results & Discussions

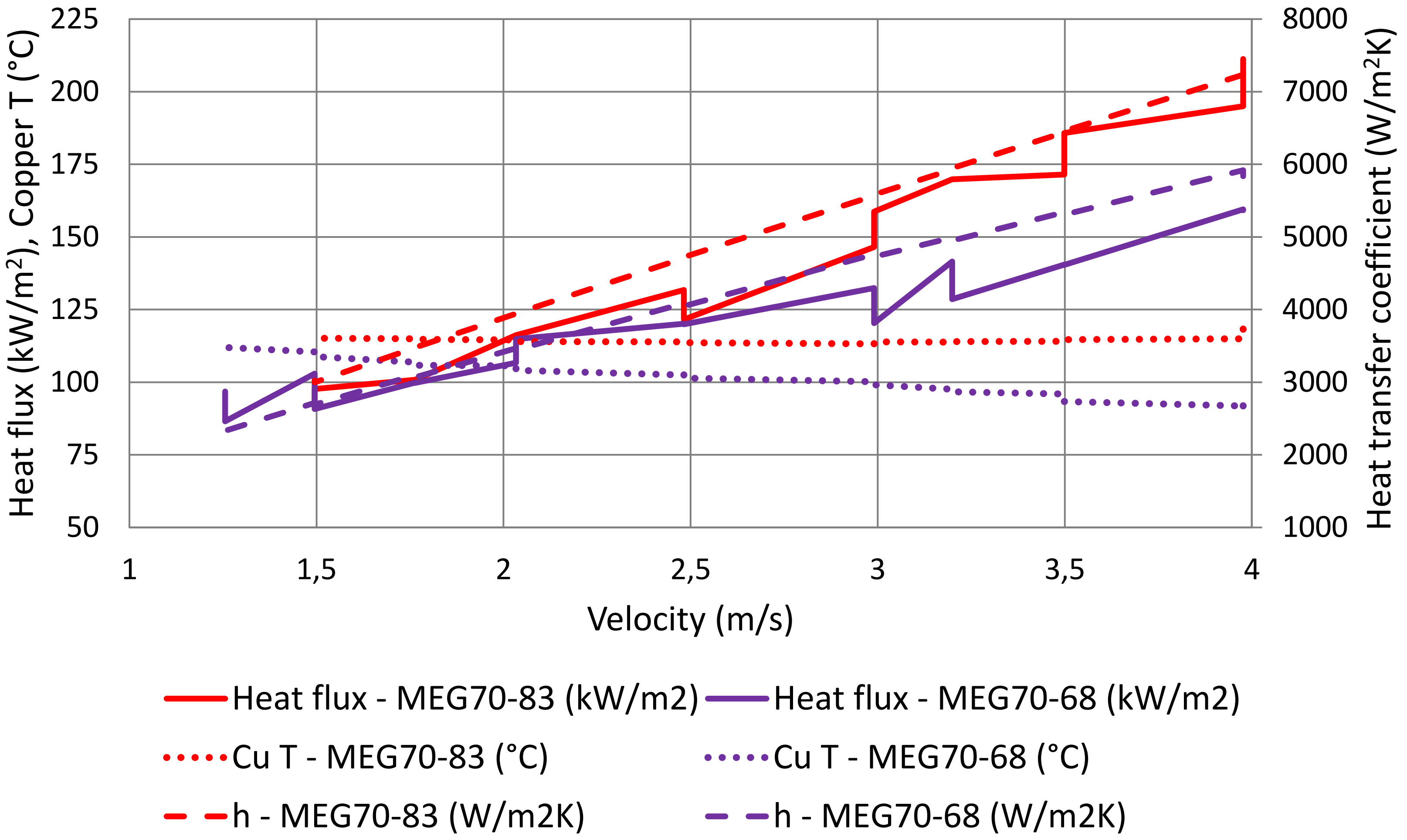
COOLING EFFICIENCY



- The heat flux obtained with MEG70 at a bulk velocity of 4 m/s (~200 kW/m²) was comparable to that achieved with water at 2–2.5 m/s.
- **Consistent with earlier finite element modelling results**

