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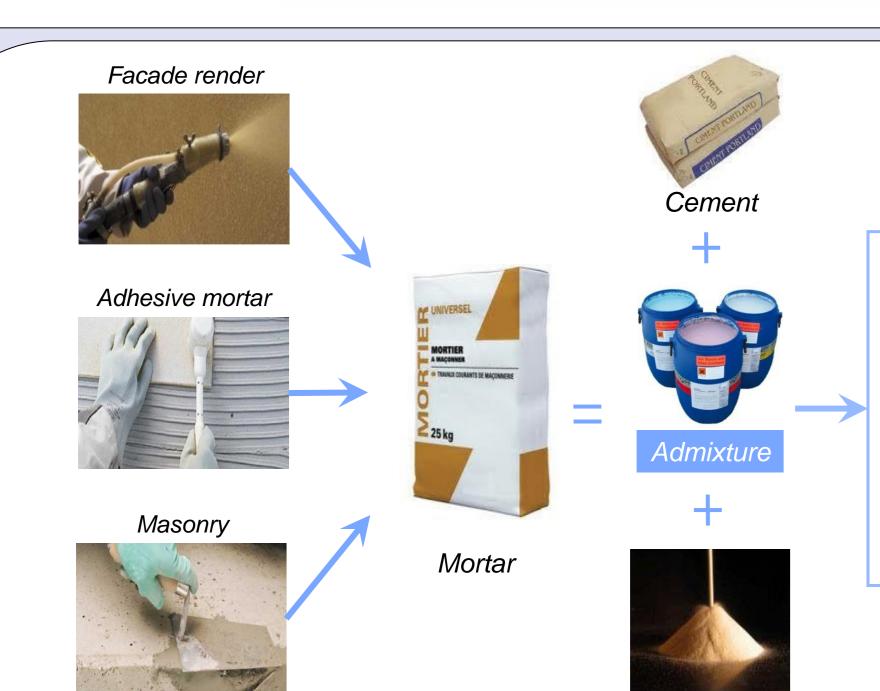
Impact of Guar Gum Derivatives on Properties of Freshly-Mixed Cement-Based Mortars



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Water Retention Agent (polysaccharide) Most widely used admixture: Cellulose Ethers ~ 1/3 of raw materials cost for only 0,5 wt%

Water Retention = Capacity of fresh mortar to keep its mixing water With Water Retention Agent Support Support Desired **Effect** Absorption of water by the substrate Mixing water stay into the fresh mortar → Good Mechanical and adhesive properties Adhesion Cracking failure

Polysaccharides are also expected to act as VEA

Major drawback: **Cement hydration** delay

Study of bio-based Water Retention and VEA admixture: Hydroxypropyl Guar (HPG)

