Journal of Zhejiang University-SCIENCE A (Applied Physics & Engineering)

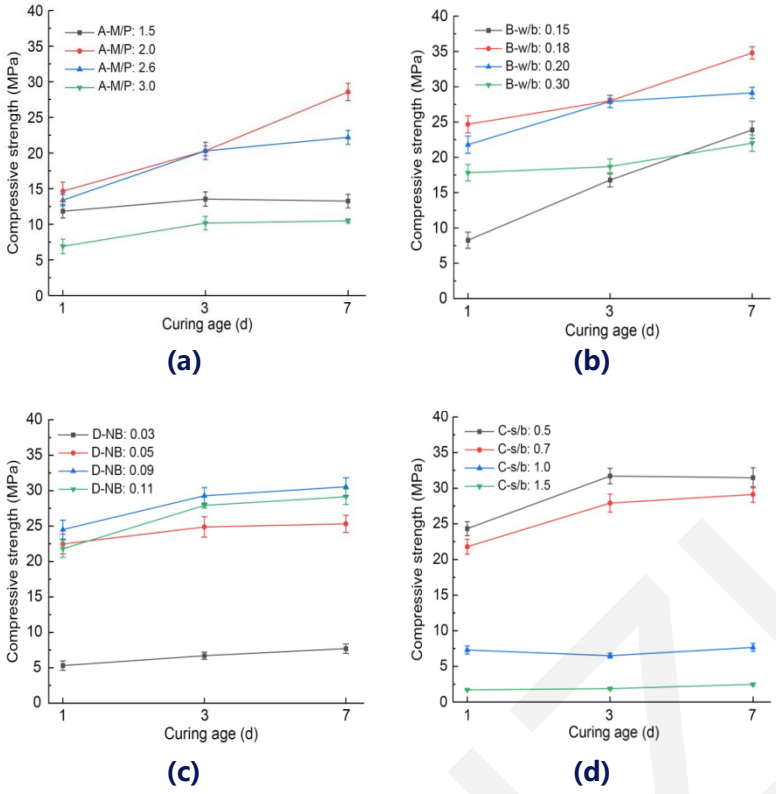
Effect of coral sand on the mechanical properties and hydration mechanism of magnesium potassium phosphate cement mortar

Authors: Hao LIU, Huamei YANG, Houzhen WEI, Jining YU, Qingshan MENG, Rongtao YAN

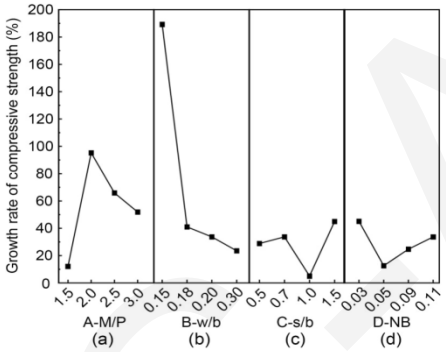
Key words: Magnesium potassium phosphate cement (MKPC); Coral sand (CS); Mechanical properties; Corrosion resistance; Hydration mechanism

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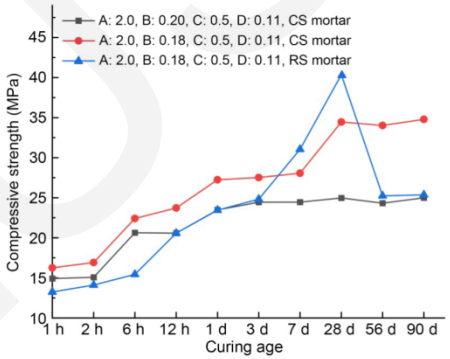
Compressive strength and corrosion resistance properties



