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Introduction

Improvements in brushite cements for bone substitution may offer clinicians increased opportunities for repairing bone. Current problems include site leakage, insufficient mechanical properties, slow replacement by new bone and infection.

Aim

This study aim was to develop fast-setting, high strength, porous and degradable, antibacterial-releasing brushite cements to help solve the above issues.

Materials & Methods

Monocalcium phosphate monohydrate (MCPM) was reacted with equimolar β -tricalcium phosphate (TCP) and 800mM aqueous citric acid (CA) containing 0-10 wt% of antibacterial ϵ -polylysine (PLS). The powder to liquid ratio was 4:1. Setting kinetics (by FTIR), biaxial flexural strengths, degradation rates, PLS release and antibacterial studies were undertaken.

Results

Increased PLS level led to formation of PLS/CA/Monetite complexes with multiple peaks above 1000 cm^{-1} and slower Brushite formation (see 980 cm^{-1} peak profile, inset in Fig 1). Placement of materials in water for 24 hours decreased strength by 15 MPa. Increase in PLS, however, caused a smaller reduction in strength (Fig 2). Dissolution rates were not significantly affected by PLS content (see inset Fig 3). Pores / channels with dimensions comparable with those of the original MCPM crystals were detected on the fracture surfaces (Fig 3). PLS release can stabilise within 24 hours and its release from the cement containing 8 wt% PLS was sufficient in the first 24 hours (Fig 4) to reduce MRSA growth in surrounding medium from 10^{10} down to less than 10^1 colony form units.

