

Sirkulær betong - syrenøytralisering

Miljøringen – 22-23.november 2023

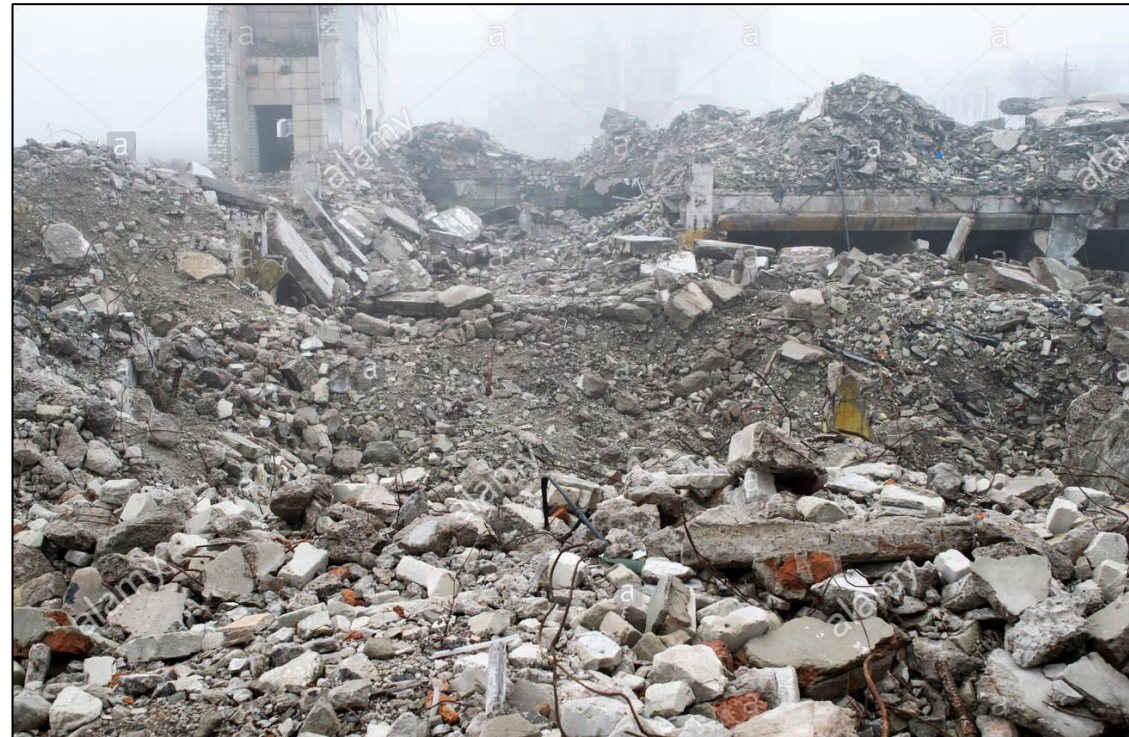
Cathrine Eckbo, PhD student NMBU, Environmental Engineer NGI

Hanne Ugstad, master student, NMBU



Background – concrete waste management and circular economy

- Concrete is the most common building material in the world
- Norway:
 - 1.3 mill tons of concrete and brick waste
 - around **55%** of the concrete waste goes to landfill
 - **40%** to backfill
 - **1.5 %** is registered as recycled
- **100%** of contaminated concrete goes to landfill



What is concrete?

- Concrete is mainly cement, water, sand and gravel
- Very little chemical additives
- The exact content depends on the use of the concrete
- Concrete has a high pH - > 12



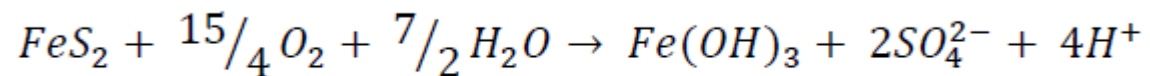
Kilde: Normet

How can we recycle the concrete?