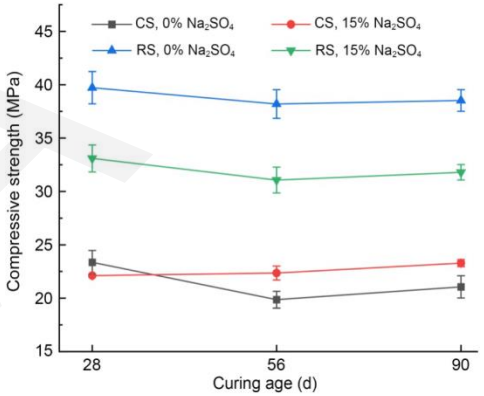
Compressive strengths of MKPC CS mortar under different mix proportions: (a) A-M/P; (b) B-w/b; (c) C-s/b; (d) D-NB



Compressive strength growth rates of MKPC CS mortar: (a) A-M/P; (b) B-w/b; (c) C-s/b; (d) D-NB



Compressive strengths of optimal proportions of MKPC CS mortar and RS mortar



Compressive strengths after immersion in the Na_2SO_4 solution

Corrosion resistance coefficients of MKPC CS mortar and RS mortar

Curing age (d)	*K*	
	CS	RS
28	0.95	0.83
56	1.13	0.82
90	1.11	0.83

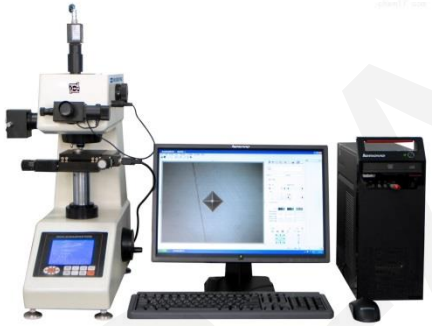
The compressive strength of MKPC CS mortar were better than those of MKPC RS mortar and remained stable after long-term immersion in water and Na_2SO_4 solution.

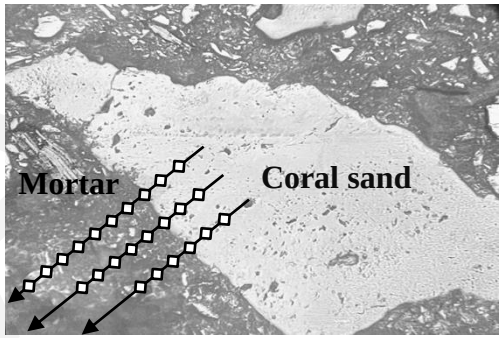
Micro- and Macro-Mechanical Properties of MKPC Mortar



