

Memo: CO2 balance Greensand 0 – 3 for project Hoekse Lijn
Date: September 21st, 2020
Version: 1 Base
2 Comparison with reference scenario
3 With quantities applied in the project
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Topic: LCA GreenSand. A Coruna Spain to Schiedam (the Netherlands)

Background:

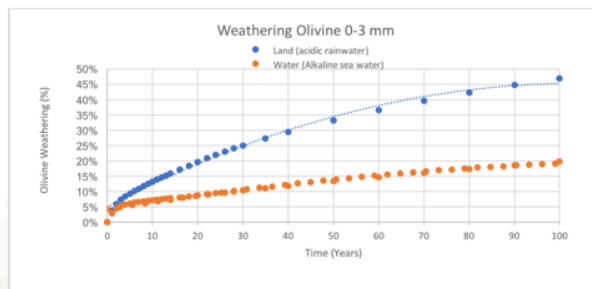
Olivine is used at a railway inspection path to replace the conventional material.

The CO₂ uptake of this mineral is known (see the graph). And it is also known that there is energy required for mining, milling and transportation. But the fact that the material is used to replace a conventional product is less known. For the project :”Hoekse Lijn” a comparison has been made with these factors.

Questions LCA

**Sand
(0-3 mm)**

Based:
- pH sea-water
- Full contact



pH Rain 5.5

pH Sea 7.95

The efficiency is calculated by the net CO₂ absorption (absorption after correction for mining, milling and transport, so the avoided CO₂ emissions) to be divided by the gross CO₂ uptake.

And secondly to be compared with the reference scenario (truck from Belgium)

The following factors are taken into consideration:

- Absorbed CO₂ (CO₂ absorbed), based on lifetime,
- energy of the mining of the olivine (or more precise the CO₂ emissions from the mining)
- Energy for the milling to the required particle size: CO₂ milling)
- Transport energy (both ship and road transport CO₂ ship, CO₂ truck)
- Trucks from Quenast to Schiedam <https://www.routeyou.com/nl-be/location/view/47448699/porfiergroeve-van-quenast>
- 13.000 ton of Olivine is applied for this project
- A 30 year lifetime. The actual lifetime will be longer, but most civil projects are calculated based on this lifetime

Table 1 Efficiency calculations for CO₂ sequestration

	Typical value	Olivine from Spain		Reference with truck from Quenast	
		Unit (km/ton)	CO ₂ emission (kg/ton)	Unit (km/ton)	CO ₂ emission (kg/ton)
CO₂ sequestration	1000 kg Olivine weathered	25% (30 years lifetime)	250 kg CO ₂	0	-
CO₂ emissions:					
CO₂ mining	1,79-3,90n kg CO ₂ /ton	-	2,8 kg CO ₂		2,8 kg CO ₂
CO₂ milling (coarse)	0,46-1,02 kg CO ₂ /ton	-	0,7 kg CO ₂	-	0,7 kg CO ₂
CO₂ ship	15 gr CO ₂ /ton km	1400 km * 1,5 (partially return freight)	42,0 kg CO ₂	0	-
CO₂ truck	138 gr CO ₂ /ton km	50 km (part in Spain/Part in Netherlands)	6,9 kg CO ₂	185*2 km (from Quenast to Schiedam)	51,1 kg CO ₂
Total CO₂ emissions			59,4 kg CO ₂ /ton olivine		54,6 kg CO₂/ton olivine
CO₂ net removed 13.000 tons olivine applied		13.000 ton olivine 30 years	208,1 kg CO ₂ /ton olivine 2.705 ton CO₂ Sequestered 90 ton CO ₂ /yr		-54,6 kg CO ₂ /ton olivine
η CO₂		Mining, milling & transport	85%		Negative (no CO ₂ sequestration)
η CO₂ (compared to reference)		Avoided CO ₂ emissions	105%		

CO₂ sequestration and CO₂ emissions, including CO₂ efficiency)

- 1) Data from S. Hangqx & C. Spiers, Coastal spreading of olivine to control CO₂ concentrations, a critical analysis of viability, International Journal of Greenhouse Gas Control (2009). Ship data from
- 2) J. Koornneef, E. Nieuwlaar, Environmental Life Cycle Assessment of CO₂ sequestration through enhanced weathering of olivine

