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THE EUROPEAN SOCIETY OF RHEOLOGY

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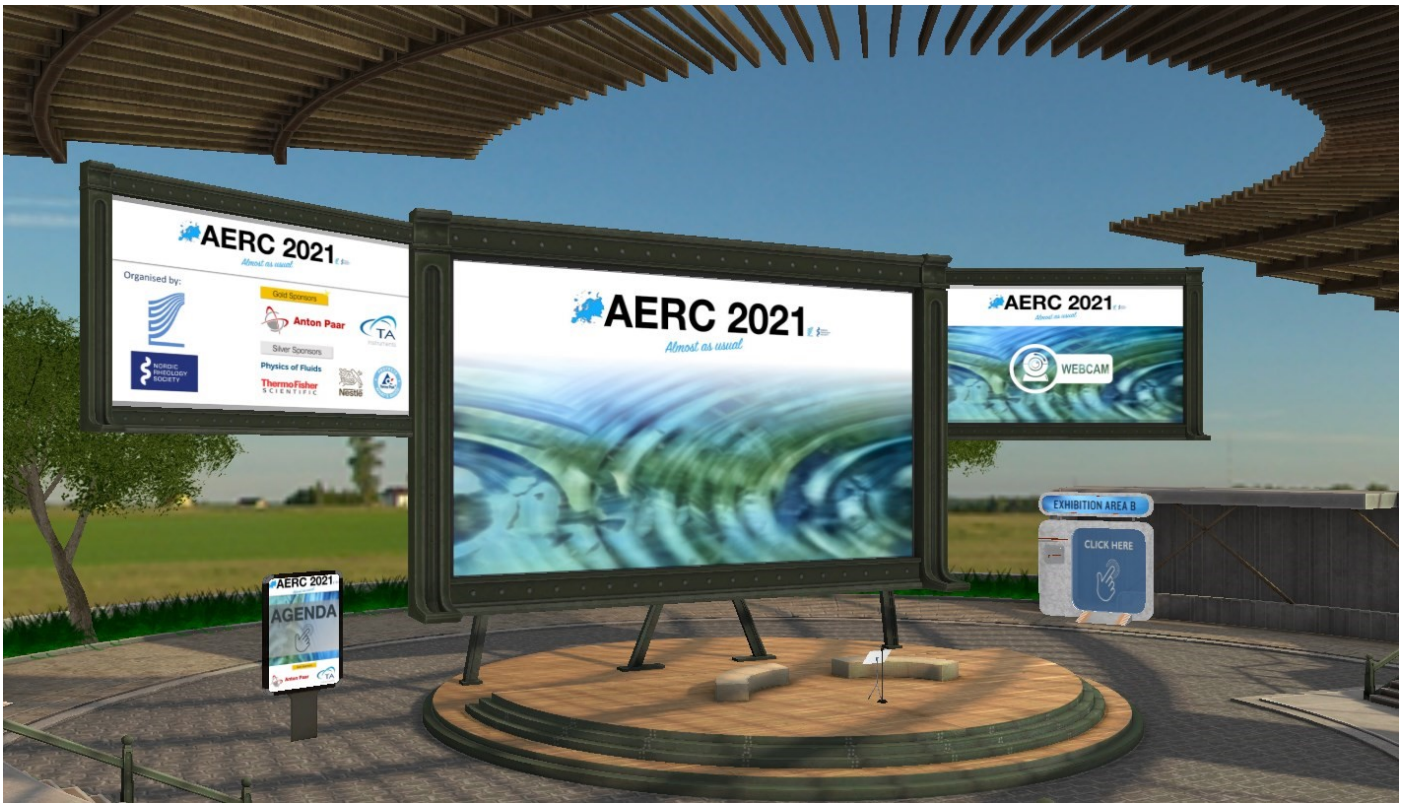
## *14th Annual European Rheology Conference*

Cyberspace

April 13-15, 2021

# BOOK OF ABSTRACTS



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Refs: [1] Nature Nanotechnology 12, 283 (2017). [2] Nat Nanotechnol 12, 343-350 (2017). [3] PoF 26, 033101 (2014). [4] JoR, 64(1), 81-93 (2020). [5] JoR, 64(1), 43-54 (2020).