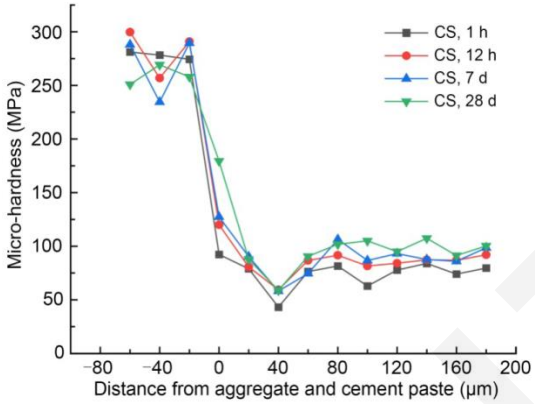


Compressive strength tests

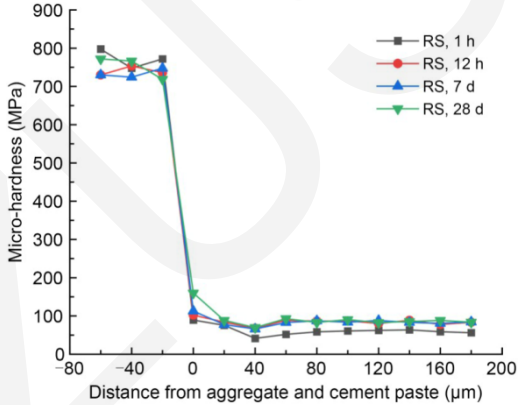




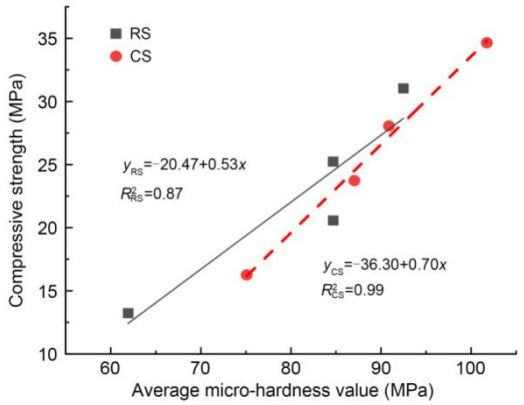
Micro-hardness tests



Micro-hardness values in the interfacial transition zone of MKPC CS mortar



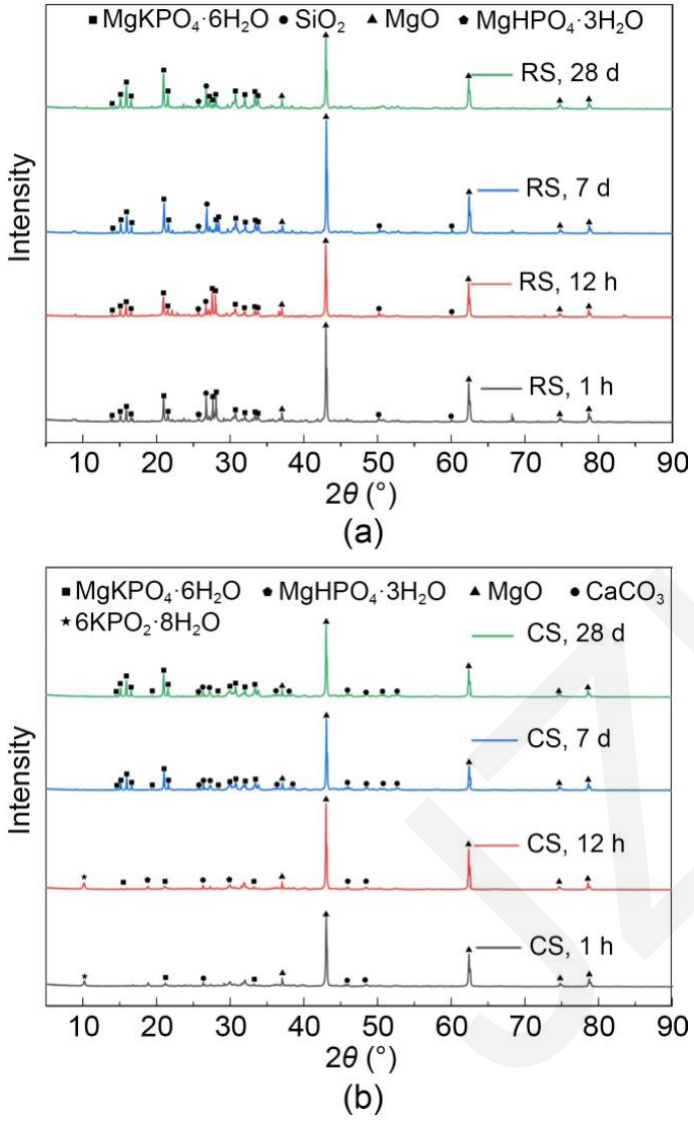
Micro-hardness values in the interfacial transition zone of MKPC RS mortar



Relationship between compressive strength and average micro-hardness value

The rough and porous surface of CS contribute to the filling of MKPC between the internal pores of particles, resulting in higher micro-hardness of MKPC CS mortar than that of MKPC RS mortar.