Acid rock drainage

- Black shale is a sedimentary rock
- Found in “Oslofeltet”
- Sedimentation of marine clay and organic material
- Sulphide will oxidate to sulphate and produce sulphur acid when black shale is exposed to air and water
- Low pH (<4)
- Causes metal leaching
 - Heavy metals, Uranium, Aluminium
- Acid production will accelerate the process



Uranium



- Uranium (238U) naturally radioactive metal
- Rocks with ≥ 1 Bq/g defined as radioactive (U > 80 mg/kg)
- U4+ most common in reducing environment in the form of insoluble oxides
- U6+ most common in oxidizing conditions with low pH (2-4) – very mobile
- Acid producing rock must be deposited at an approved landfill for radioactive waste

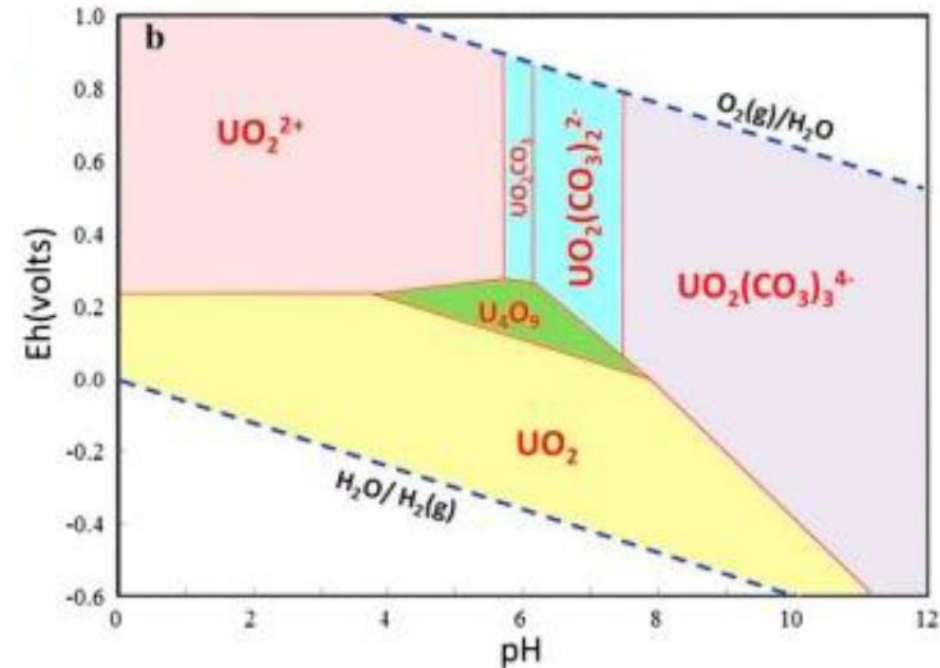


Figure: Xie, Y., Chena, C., Rena, X., Wangd, X., Wange, H. & Wang, X. (2019). Emerging natural and tailored materials for uranium-contaminated water treatment and environmental remediation.

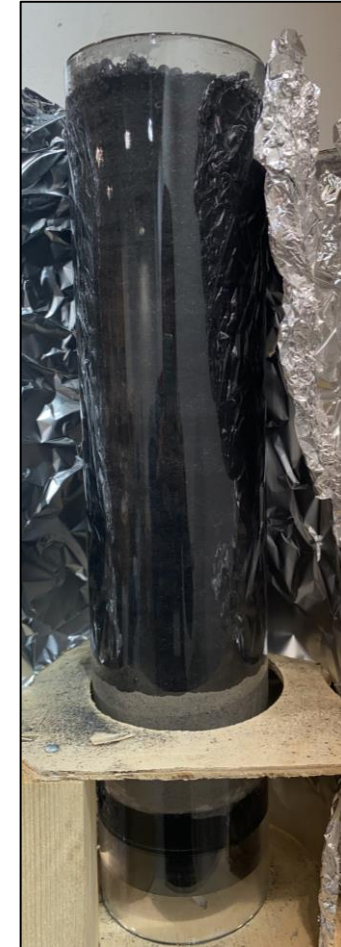
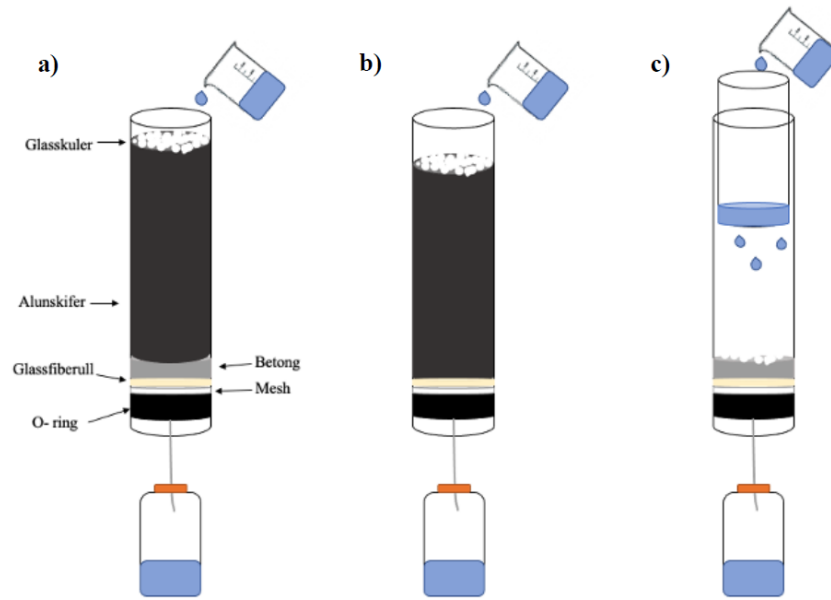
“Using one waste fraction to remediate environmental harmful effects of another type of waste”



