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

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

Materials

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

- **Sample**
  - **MSHP**
  - **Additional Substitution**
  - **DSAC**
  - HPG 1: Low
  - HPG 2: Medium
  - HPG 3: High
  - HPG 4: Short alkyl chain
  - HPG 5: Higher than HPG 4

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

Water Retention

- Water Retention: Capacity of fresh mortar to keep its mixing water
  - With Water Retention Agent
  - Without Water Retention Agent

Adsorption

- TOC - Centrifugation - Depletion method
  - Low dissolution kinetics of GG
  - MSHP: Adsorption of GG because of free -OH and polarity
  - Hydrophobic alkyl chain: Low Adsorption in conformation of HPG (Simon et al.)
  - Alkyl chains inside the coils / Hydrophilic groups at the outside

Rheological properties of mortars

- Herschel-Bulkley model:
  - \( \tau = \tau_0 + K\gamma^n \)
  - \( \tau_0 \): yield stress
  - \( K\): consistency coefficient
  - \( n\): fluidity index

- \( K \) and \( n \) with HPGs 4, 5
- Adhesion, Cracking

Conclusions

- HPGs are good water retention agents
- Huge impact of HPG chemical composition
  - MSHP promotes WR by GG[HGP]
  - Hydrophobic side chain promotes WR by C

Chemical composition of HPGs is a key parameter of mortar formulation