Phase composition and relative content analysis



XRD patterns for MKPC mortars: (a) RS mortar; (b) CS mortar

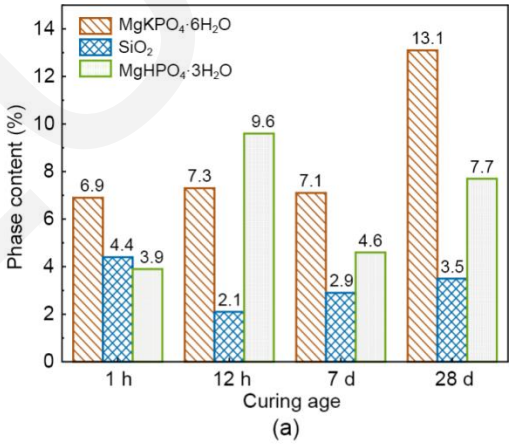
The relative content of the contained phases was quantified by the adiabatic method

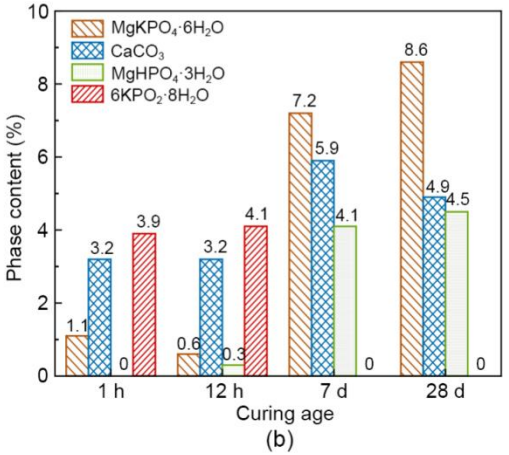
$$R=\sqrt{\frac{\sum\frac{(I_0-I_c)^2}{I_0}}{\sum I_0}}\times 100\%$$

$$w_s=\frac{I_s}{k_i^s\sum_{i=1}^{N}\frac{I_s}{k_i^s}},\quad k_i^s=\frac{k_c^s}{k_c^i}$$

Values of 2θ of the strongest diffraction peak of the material phases

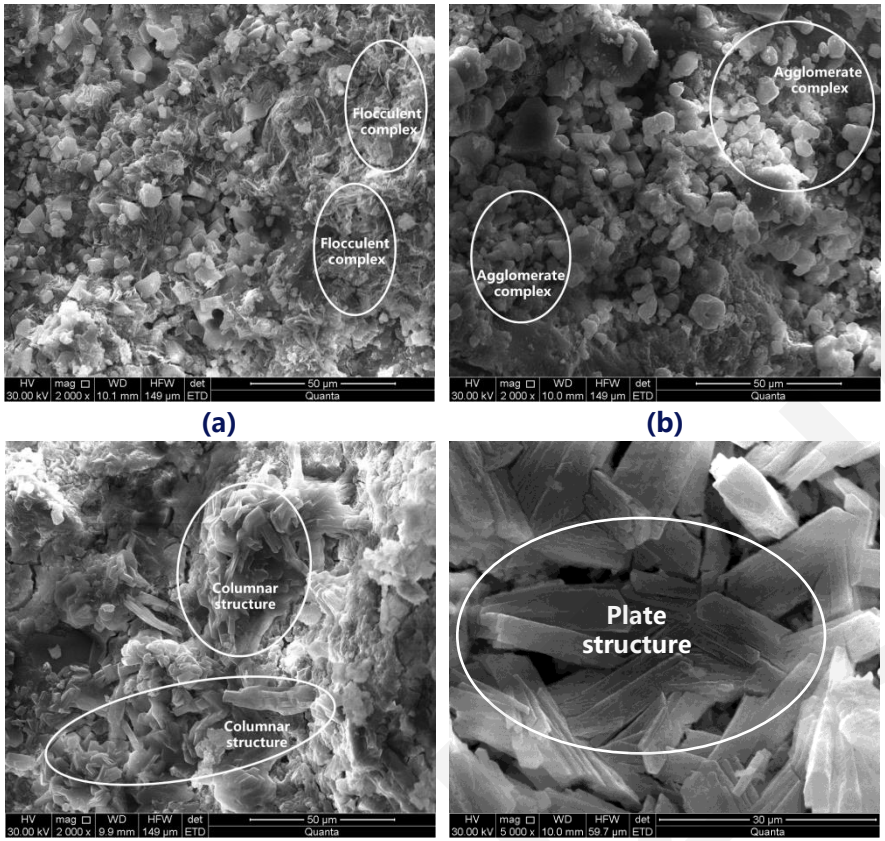
Material phase	2θ (°)
MgO	43.007
$MgKPO_4·6H_2O$	20.943
$MgHPO_4·3H_2O$	25.754
$6KPO_2·8H_2O$	10.17
SiO_2	26.734
$CaCO_3$	26.319