Laboratory tests

Column tests

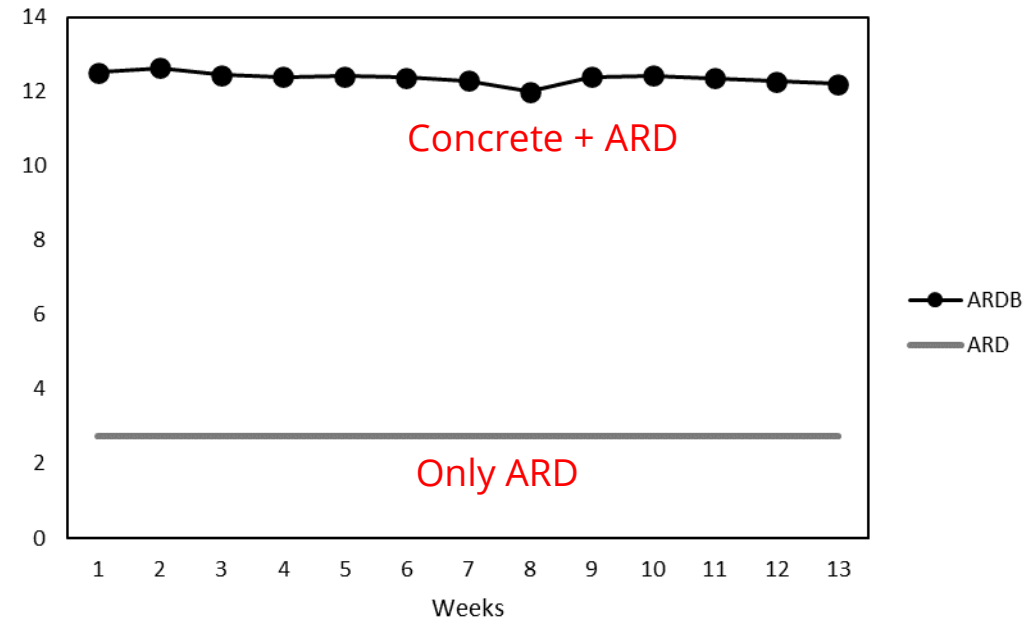
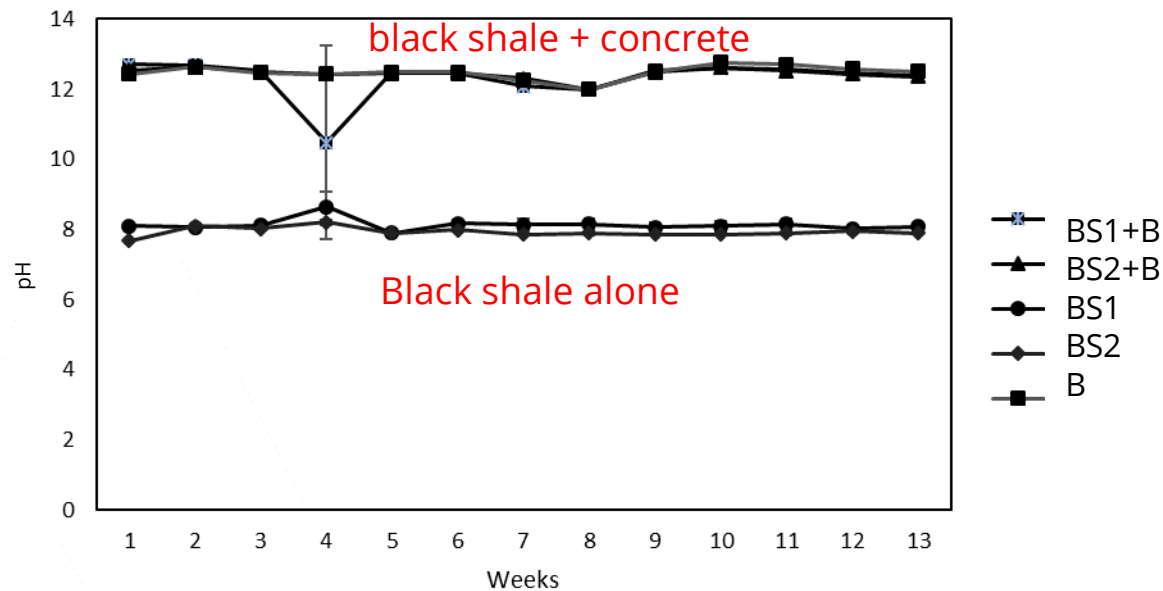
- Layered: black shale on top, concrete at the bottom
- Two types of black shale
- Controls – only black shale and only concrete
- Only concrete added Acid Rock Drainage