Results & Discussions

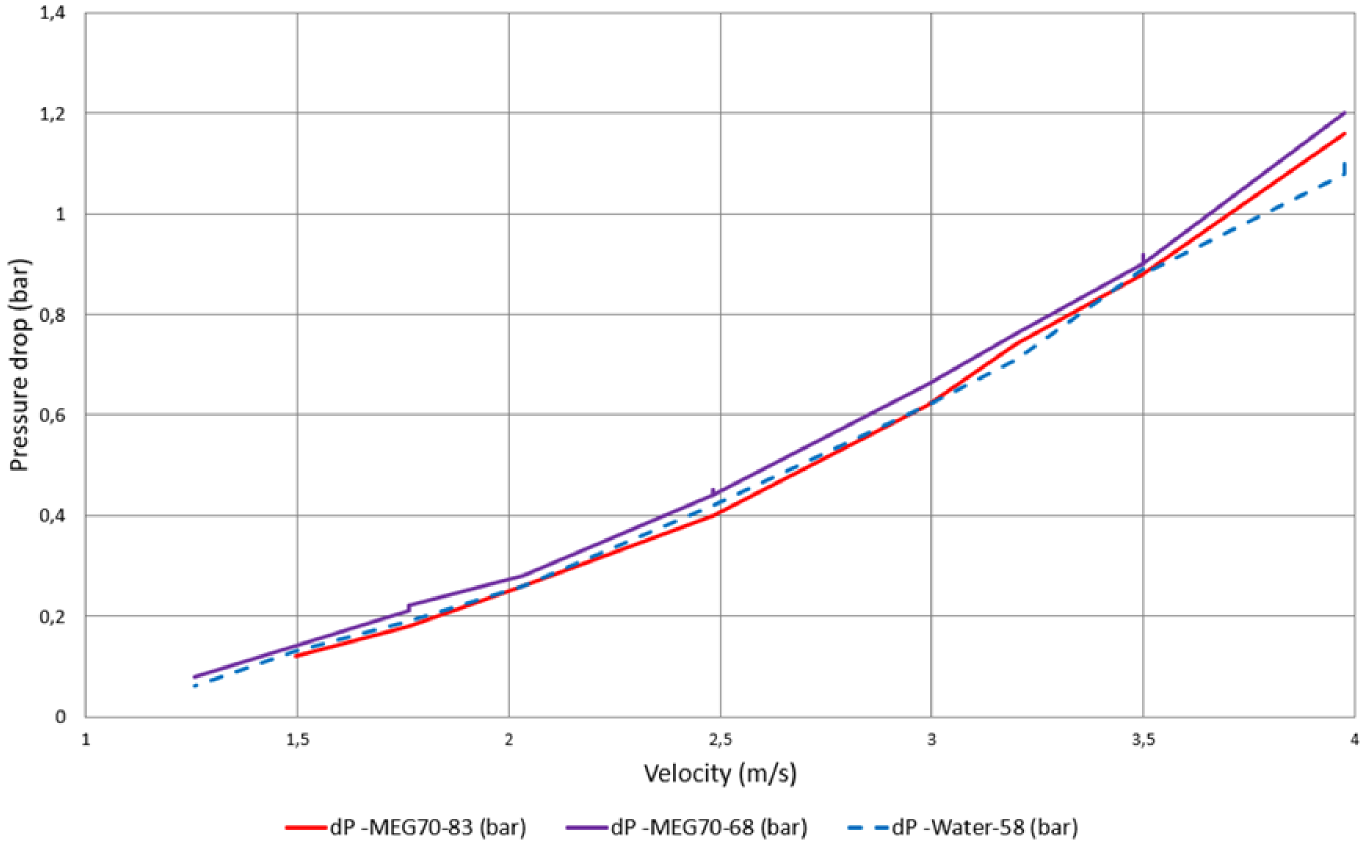
COOLING EFFICIENCY: EFFECT OF TEMPERATURE AND FLOWRATE ON MEG COOLING EFFICIENCY



- Higher-temperature MEG70 exhibited greater heat flux, indicating an increased heat removal capacity for the test cooler.

Results & Discussions

COOLING EFFICIENCY: DIFFERENTIAL PRESSURE



- The pressure drop was found to be similar for MEG70 at an average temperature of 83°C and water at 58°C, with slightly higher values recorded for MEG70 at 68°C.

