ECO-EFFICIENT BIOCONSOLIDATION OF BUILDING MATERIALS

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Bioconsolidation - or biotreatment - and biocementation - or bioformulation - are innovative techniques that has awakened interest for consolidation, repair, protection and optimization of the properties of building materials. These biotechnologies are mainly based on the precipitation of chemical compounds through the metabolism of bacterial cultures. Although these biotechnologies have been recently studied in different materials, concrete has been the most studied material, and the main studied biotechnology is based on calcium mineralization.

OBJECTIVES

The present thesis aims to study the effect of bioproducts (Fig. 1) as consolidants of building materials, such as ceramic brick, adobe masonry and earth plasters (clay-based), stone, lime-based mortars and old concrete (mainly calcium-based), to improve their surface properties (Fig. 2). The use of the bioproducts as a component in the bioformulation of repair mortars (Fig. 3) may also be evaluated to optimize some of its characteristics.

RESEARCH QUESTIONS

- What is the embodied energy of the bioproducts?
- To what type of conditioning are the bioproducts adapted for before being used?
- How can the bioproducts be applied? Definition of the biotreatments and bioformulation.
- Which is the effect of the biotreatments or the bioformulation and how to assess it?

The research questions outlined above need to be addressed because a significant part of the building materials exposed in the built heritage requires repair and protective interventions. They present surfaces in different states of degradation. This type of intervention is preferable to the replacement of these building materials for economic, ecological and technical (eco-efficiency) reasons, ensuring the preservation of cultural identity.

METODOLOGY

Bioproducts developed at the Chemistry Department of FCT NOVA will be based on iron biomineralization by *Escherichia coli* cells supplemented with iron, if possible obtained from industrial waste, and on biopolymers produced by bacterial cells grown using industrial or agricultural wastes that are financially accessible, non-toxic and easy to handle. They will be applied as biotreatments on the surface of samples simulating clay-based and calcium-based building materials and tested at short term and after natural and accelerated aging. It is intended to define biotreatments (application procedures) that are also compatible with the practice of conservation and construction. They may also be used as kneading water of repair bioformulated mortars and tested. Bioformulation procedures that can be used by industry of ready-mixed mortars will be defined.

RESEARCH IMPACT

Therefore, the aim is to define biotreatments that are easy to apply, economical, ecological, compatible with original building materials and reversible.

Supervisors: Paulina Faria and Alice S. Pereira

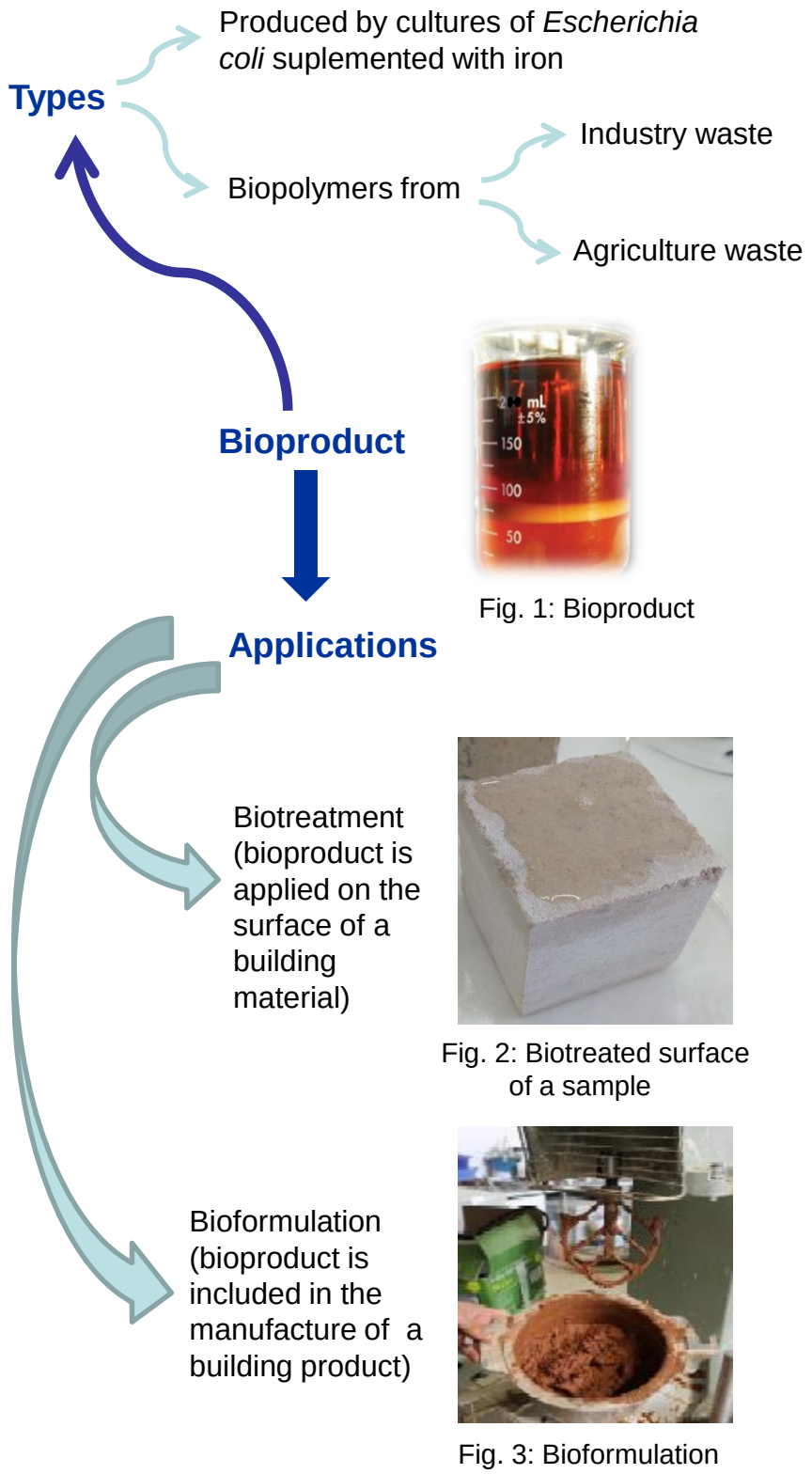

Fig. 1: Bioproduct

Fig. 2: Biotreated surface of a sample

Fig. 3: Bioformulation of a mortar