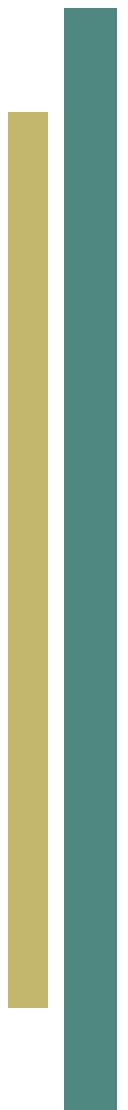
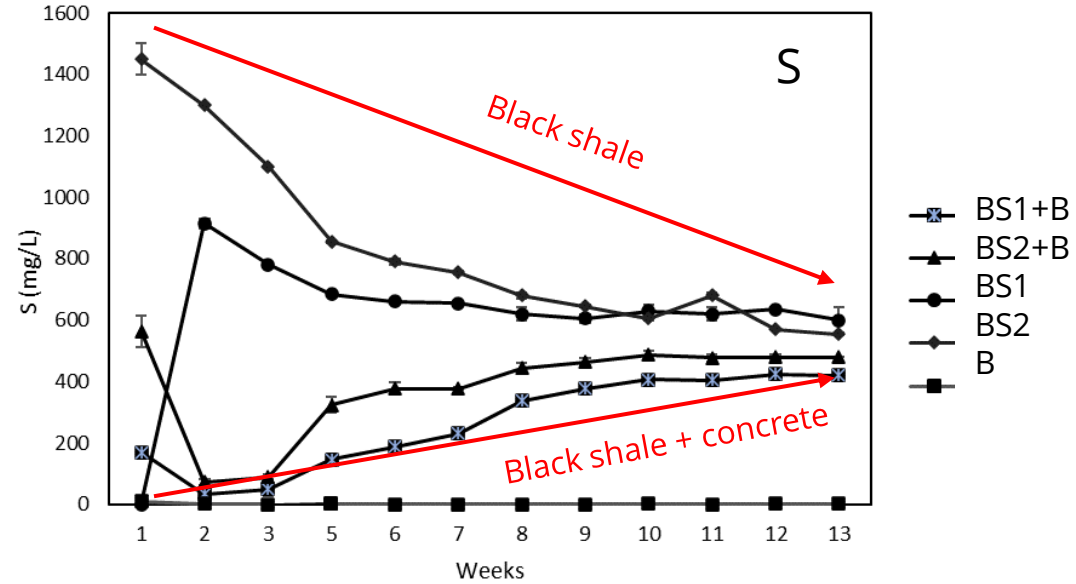
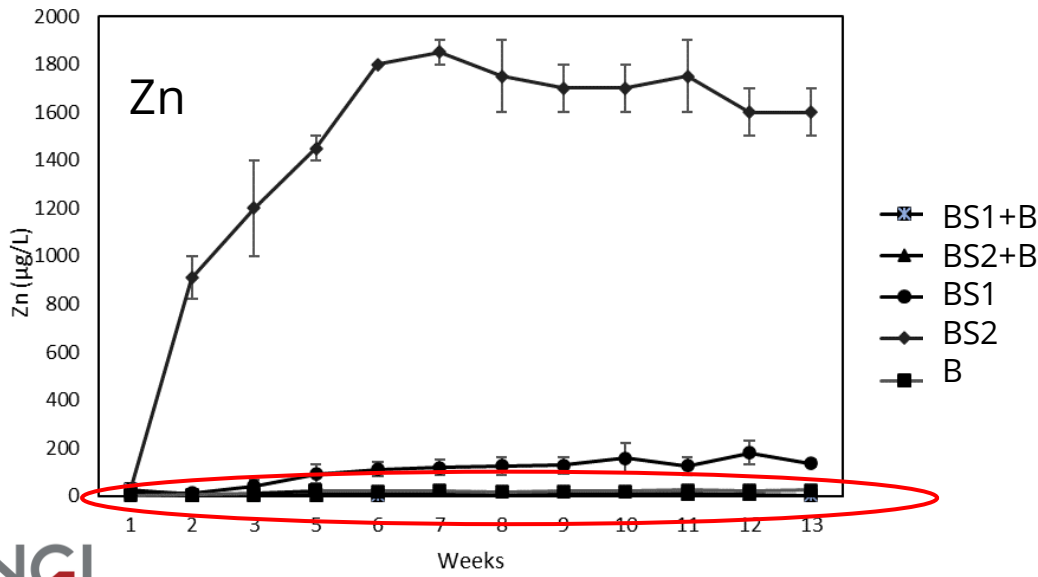