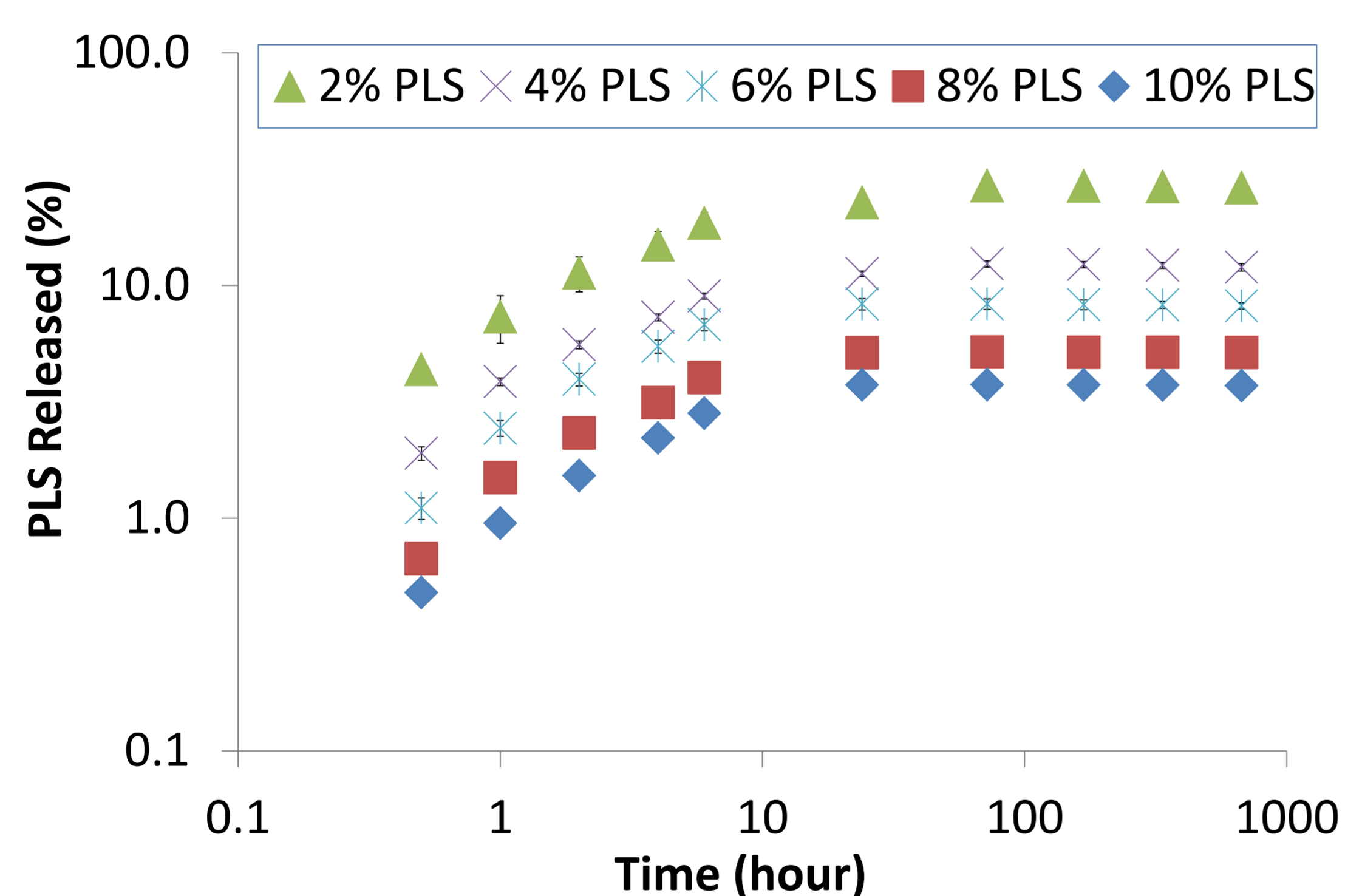


Fig 4: PLS release from brushite cement

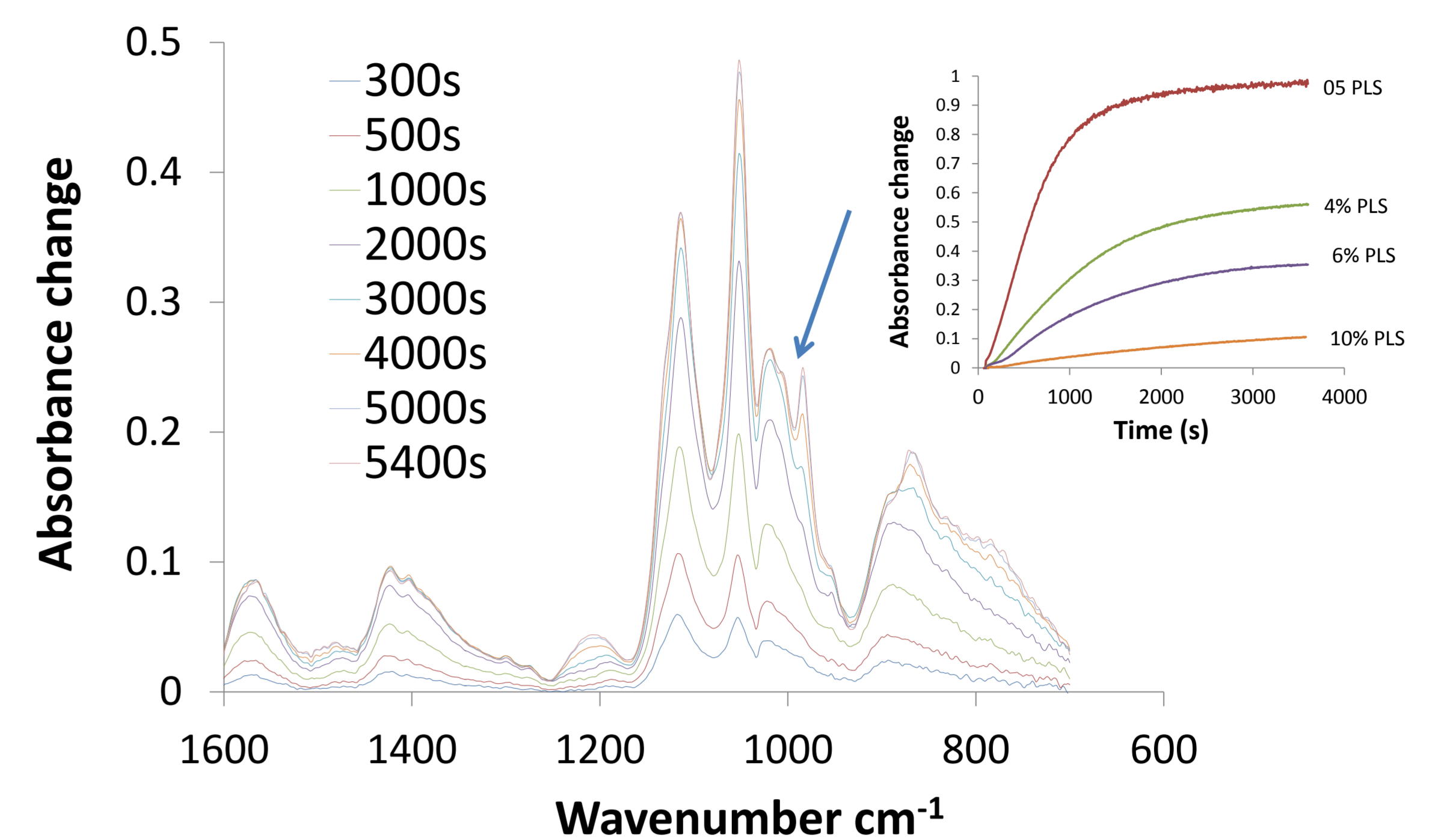


Fig 1: FTIR spectra of cement containing 4% PLS (inset: 980 cm^{-1} brushite peak profiles)

