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Physical and Chemical Characterization on Durability of Basalt Fibers

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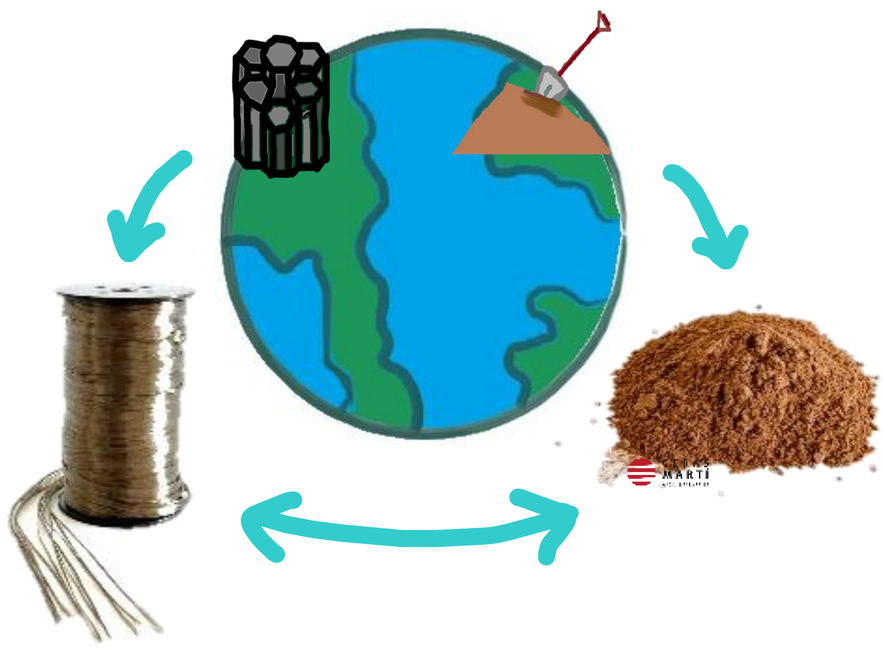
Motivation

Austria has an annual cement consumption of 5.2 million tons and emits around 2.9 million tons of CO_2 per year during production[1]. In order to reduce CO_2 emissions, alternatives to conventional reinforced concrete are being sought worldwide. In this regard, the **BasaltClayCrete project** is developing basalt-reinforced clay building materials that are tailored to low to moderate performance levels and have a minimal environmental impact. Fiber reinforcement, especially from natural fibers such as basalt, improves the mechanical properties of the clay concrete to be developed and makes the material suitable for construction. **Basalt fibers** (BF) are extracted from basalt rock, a natural material with a melting temperature between 1500 and 1700 °C.

Basalt fiber reinforcement

- Natural and environmentally friendly
- High tensile strength
- Chemical resistance
- Heat resistance
- Electrical insulation
- Low weight
- Cost effective



Clay Concrete

- Natural material
- Good thermal insulation properties
- Moderate compressive strength
- Environmentally friendly and sustainable
- Low cost
- Good acoustic insulation
- Can be sourced locally
- Provides a healthy indoor climate

Problem definition and Research question

Basalt fibers are susceptible to corrosion in the alkaline environment of concrete. Are basalt fiber reinforcements in clay concretes more resistant?

Methodology

Immersion of basalt yarns in solutions at 60° C with different pH values to simulate aging

1. pH 12.7 - highly alkaline environment in ordinary concrete
2. pH 7.7 - low alkaline environment in clay-based concrete
3. pH 7.0 - tap water as a reference

After aging, the tensile strength of the reinforcement is determined.

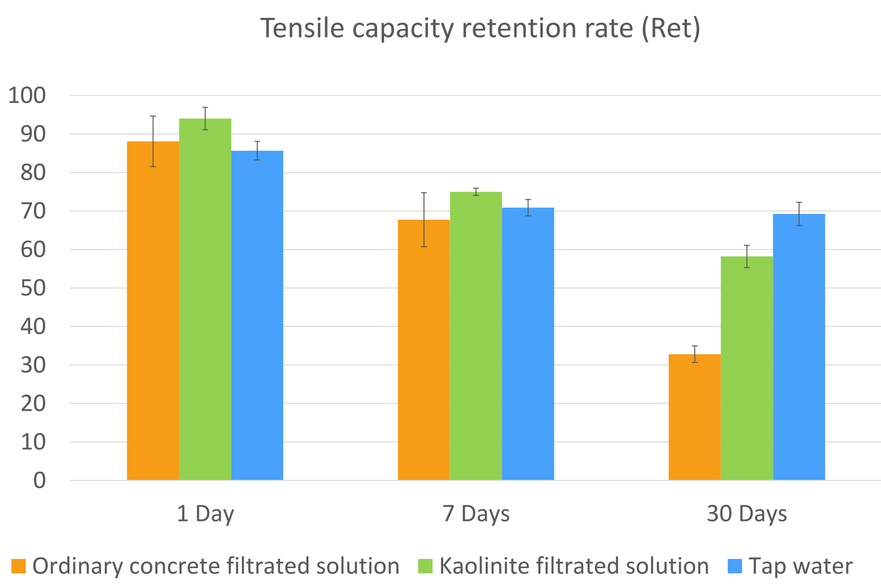
Basalt yarns in solutions heated at 60° C

Results and Discussion

Alkaline solutions initiate a continuous process in which OH^- breaks up the fiber mesh and dissolves Si and Al. A comparison of the variants gives the following graph:

- The tensile strength decreases the most in the highly alkaline environment of variant 1.
- In the Kaolinite filtrated solution (variant 2), the tensile strength remains higher, which indicates better durability in clayey environments.
- As expected, storage in tap water shows the least degradation,

This confirms the high potential for the use of basalt textiles in clay-based concretes with lower alkalinity than conventional concrete.



[1]Mauschitz, “Emissionen aus Anlagen der österreichischen Zementindustrie Berichtsjahr 2020.”