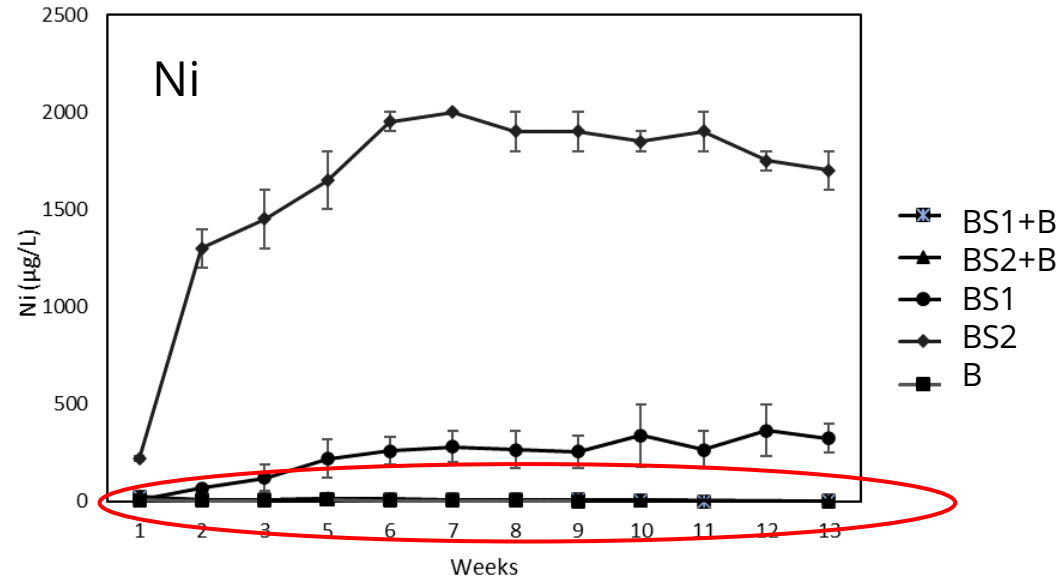
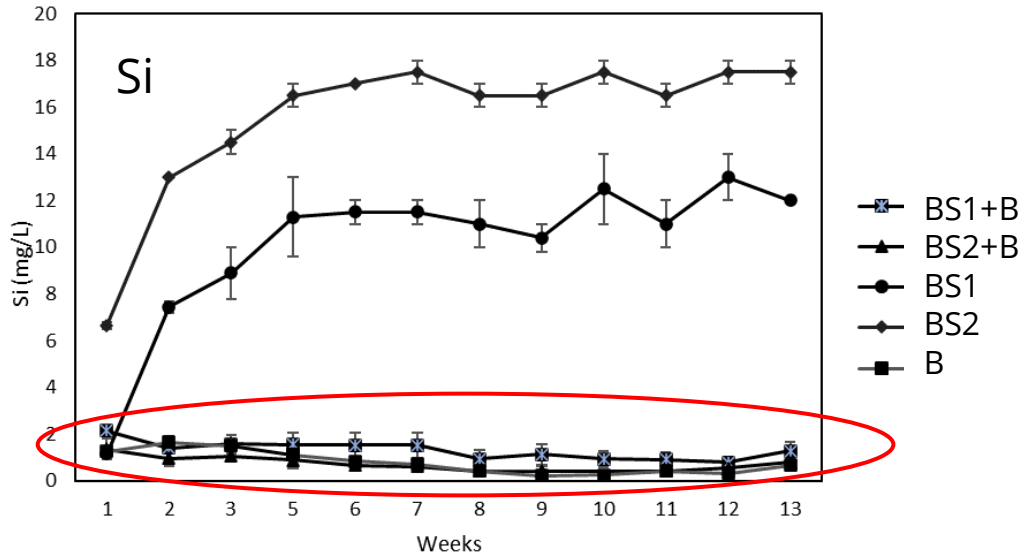




