Mechanical Performance of Latex-Enhanced Geopolymer Cement Systems Under Elevated Temperature and Pressure

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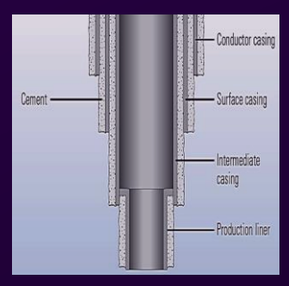
1 INTRODUCTION

- Cement integrity is critical in oil & gas wells.
- OPC faces CO_2 degradation under HTHP conditions.
- Geopolymer cement is a low-carbon alternative.
- Fluid loss control and early strength remain key challenges.



Well casing schematic
Source from: Reference [29]

Research Motivation

- Latex polymers (e.g., styrene–butadiene) are widely used for fluid loss control in cement systems.
- Evaluate the potential of latex to enhance geopolymer cement performance under elevated temperature and pressure conditions.
- Bridge the performance gap between ordinary Portland cement (OPC) and geopolymer cement..

How is latex significant to industry?

- Reduces Fluid Loss → Protects formation integrity
- Maintains Slurry Stability → Ensures reliable placement
- Controls Setting → Precise job timing
- Enhances Bonding → Long-term well durability

Research Objectives

To investigate the influence of styrene-butadiene latex (SBL) on:

- Compressive strength development
- Microstructural composition of geopolymer cement under HPHT conditions.

2 METHODOLOGY

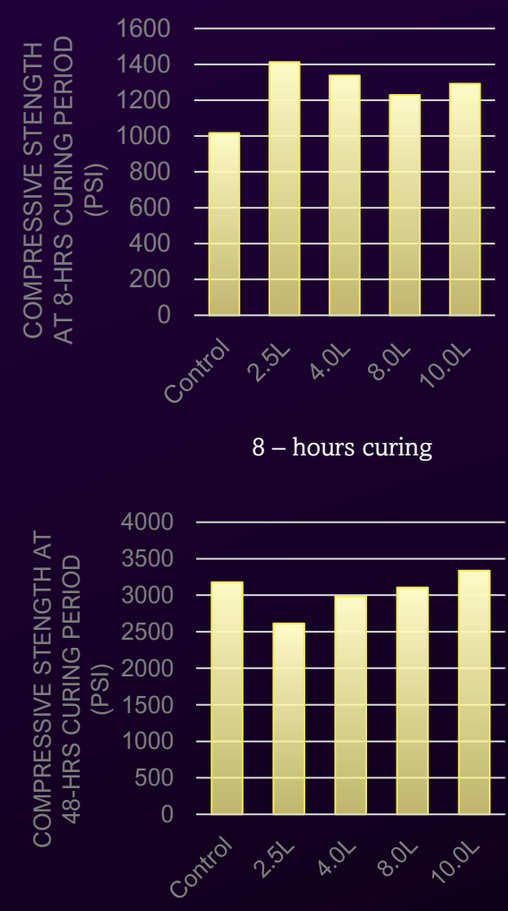



Material Preparation → Cement Mould Preparation → Compressive Strength Test → Morphology analysis

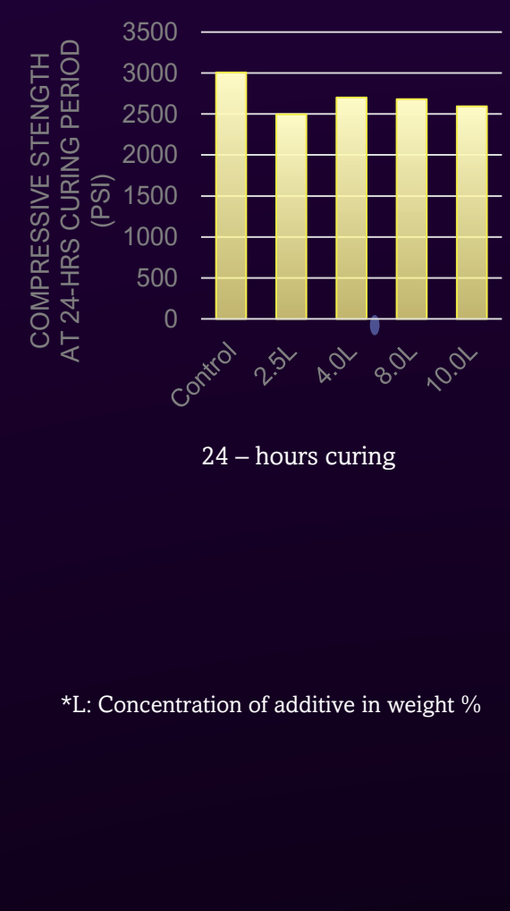
Temperature: 100 °C
Pressure: 3,000 psi
Duration: 8, 24 and 48 hours.

3 RESULTS

Compressive Strength



8 – hours curing



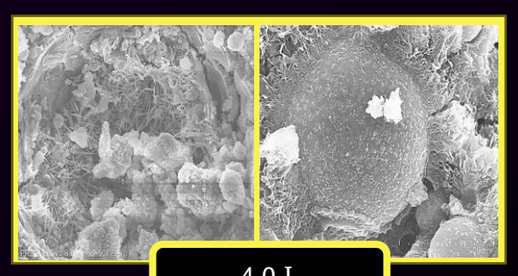
24 – hours curing

48 – hours curing

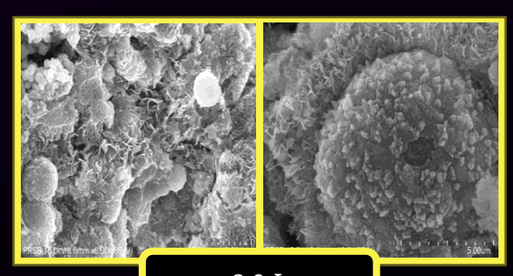
*L: Concentration of additive in weight %

Microstructural Observation (SEM) at 24-hours curing

Control



4.0 L



6.0 L

4 DISCUSSION

- Latex improves fluid retention to promotes early-stage geopolymerization → Ensures uniform reaction and consistent strength development in precast or in-situ applications.
- It promotes needle-shaped & networked structures → Better load transfer Increases toughness and load-bearing capacity, reducing cracking and failure in structural applications.
- It forms silica-rich film to strengthens particle bonding → Enhances adhesion between fly ash particles, improving durability and mechanical performance.
- Overdosage of latex resulted in free polymer accumulation creates weak zones

5 FUTURE WORK

- Study long-term durability and phase stability.
- Explore co-additive synergies.
- Scale-up under realistic wellbore simulations.

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