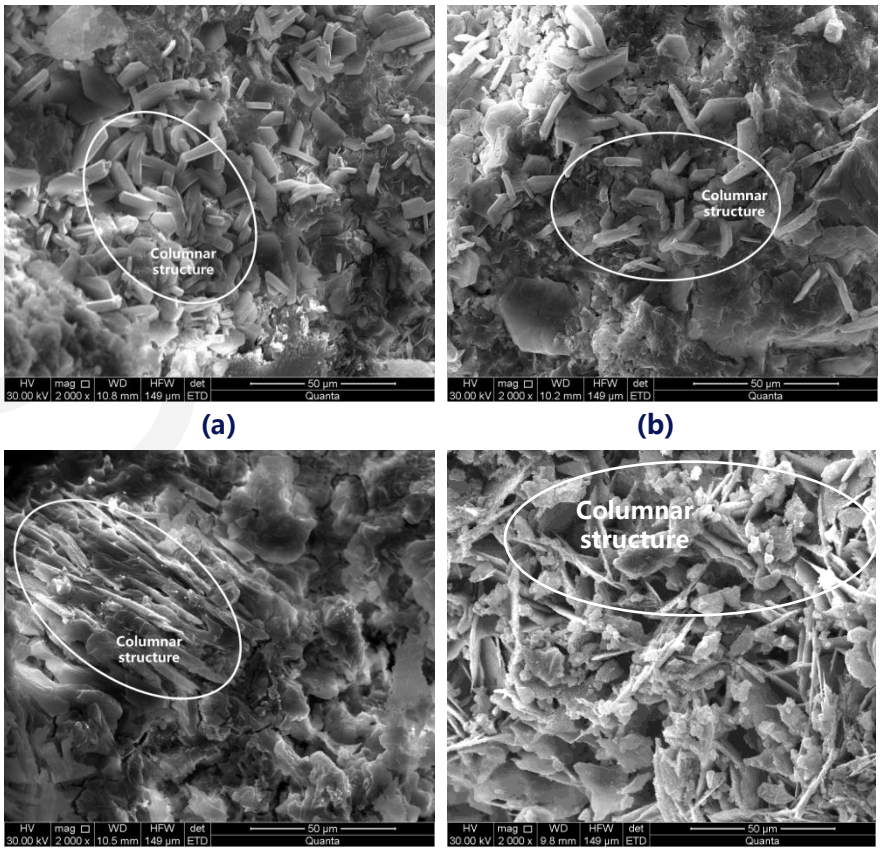
XRD quantitative analysis of phase content for MKPC mortars: (a) RS mortar; (b) CS mortar

The morphological and microstructural characteristics of hydration product phases



(a) (b) (c) (d)

SEM photographs of MKPC CS mortar after 1-h (a), 12-h (b), 7–d (c), and 28-d (b) curing times



(a) (b) (c) (d)

SEM photographs of MKPC RS mortar after 1-h (a), 12-h (b), 7–d (c), and 28-d (b) curing times

The morphology of CS mortar crystalline phases appeared flocculent, agglomerate, columnar, and plate sequentially with increased curing time, which behaved more compactable and regular.