Results - pH

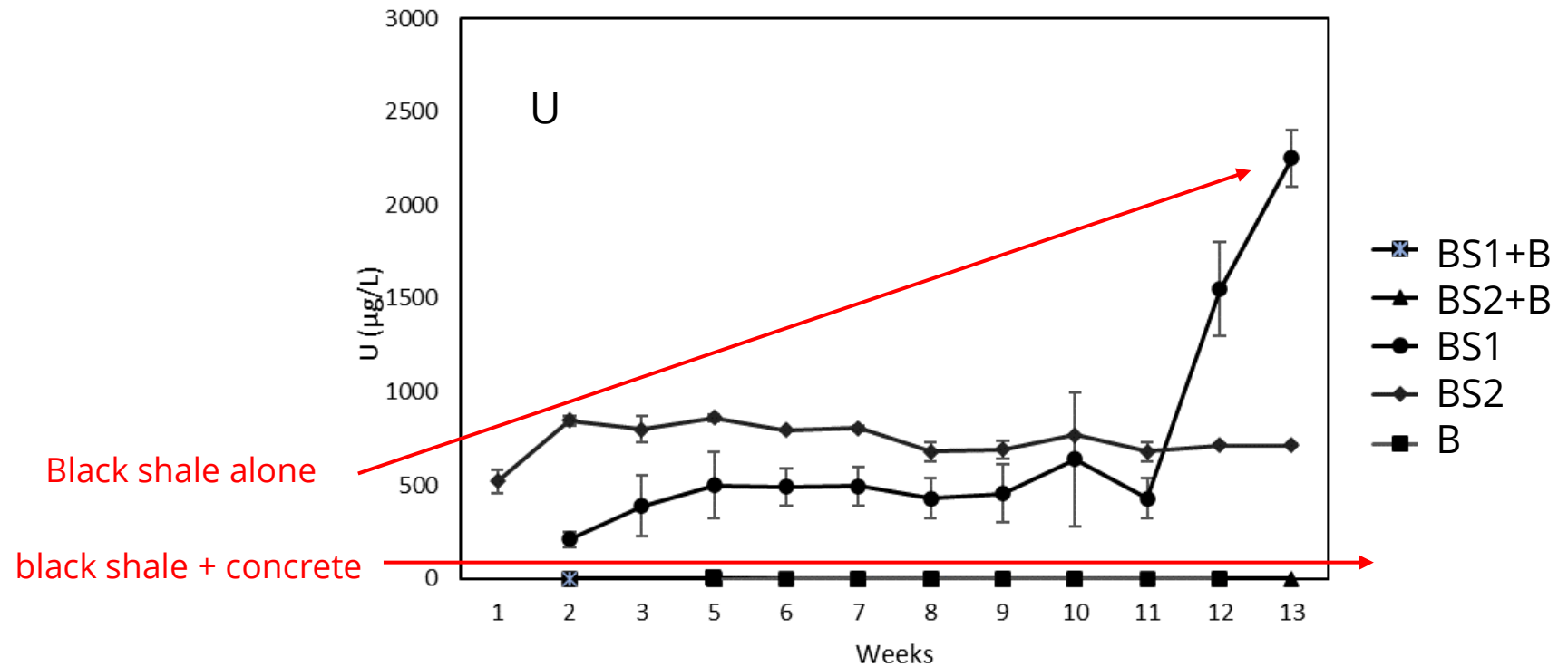
- Black shale neutral pH
- Treatments has same pH as concrete alone
- The concrete buffers ARD