Experimental Setup

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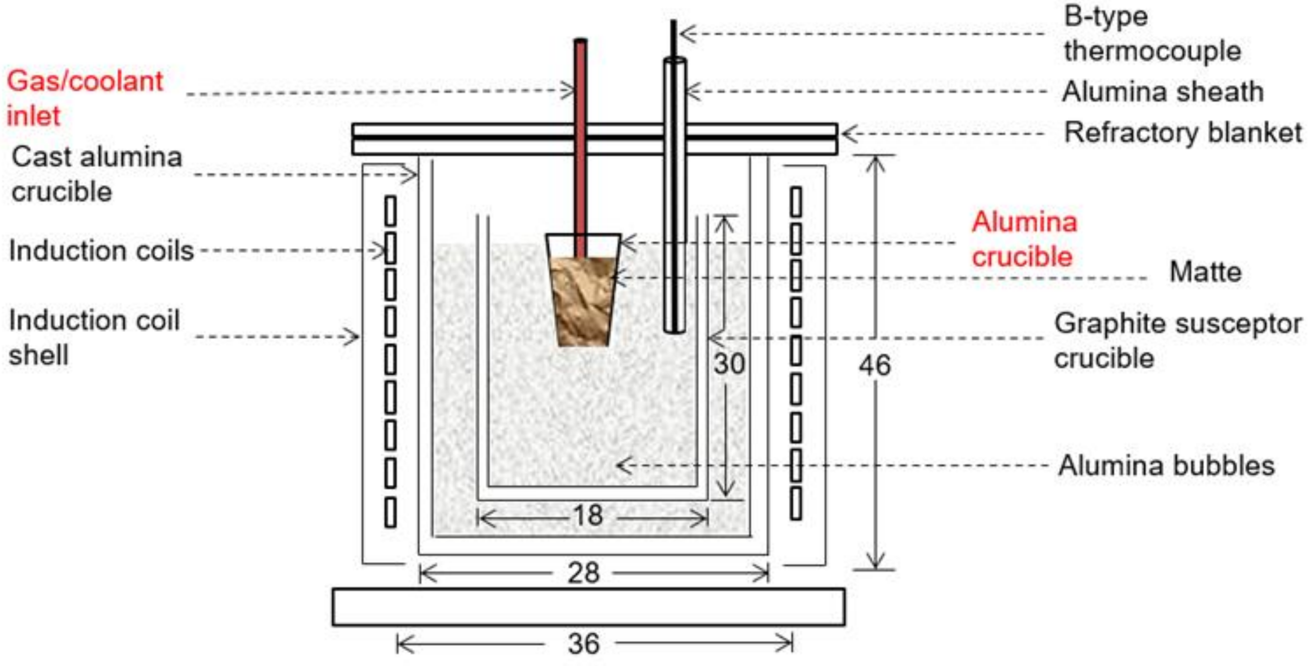
EXPLOSION TEST SETUP 1: ADDING MEG TO MOLTEN MATERIAL



- 1600 g PGM furnace matte
- Furnace temperature: 1600°C
- Coolant inlet depth: 10 cm
- Coolant flow rate: 85 mL/min

Test	Cooling agent	% MEG addition	% Water addition
1	MEG100	100	0
2	*MEG70-1	70	30
3	MEG0	0	100