─→ HPG 5

→ HPG 1 ---HPG 2

¥ ≥ 85

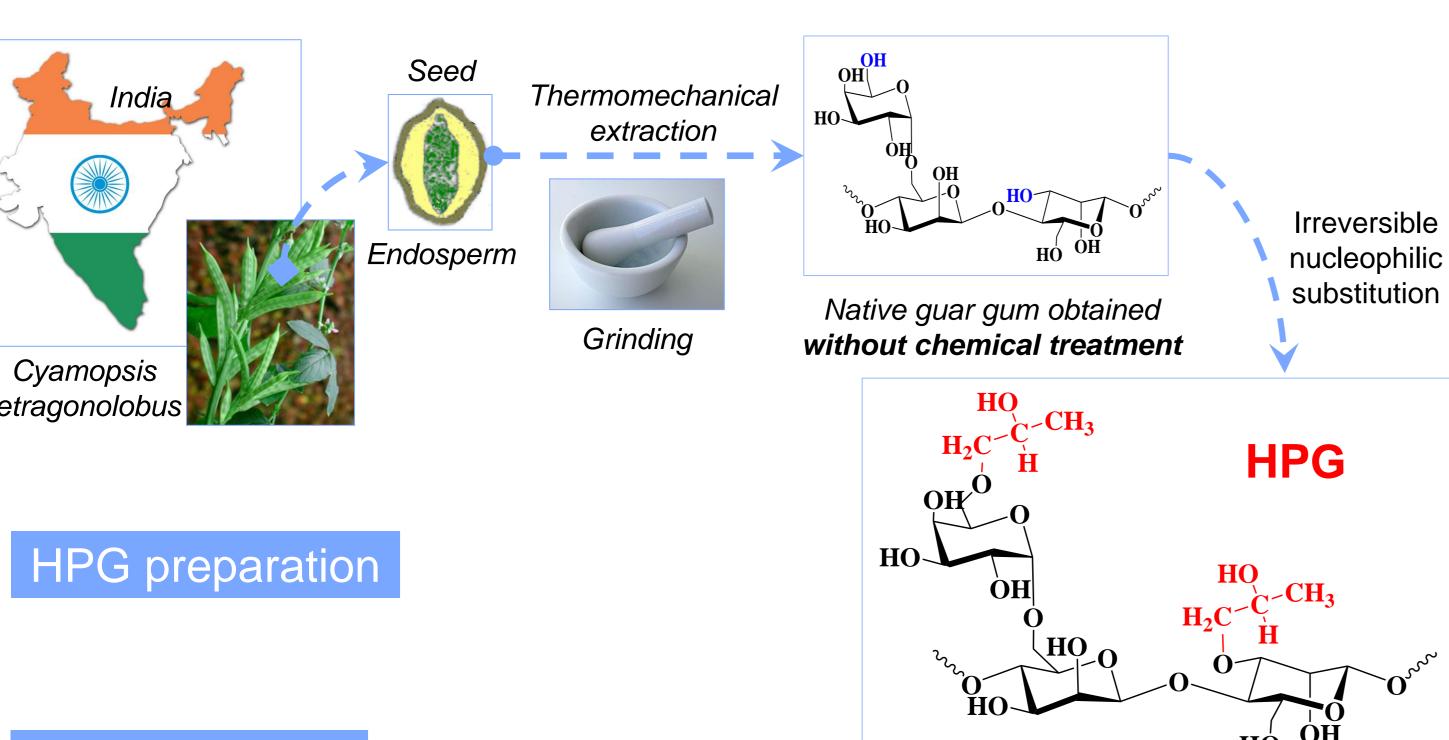
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Materials

HydroxyPropyl Guars

Saint-Étienne



HPG Studied

- > A native Guar Gum (GG) + 3 HPGs + 2 hydrophobically modified HPGs
- ➤ Roughly the same molecular weight (≈ 2.10⁶ Da)

Sample	MS _{HP}	Additional Substitution	DS _{AC}	
HPG 1	Low	-	-	
HPG 2	Medium	_	_	
HPG 3	High	_	_	
HPG 4	High	Short alkyl chain		
HPG 5	High	Short alkyl chain	Higher than HPG 4	
GG	-	_	-	

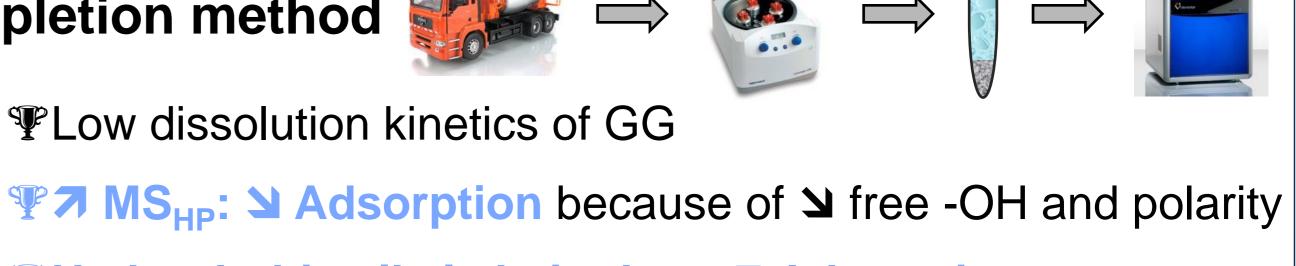
Mortar Formulation

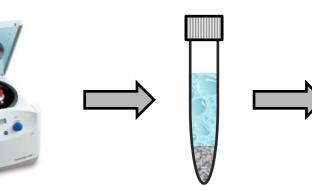
Component	CEM II/B- LL 32.5R	Lime	CaCO ₃	CaMg(CO ₃) ₂	Water
% mass of dry mixture	12 %	3 %	18 %	67 %	22 %

- ➤ Water-to-Binder ratio: W/B = 0.22
- ➤ Admixtures in addition to the binder: 0.05% 0.15% bwob

Adsorption

TOC - Centrifugation - Depletion method







PHydrophobic alkyl chain: Low 7 Adsorption Change in conformation of HPG (Simon et al.)

