Marine bio-glue: from molecular characterization to applications in wet environments

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Background

- Sources of inspiration to produce natural or synthetic bio-adhesives are diverse. Biological compounds are also to find in different types of tissues and abiotic surfaces.
- Glues and adhesives inspired by nature are a great source for biomimetic developments, and have multiple interests regarding their area of use in industrial processes.

Production of envelopes

- Lamination of tissue
- Types and functions
- bacillary glues
- Production of glues
- bacillary glues
- Bacillary glues

Industrial applications

- Coated paper
- Manufacturing of glues
- Bacillary glues

Back binding

Bioinspired compounds

Bioinspired glues are produced by a wide diversity of organisms. Some are used in multiple industrial processes.

Objectives

At first, our project focuses on general approaches to identify and characterize organic compounds and molecular patterns used by Polychaeta species for adhesion. Second, in collaboration with our industrial partner, the R&D team “Produits, Systèmes et Solutions” of Saint-Gobain Isover, biomimetic approaches will be employed to adapt and transfer the molecules and functions to industrial processes.

Strategy to explore adhesion in marine Polychaetes Worms

1. Structural and Elemental Analysis
- Scanning Electron Microscopy (SEM)
- Visualization and EDX

2. Biochemical analysis
- Characterization of proteins and carbohydrates

3. High-throughput genomic approach
- Identification of genes encoding for adhesive proteins

1. 3D structure and elemental composition of the glue

- Sabellaria alveolata
- Phaneroptilum caudata

2. Identification of Carbohydrates

- Identification by gas chromatography of carbohydrates in glues (A) S. alveolata and (B) L. concilium

3. Identification of genes encoding for adhesive proteins

- Next generation sequencing
- 176,000 contigs
- 350 putative genes involved in glue production
- 174,000 contigs
- 253 putative genes involved in glue production

Perspectives

- The contigs/genes identified with the high-throughput genomic approach are currently being annotated using reference databases. The ~200 new proteins, that are putatively involved in glue formation, will be investigated for the presence of novel specific domains.
- Characterization of proteins forming the cement will be performed by mass spectrometry.
- With the R&D team of Saint-Gobain Isolver, in the light of new knowledge of the glue produced by marine worms, we are discussing how we can improve adhesives for wet environment.