Uranium

- Close to 100% reduction of Uranium after treatment

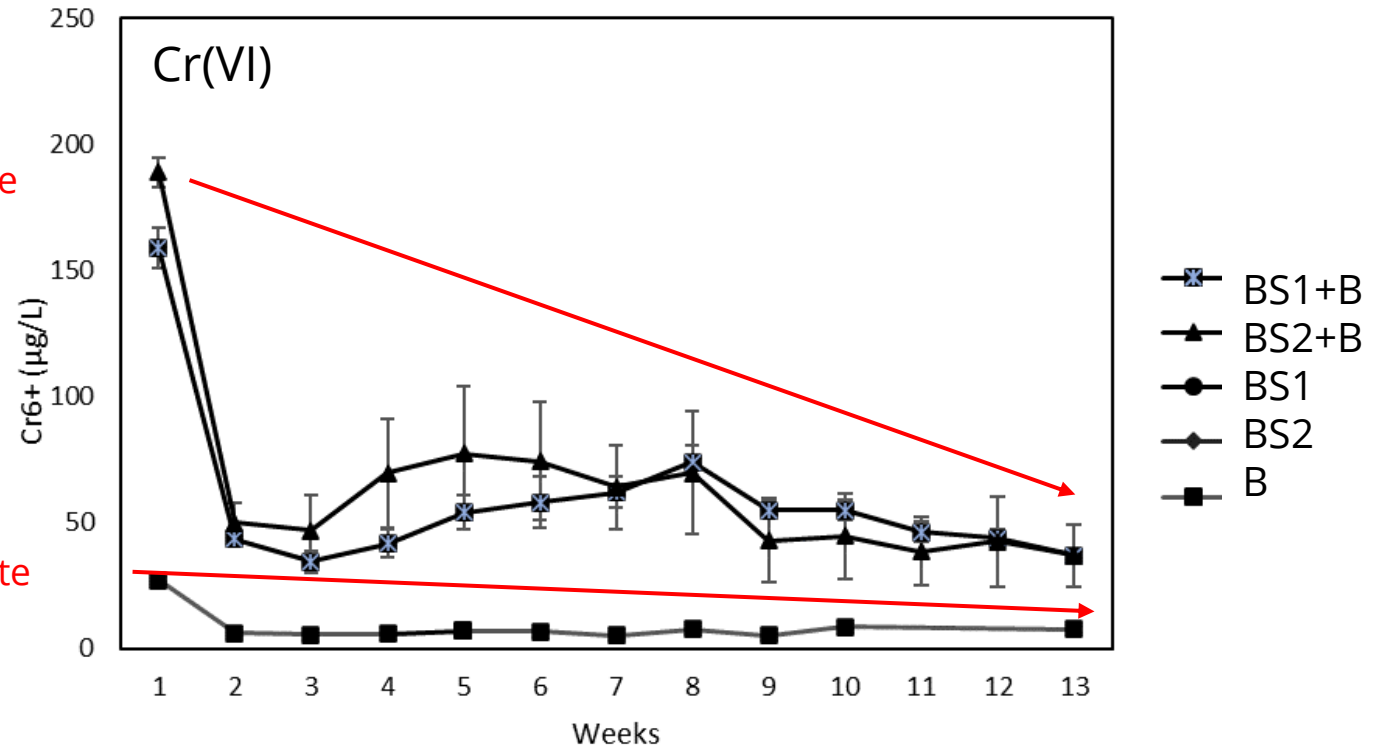


Chromium 6+

- Increased Cr(VI) leaching from treatment
- Also higher than concrete alone

black shale + concrete

Only concrete



Take home message

- Concrete buffers pH also when ARD with pH = 2 is added
- Clear reduction of metals Ni, Zn, Si, Cu and U
- Particularly U is reduced by almost **100%**
- Leaching of Cr(VI) from the concrete increases when in contact with black shale
- More research needed

Take Home Messages



Takk for meg!