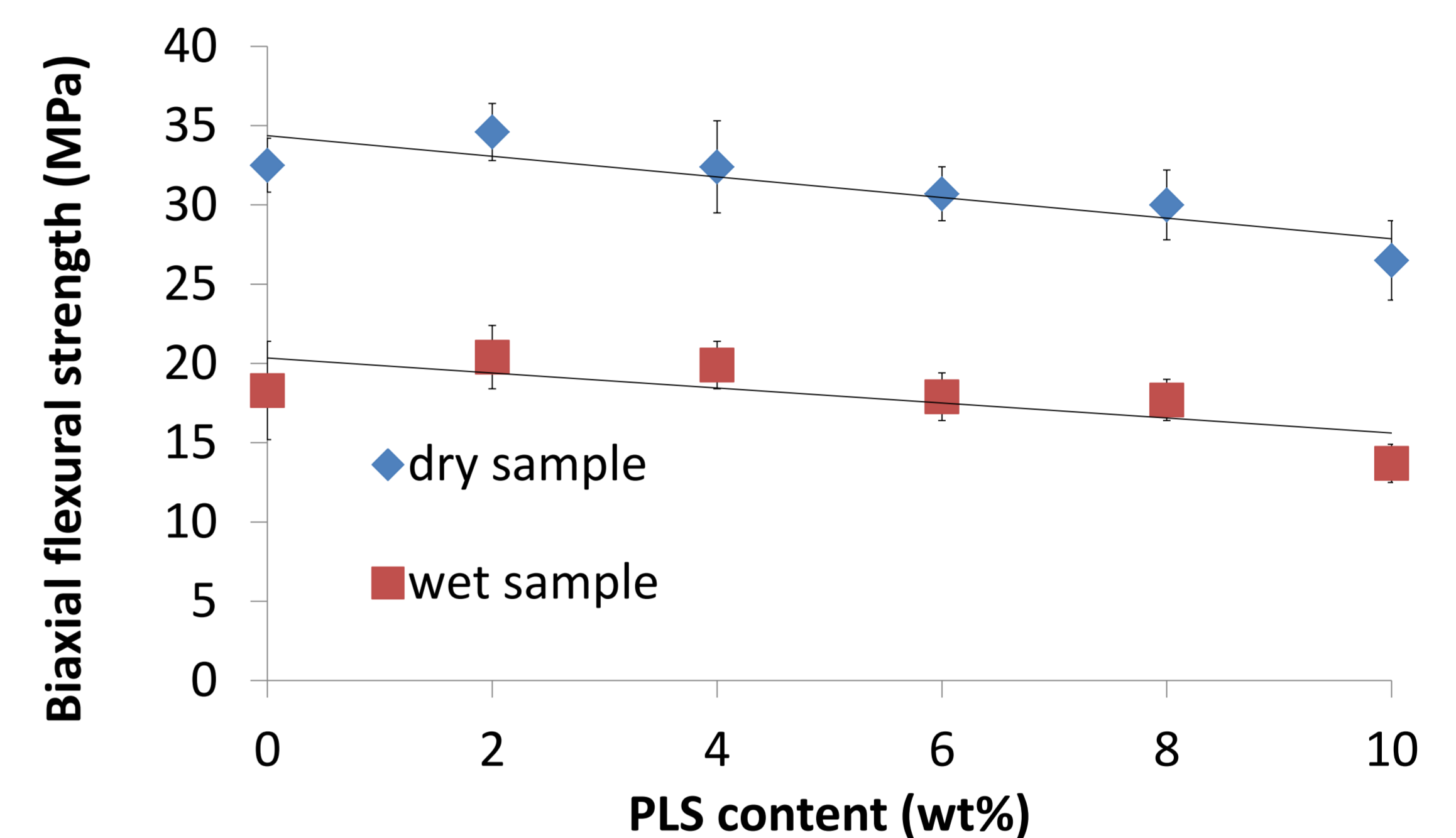


Fig 2: Biaxial flexural strength of antibacterial cement

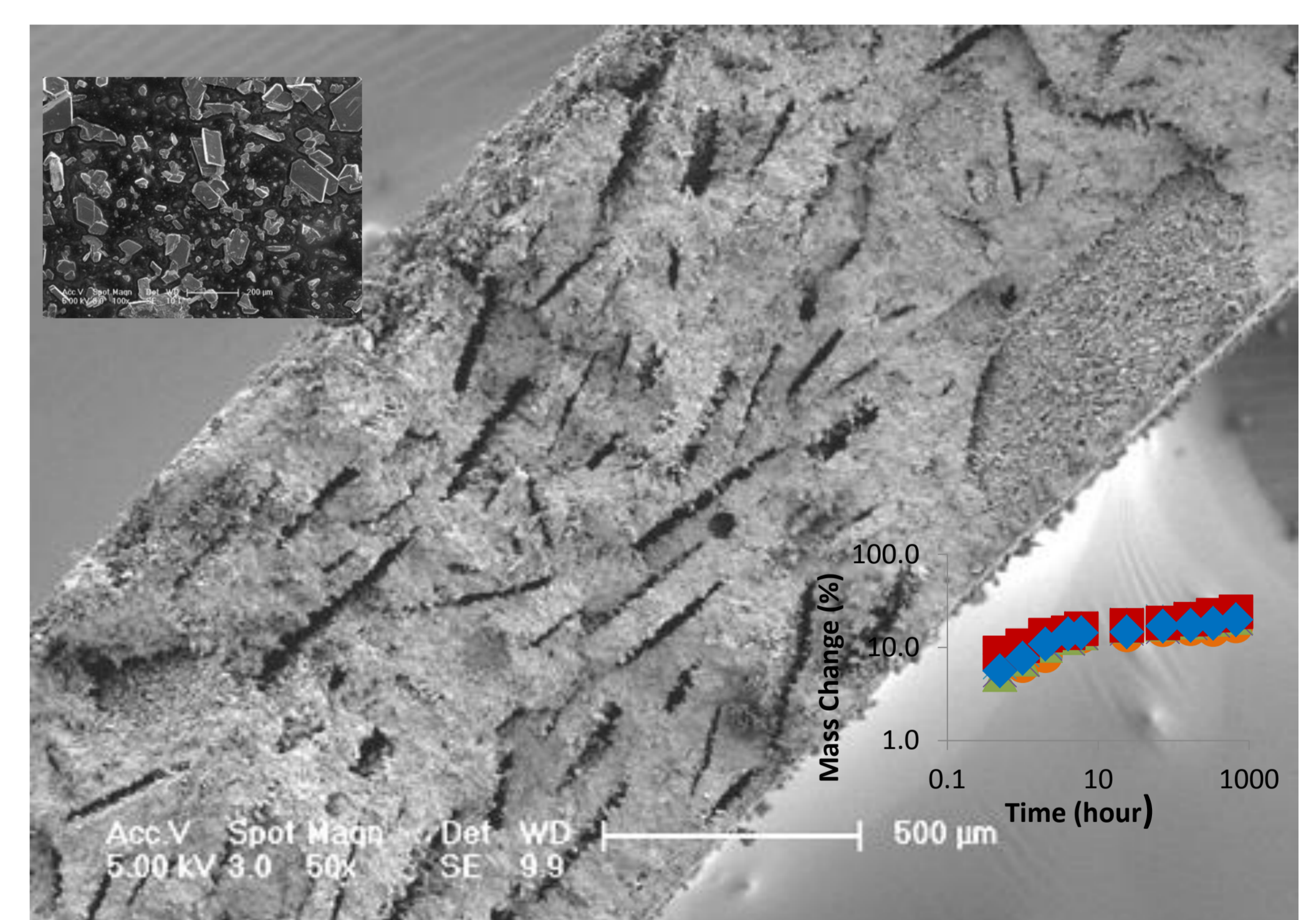


Fig 3: SEM images of fracture surface of cement (inset: mass change)

Conclusion

The above antibacterial Brushite cements could be employed in the treatment of infected bones. Controlled setting is required to minimise leakage away from the site of application. The high strengths will enable application in greater load bearing clinical situations. The channels in the cements and dissolution will also allow bone cell penetration and provide ions for new bone formation respectively.

Acknowledgments

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