Explosion Safety Trials

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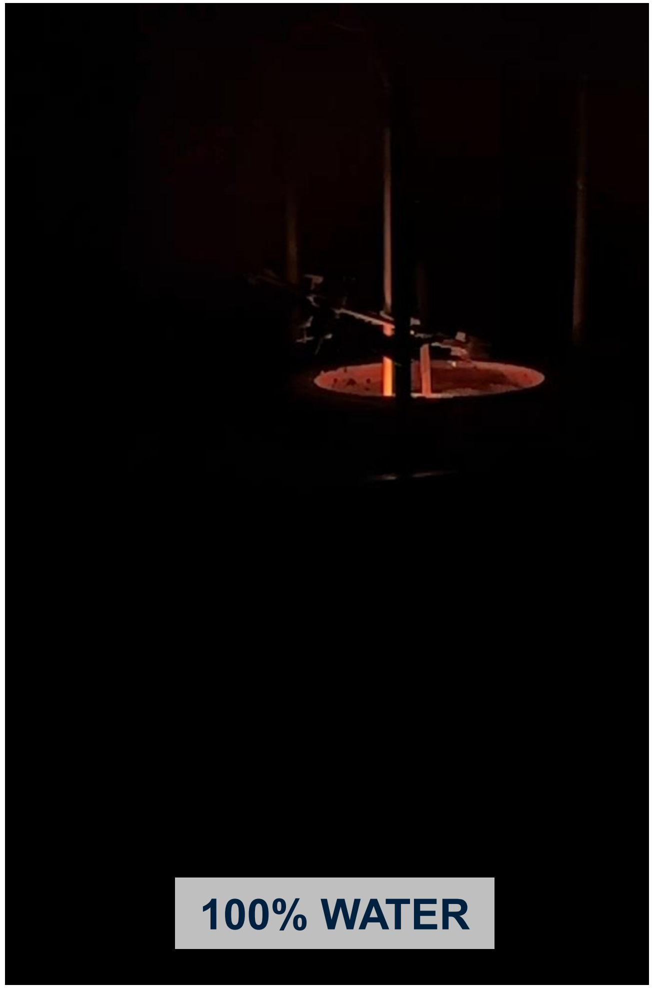
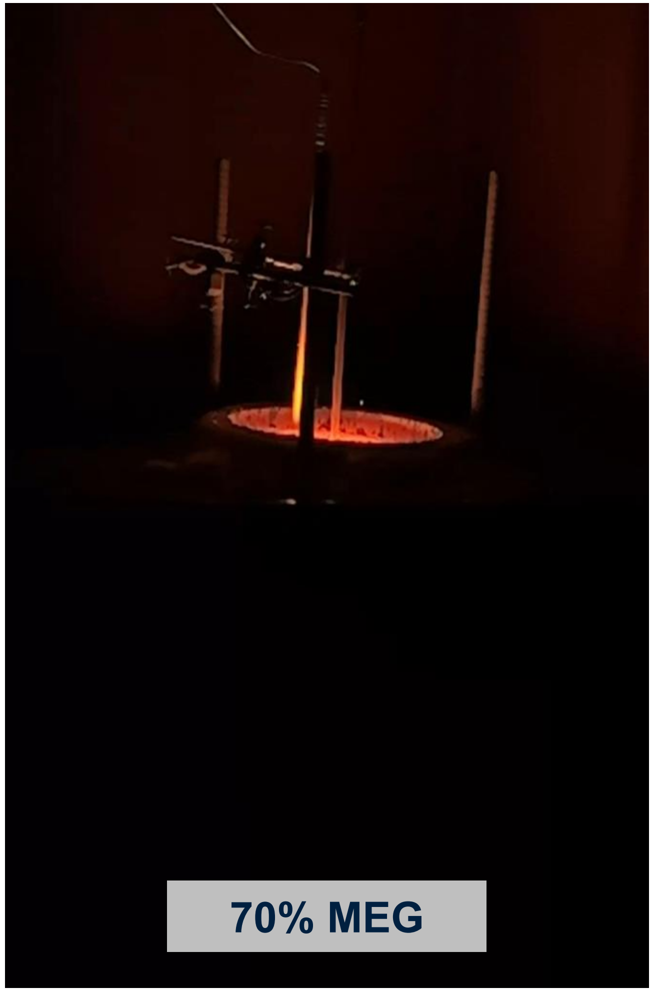
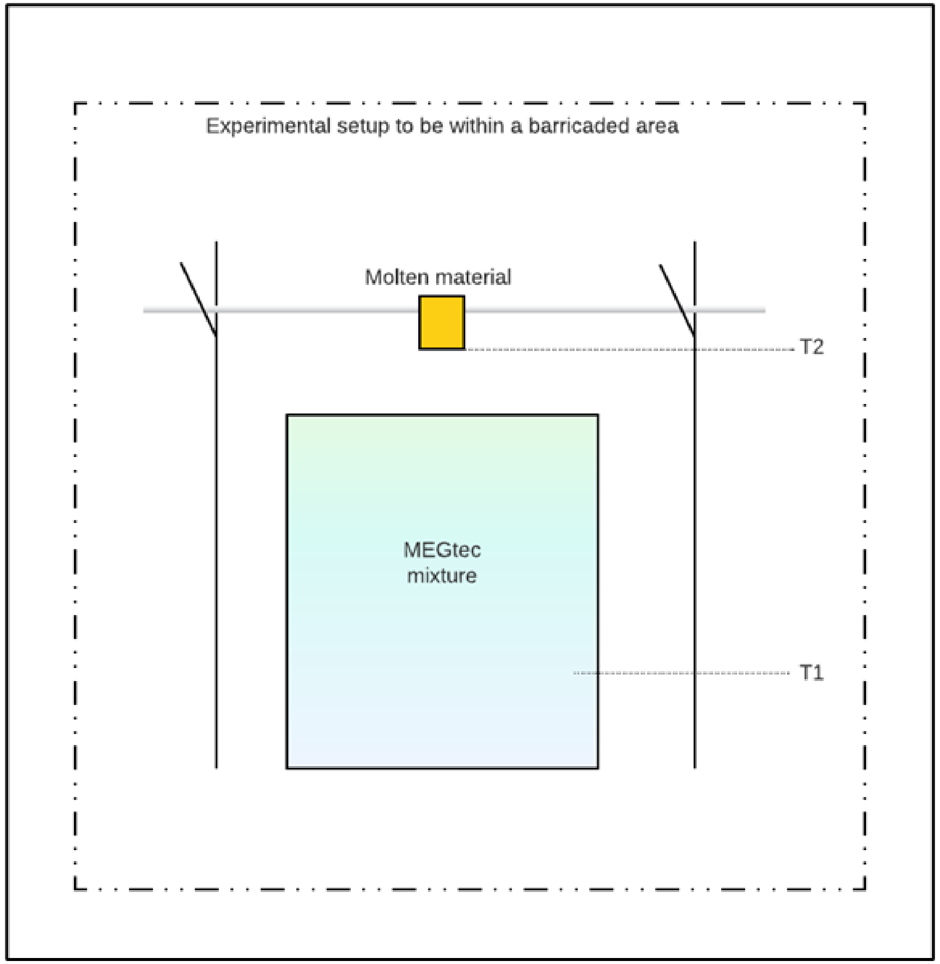
ADDING MEG TO MOLTEN MATERIAL - VISUALS