Wednesday 11:00 Virtual / Track 12 CS37

## Shear-induced glass-to-crystal transition in anisotropic clay-like suspensions

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We report and elucidate a rarely observed glass-to-crystal transition happening upon flow cessation, after a period of shear, in a system of anisotropic clay-like colloids. We first present a new simulation strategy to study the structure evolution and mechanical response of anisotropically charged, plate-like colloids to a shear flow. Hydrodynamics are computed using an extension of Accelerated Stokesian Dynamics for anisotropic objects, and electrostatics are accounted for with a site model including charge renormalization. We then briefly present the structures obtained in quiescent conditions as a function of volume fraction and salt concentration, and we confirm previous results obtained on clay-like systems with different numerical methods, in particular the existence of bonded or non-bonded glasses and different gel states. The main results of this work concern the study of partial orientational and positional ordering of initially glassy suspensions by shear and the subsequent evolution towards a nematic crystal upon flow cessation. The detailed mechanisms at play are elucidated by examining time-resolved statistical information on the structure and on the hydrodynamic and electrostatic stresses that develop as shear is started and stopped. The key for shear-induced partial ordering is the forced alignment of platelets upon shear startup, which unlocks translational degrees of freedom in the initially arrested state. Hexagonally packed strings of platelets are thus formed under shear. A crystal cannot be obtained at this point due to the continuous hydrodynamic forcing, but the flowing structure is then energetically sufficiently close to the crystal state for the latter to be reached after flow cessation. This mechanism involving a flow-induced weakening of the translation-orientation coupling could be actually quite generic for other suspensions of strongly anisotropic colloids interacting at long range.

Wednesday 11:20 Virtual / Track 12 CS38

## The role of the water soluble organic carbon of soils on the stability of natural slurries

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Mudflows are real natural hazards; many studies have been performed to prevent these disasters. Triggering and evolution of mudflows depend on several factors, and one of them is the soil organic carbon (SOC) content. In previous studies, we analysed the stabilizing effect of the SOC on the rheology of natural soil-water slurries [e.g., Carotenuto et al., Earth Planet. Sci. 16:89(2016)]. We tested samples with their original SOC and with fractions of it, selectively removed with specific treatments. Mild treatments remove the dissolved organic carbon (DOC) which is the SOC water soluble fraction weakly linked to the soil mineral matrix, while strong treatments can act on the intimately linked SOC. Samples with similar granulometry and mineralogy were collected from two sites: one involved (Cervinara, South Italy-SOC=8,51g/Kg) and one never involved (Camposauro, South Italy-SOC=76,4g/kg) in a landslide. The yield stress and the viscosity of slurries can affect the mudflow trigger and propagation, respectively; we demonstrated that they both decrease by reducing SOC. DOC can stabilize the slurry made with Cervinara soil while it is less effective with Camposauro's one.

A rain can solubilize the soil DOC fraction. We here investigated the stability of a slurry prepared with soils subjected to different water-treatments: a) "wetted", b) "washed". In both cases the soil is immersed in water. In the case a), it is dried without spilling any liquid; in the case b), after the solid decantation, the clear liquid is spilled and then the sample is dried. We showed with rheological measurements and granulometric tests that it is enough to wet the soil to destabilize the slurry similarly to the case when the DOC is removed for Cervinara sample, while for Camposauro soil both water-treatments, though destabilizing the sample, do not act as the total DOC removal does. These results suggest that a soil prone to be involved in a mudflow can be destabilized by a meteoric event preceding the one that triggers the landslide.

Wednesday 11:40 Virtual / Track 12 CS39

## Proving attraction nature on cementitious materials through oscillatory rheology

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Oscillatory rheology has proved a promising method to measure the nature of interactions between particles of inorganic materials [1]. One of the most widespread materials is Ordinary Portland Cement (OPC), for which interactions are known to be "strong-short-range attraction" [2]. Due to its substantial environmental impact, alternative materials such as Alkali-Activated Binders (AABs) have been developed since the 1930s [3], but are not well characterized yet.

In this work, oscillatory rheology is applied to both cementitious materials: OPC and AAB pastes are characterized and compared to a model material, a calcite suspension. The interstitial solution composition of the AAB is also varied (i.e. $Ca^{2+}$ concentration). The elastic properties (elastic modulus and critical strain amplitude at which the paste yields) are measured as a function of volume concentration of particles, in a range for which an "attractive gel-like behavior" is observed [4]. The amplitude of this concentration range depends on the extension length of the interparticle forces, and on their nature. At first, we characterized the elastic domains (dominated by interaction forces) using a classic fractal model. Then, we extracted the fractal dimensions of the flocs formed upon self-assembly of the primary particles, using the method by Shi et al. [4].

We found that the nature of interactions in AAB is intermediate between cement and calcite pastes [5], explaining the difference in their fresh behaviors. Results suggest that the interstitial solution composition in AABs plays a key role in determining and optimizing their properties (i.e. surface potential, superplasticizer effect, setting time...).

[1] Liberto et al. JCIS, 2019. [2] Jönsson et al. Langmuir, 2016. [3] Shi et al. Alkali-activated cement and concretes, 2003. [4] Shih et al. PRA, 1990. [5] Liberto et al. Soft Matter, 2017.