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INNOVATIVE "GREEN" VISCOSITY AGENT FOR THE CONCRETE INDUSTRY!

Context

Competitiveness in the construction industry depends primarily on improving construction rates, reducing associated costs and improving the quality and service life of the finished product. The development and use of high value-added products, such as flowable concretes with adapted rheology (FCARs), are becoming a very important issue. FCARs have mechanical and durability properties comparable and even superior to those of vibrated concrete. FCARs are booming today and will play an important role in improving productivity and reducing overall construction costs in the years to come. For example, self-compacting concrete (SCC), a type of FCAR, is gradually gaining acceptance as a replacement for vibratory placed concrete in a wide range of applications. SCC is considered one of the most significant technological advances that have taken place in the concrete industry over the years.

The formulation of SCCs is initially based on the use of mineral additions with variable characteristics and superplasticizer (SP) to reduce the flow threshold and improve the fluidity, without increasing the water/cement ratio (W/C). However, this high fluidity can lead to instability characterized by separation of particles with varying densities. The higher density particles tend to settle downwards (segregation), while the less dense laitance rises to the surface (bleeding). This instability can greatly affect flow performance, including blockage during pumping, consistency of mechanical properties in the hardened state, and durability of concrete infrastructure. A viscosity agent (VA) is then used to improve the cohesion of the matrix, which makes it possible to keep the various particles in suspension. *Viscosity agents used in concrete are water-soluble polymers of high molecular weight. These agents are of microbial, or plant origin obtained using expensive preparation and transformation processes (e.g.: fermentation). In addition to increasing the cost of producing concrete, these admixtures can contribute to the release of toxic by-products into the environment.* **Considering the current market trend, the demand for environmentally friendly products is growing. The development of natural VA from a renewable source will reduce the production cost of FCARs associated with the high cost of standard VA and its environmental impact. Furthermore, the application of natural VA modified concrete in the construction industry will contribute to develop more sustainable and environmentally responsible building materials.**

TECHNOLOGY

Our invention solves these problems: a high-performance biopolymer based on red algae polysaccharides to improve the performance of BFRA: carrageenans. These are natural colloidal agents (or viscosity agents (VA)) capable of replacing the polymeric VAs currently used in concrete. More specifically, this innovation bridges several gaps in SCC technology, where the polymers conventionally used (SPs and viscosity agents) do not promote effective dispersion or stability of concrete due to SP/viscosity agent incompatibility issues, delayed setting, air capture, “young age” resistance development, shrinkage, and other issues. **This new AV is very effective at modifying rheology, reducing bleeding and improving the stability of cementitious suspensions compared to commercial colloidal agents currently available on the market.**

The Atlantic coasts of Quebec and Canada abound in marine algae; they constitute an invaluable source of natural polymers with interesting viscosity or thixotropic properties. These new biopolymers are available at low cost and are environmentally friendly (renewable and biodegradable). No product currently on the market offers the same benefits as this new VA (Yahia et al., 2020).

ADVANTAGES

TECHNICAL ADVANTAGES

- **Thickening and gelling power** to improve rheology and volumetric stability of cementitious suspensions - Figure 1; Figure 2.
- **Naturally sourced** – clean, non-chemical AV.

COMMERCIAL ADVANTAGES

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- **Great market opportunity** due to the continuous growth of the construction industry and its need to develop materials more suitable to the requirements of new applications, with a reduced environmental impact.
- **Reduces the production costs** of cementitious materials associated with the high cost of standard VAs (Welan gum, starch, cellulose, etc.); as well as reduces the amount of cement in concrete.
- **The concrete admixtures market** (including VAs) has been estimated to reach approximately USD 13,500 million by 2020. The market is expected to register a CAGR of over 6% during the forecast period (2021-2026).
- **The self-compacting concrete** (SCC) market is expanding (USD 18.60 billion by 2028).
- **Natural and abundant** AV from marine algae.
- **Easy** to manufacture.

APPLICATIONS

- High and ultra-high performance fluid concretes (HPC, UHPC).
- Companies of interest :
    - Concrete chemical admixture companies, concrete producers, and construction companies that:
        - Are looking for low-cost bio-based products;
        - Are looking for new technologies to improve concrete performance, including adapting admixture formulations to meet very specific seasonal conditions; and
        - Will be able to offer a new range of admixture products that are in high demand.

Technology Readiness Level (TRL)

Technology maturity level (TRL): TRL 3-4. Project in progress for the development of the technology.

Intellectual Property

Patent application filed in Canada and US.

Seeking

- Development partners
- Investors
- Licensing

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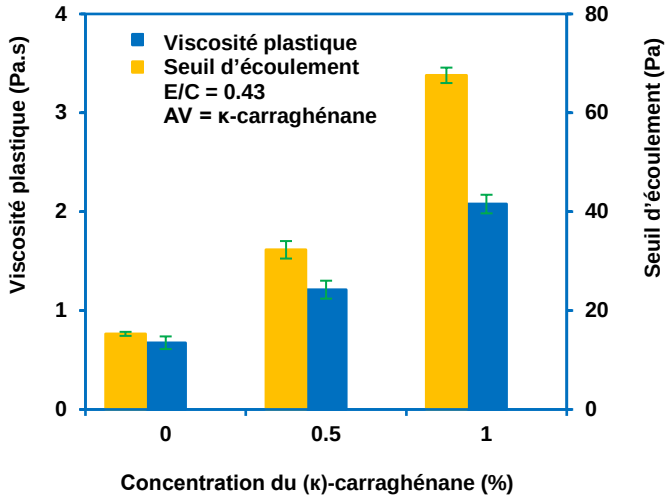
PROOF OF CONCEPT

Figure 1

Photo courtesy of A. Boukhatem (2019).

Figure 2



Variation of flow threshold and plastic viscosity of cement paste mixtures with (κ)-carrageenan concentration (Yahia et *al.*, 2020).