Explosion Safety Trials

SETUP 2: ADDING MOLTEN MATERIAL TO MEG



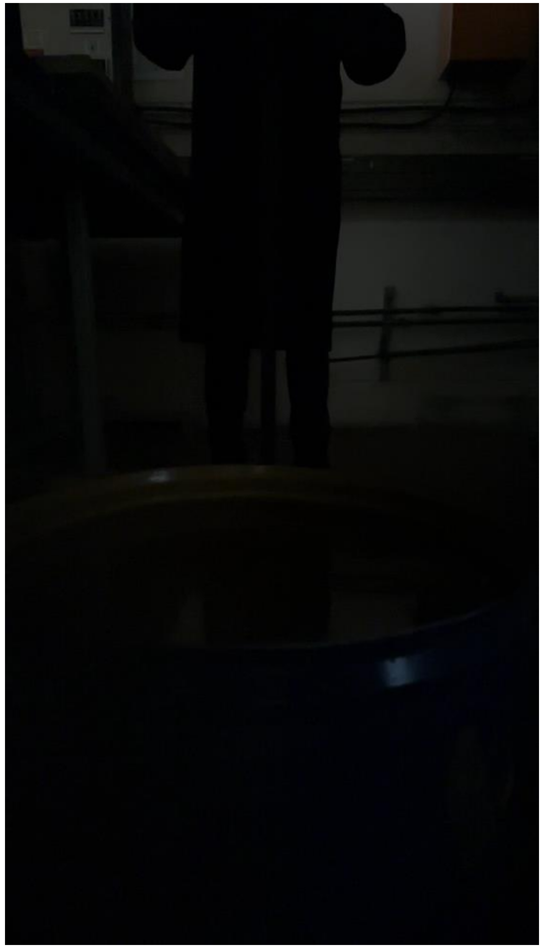
- Matte temperature: 1600°C

Test	Cooling agent	%MEG addition	%Water addition	Matte: coolant ratio	Height, mm
4	MOLT70	70	30	500 g: 10 L	400
5	MOLT30	30	70	200 g: 65 L	800
6	MOLT0	0	100	200 g: 600 mL	250

