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► **To cite this version:**

Cédric Roosz, Stéphane Gaboreau, Sylvain Grangeon, D. Prêt, V. Montouillout, et al.. Distribution of water in synthetic calcium silicate hydrates. 14ème Colloque du Groupe Français des Argiles, May 2016, Poitiers, France. hal-01297641

HAL Id: hal-01297641

<https://hal-brgm.archives-ouvertes.fr/hal-01297641>

Submitted on 4 Apr 2016

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Distribution of water in synthetic calcium silicate hydrates

Roosz, C.^{1,2,3}, Gaboreau, S.², Grangeon, S.², Prêt, D.¹, Montouillout, V.⁴, Maubec, N.²,
Ory, S.⁴, Blanc, P.², Vieillard, P.¹, Henocq, P.³

¹ UMR CNRS 7285 IC2MP, Université de Poitiers, Equipe HydrASA, rue Albert Turpain, Bat B8, 86022 Poitiers, France

² BRGM, Environment and Process Division, 3, avenue Claude Guillemin, F-45060 Orléans Cedex 2, France

³ Andra, 1/7 rue Jean Monnet, Parc de la Croix Blanche, 92298 Châtenay-Malabry Cedex, France

⁴ CNRS-CEMHTI UPR 3079, 1D Avenue de la Recherche Scientifique, 45071 Orléans, cedex 2 France

Courriel : s.gaboreau@brgm.fr

Calcium silicate hydrates (C-S-H) are of main importance to understand the behavior of cement materials, as they control most of the properties [1, 2] of these man-made materials. By analogy with clay minerals, their water content and structuration at the atomic scale certain have a major influence on their properties, which needs to be assessed. Here, we used a multiple analytical approach to quantify water distribution in C-S-H samples and to determine the relative proportions of water sorbed on external and internal (interlayer) surfaces. Water vapor isotherms were used to explain the water distribution in the C-S-H microstructure. As for many layered compound, C-S-H have external and internal (interlayer) surfaces displaying multilayer adsorption of water molecules on external surfaces owing to the hydrophilic surfaces. Interlayer water was also quantified from water vapor isotherm, XRD and TGA data displaying non-reversible swelling/shrinkage behavior in response to drying/rewetting cycle. From this quantification most of the scattered data already published could be explained according to the different conditions of humidity and technics of measurement (Figure 1). Stoichiometric formula of the different C-S-H samples analyzed ($0.6 < \text{Ca/Si} < 1.6$) were proposed considering the interlayer water contribution.

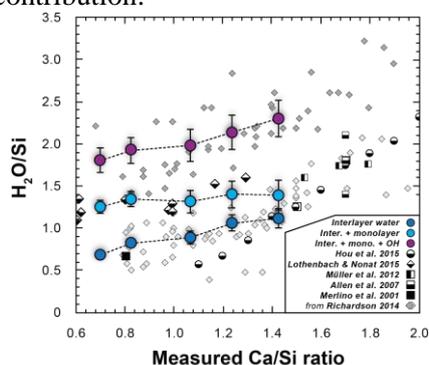


Figure 1. Plots of H₂O/Si against Ca/Si with the gray diamonds are adapted from 5. The blue circles are for interlayer water, the light blue ones for interlayer water and a single adsorbed monolayer and the purple ones are with the contribution of hydroxyls from this work.

Remerciements :

The results presented in this article were collected during the GL-Thermochimie project granted by Andra in the framework of Andra/BRGM scientific partnership

Références :

- [1] Bonnaud, P. A.; Ji, Q.; Coasne, B.; Pellenq, R. J. M.; Van Vliet, K. J. Thermodynamics of Water Confined in Porous Calcium-Silicate-Hydrates. *Langmuir* 2012, 28 (31), 11422-11432.
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