Biocrete – Carbon Neutral Concrete

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Prosjektdeltagere

Støttet av Innovasjon Norge
Background

- Industrial wood waste amounts to 1.0 million tons per year
- A large proportion of the wood waste goes to combustion
- The wood waste corresponds to an emission of 1.8 million tons CO$_2$, i.e., 40% more than what the cement industry generates!
- The construction industry accounts for 30% of the total wood waste
Wood waste can be pyrolyzed into biochar (pyrolysis is heating without the supply of oxygen)

The biochar can be mixed into concrete to store the carbon "permanently"

We break a waste cycle and allocate the CO₂ – benefit to the final product. The concrete becomes carbon neutral! Small-scale CCS!

Is this principle ok according to the LCA standards?

How does the biochar affect the technical properties of the concrete?

Who will invest in carbon neutral concrete? At the moment, Biocrete is about 50% more expensive
Pretty confusing media response....

«The least thoughtful initiative I've ever heard of»
Yngve Holt, Norskog to nrk.no

«A gamechanger for the construction industry»
bygg.no
Other applications for biochar

- **Subsidy in cattle feed**
  - Reduces methane emissions
  - Requires a very clean biochar, i.e. the content of heavy metals, dioxins etc. must be very low. Waste wood is unsuitable as a raw material.

- **Soil improvement**
  - Biochar has a large internal surface, and is therefore an effective absorbent. Favorable in sandy soils in dry areas
  - Requires a clean biochar, i.e. the content of heavy metals, dioxins, etc. must be low. Waste wood is unsuitable as a raw material.

- **Reducing agent in the metal industry**
  - Can replace fossil coal

- **Absorbent and filter material applications**
How much biochar does it take to "neutralize" the concrete?

- The biochar contains approximately 92% pure carbon
- In combustion, 1.00 kg of carbon (C) will be oxidized to 3.67 kg CO₂
- A C30/37 type of concrete, Low Carbon Grade A (NB37), has a required GWP-value of maximum 200 kg CO₂-ekv./m³
- Approximately 59 kg of biochar /m³ will thus be able to compensate for the emissions from this concrete. A little more, and we've compensated for the reinforcement steel, too.

PS! The excess heat from pyrolysis can be used as a heat source in a district heating system, or perhaps at a concrete batching plant.
Much of the development work has been done by three eager master students at NTNU

Håkon Farestvedt Nesse
Vibeke Heitmann Solheim
Petter Wedø Gjengår
How does biochar affect the concrete properties?

- The biochar is light and mechanically weak, this must be compensated with a slightly stronger binder phase.

- The biochar has a very high water absorption but is still a good filler material in a water-saturated state. Biocrete therefore has excellent workability properties, without additional consumption of cement!

- The concrete density is reduced from 2400 kg/m$^3$ to approx. 2000 kg/m$^3$. In structural design, Biocrete must probably be considered to be a LWAC.

- The durability properties are expected to be good due to the low permeability of the binder phase. Recent results confirm that the permeability of Biocrete is very low.

- *Is Biocrete within or outside the limits of concrete standards?*
The Con-Form structural design concept

- Hybrid of precast and cast-in-place concrete
- The «sandwich» type of structural design allows a combination of high strength (flanges) and low strength concrete (cores)
- Ideal for Biocrete
- «Carbon neutral» load carrying structures are obtainable
- Full scale wall and slab production tests performed
As designed for Biocrete...

Worlds first carbon neutral concrete wall!
What next?

- More tests must be performed to demonstrate technical feasibility and reliability
- Biochar produced from wood waste must be made available
- Concrete batching plants must be modified to handle ground biochar in a dry / semi-dry state. Preliminary results indicate that this is achievable
- Who will invest in a process linked to a non-existing market? The market must be developed in parallel with the technical concept
- We need to carry out one or more full-scale construction projects to demonstrate practical feasibility
- So far, two clients have shown serious interest.