Explosion Safety Trials

ADDING MOLTEN MATERIAL TO MEG – MOLT70 AND MOLT30

MOLT70 – Flame + Slight Bubbling at the surface



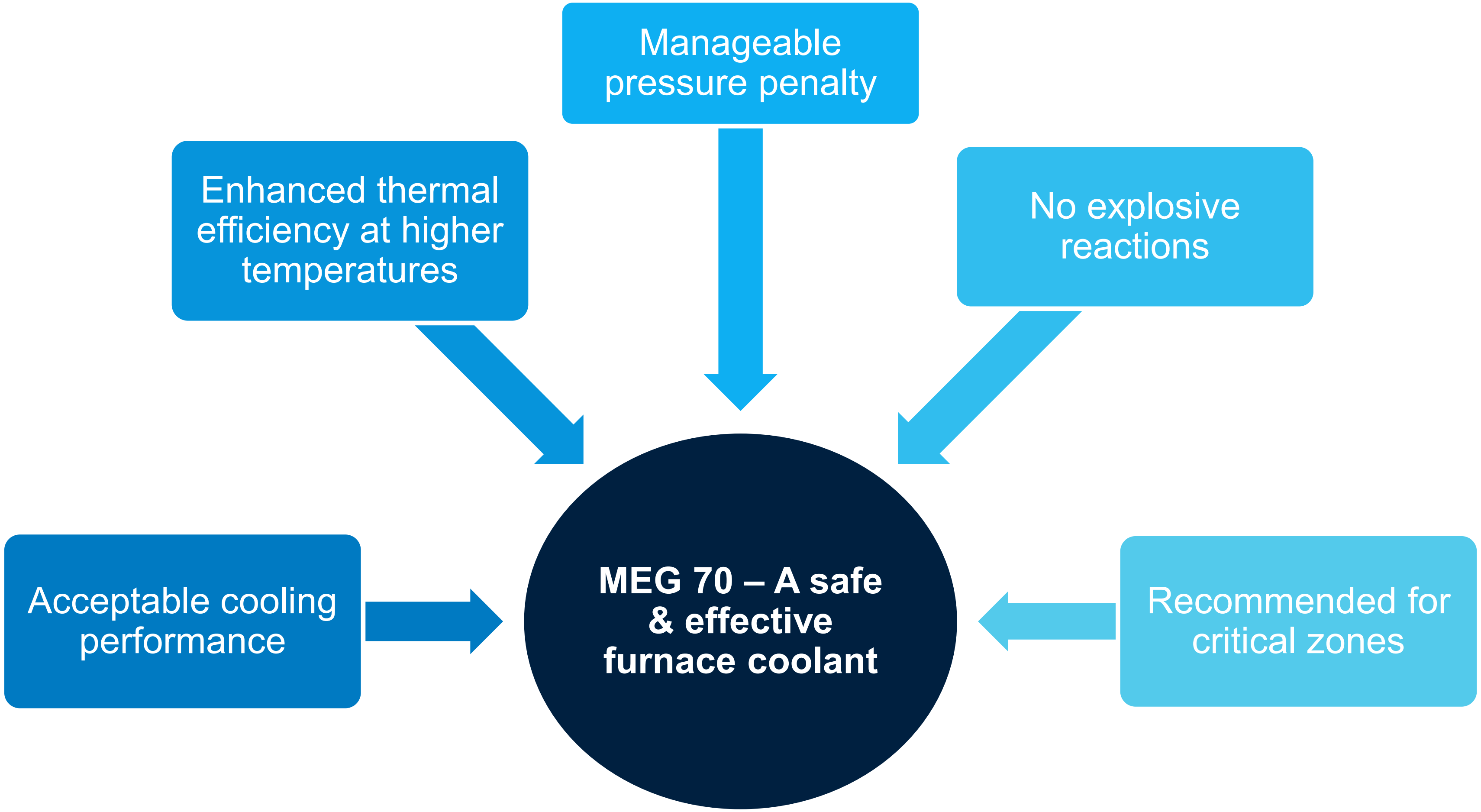
MOLT30 – No Flame

Explosion Safety Trials

ADDING MOLTEN MATERIAL TO MEG – 100% WATER

MOLT 0 – Rapid, loud gas eruption

Conclusions



Acknowledgements

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A global leader in mineral and metallurgical innovation

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for more discussions

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