Alkyl chains inside the coils / Hydrophilic groups at the outskirt of the coils

Water Retention

Standard ASTM C 1506-09:

Polymer dosage (% bwob)

– 100% adsorption

$$WR(\%) = \frac{W_0 - W_1}{W_0} \times 100$$

Fexcepted GG, HPGs improve the WR capacity of mortars

To MS_{HP} improves the WR capacity MS_{HP HPG 1} < MS_{HP HPG 2} < MS_{HP HPG 3} Thanks to > Adsorption and thus 7 [HPG] in pore

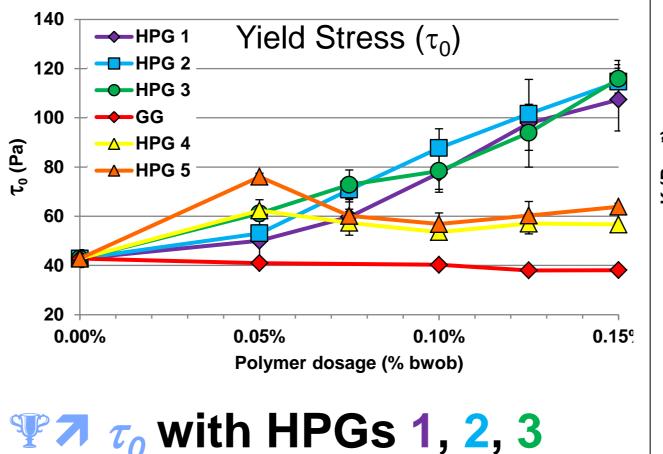
solution

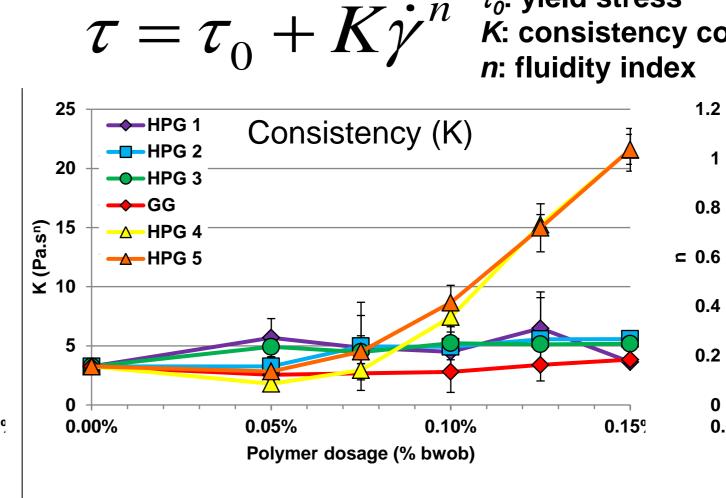
Positive impact of the additional alkyl chain 7 Adsorption compensated by 1 in coil overlapping concentration

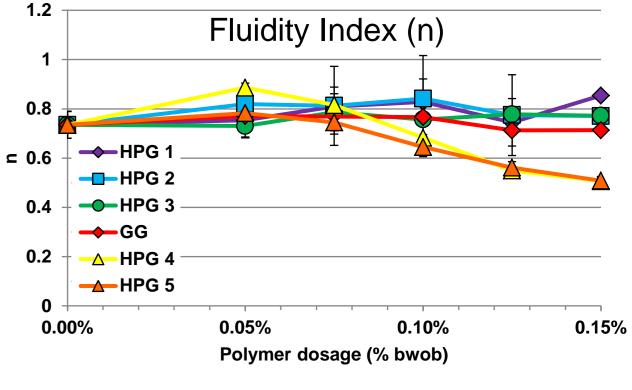
To DS Slightly reduces the WR capacity DS HP HPG 4 < DS HP HPG 5

Rheological properties of mortars

Herschel-Bulkley model:







Bridging flocculation

T MS_{HP} **≥** adsorption **≥** bridging compensated by η_0 and [HPG]

₹7 K and **≥** n with HPGs 4, 5

TRheological behavior of mortars imposed by the more and more shear thinning behavior of pore solution

Conclusions

Water Retention

- HPGs are good water retention agents
- Huge impact of HPG chemical composition
 - → 7 MS_{HP} promotes WR by 7 [HPG]
 - → Hydrophobic side chain promotes WR by > C*

Rheological properties

- ← HPGs act as VEA
- \leftarrow "Classical" HPGs 7 the stability of mortars by 7 τ_0
 - → Hydrophobically modified HPGs 7 the resistance to the flow of admixed mortars by **7** K

Chemical composition of HPGs is a key parameter of mortar formulation