BÆRELAGMATERIALER MED TRADISJONELLE OG INNOVATIVE BINDEMIDLER

NADim seminar, Oslo
1. desember 2022

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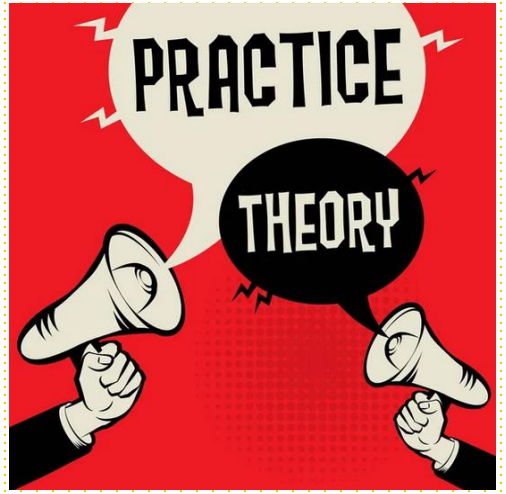
INNHOLD

INTRODUKSJON

TESTER PÅ LABORATORIET

PRAKTISKE FØLGER



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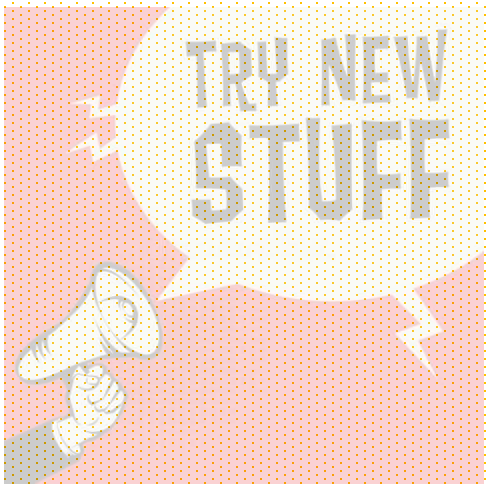
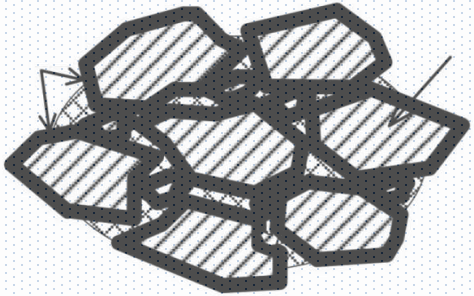


BINDEMIDDEL

Et bindemiddel er et produkt, enten naturlig eller raffinert, som påføres **for å la tilslag partiklene feste seg sammen** og dermed forbedre deres mekaniske motstand og holdbarhet



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AKKURAT SOM «LIM»

BINDEMIDDEL

Bindemidler er tilgjengelige i
flytende, halvfast eller pulverisert form og har forskjellige opprinnelser



VIKTIGE EGENSKAPER

- **Tåler trafikkslitasje**

VIKTIGE EGENSKAPER

- Tåler trafikkslitasje
- Unngå utvasking

VIKTIGE EGENSKAPER

- Tåler trafikkslitasje
- Unngå utvasking
- **Motstå aldring**

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- Tåler trafikkslitasje
- Unngå utvasking
- Motstå aldring

- **Rask og enkel påføring**

VIKTIGE EGENSKAPER

- Tåler trafikkslitasje
- Unngå utvasking
- Motstå aldring
- Rask og enkel påføring
- **Miljøvennlig**

VIKTIGE EGENSKAPER

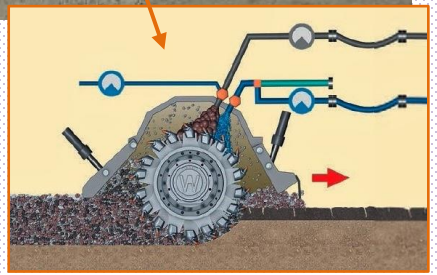
- Tåler trafikkslitasje
- Unngå utvasking
- Motstå aldring
- Rask og enkel påføring
- Miljøvennlig
- **Relativt billig**

PÅFØRING

Flere typer bindemidler, basert på anvendt prosentandel fungerer som

→ **støvlindrende midler** ved **spraying**
(gjennomtrengning 2 cm – 3 cm)

PÅFØRING



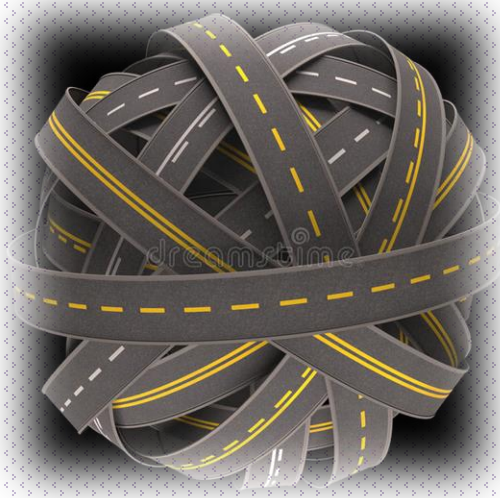
Flere typer bindemidler, basert på anvendt prosentandel fungerer som

→ **støvlindrende midler** ved **spraying**
(gjennomtrengning 2 cm – 3 cm)

→ **veistabilisatorer** når de er **blandet inn**
(gjennomtrengning 10 cm – 20 cm)

BINDEMIDLER

BITUMEN



- **bitumen** er bindemiddelet som er mest brukt globalt

BINDEMIDLER

BITUMEN

fremstilt fra jordolje ved destillasjon
→ ikke bærekraftig

- **bitumen** er bindemiddelet som er mest brukt globalt

BINDEMIDLER

BITUMEN

fremstilt fra jordolje ved destillasjon
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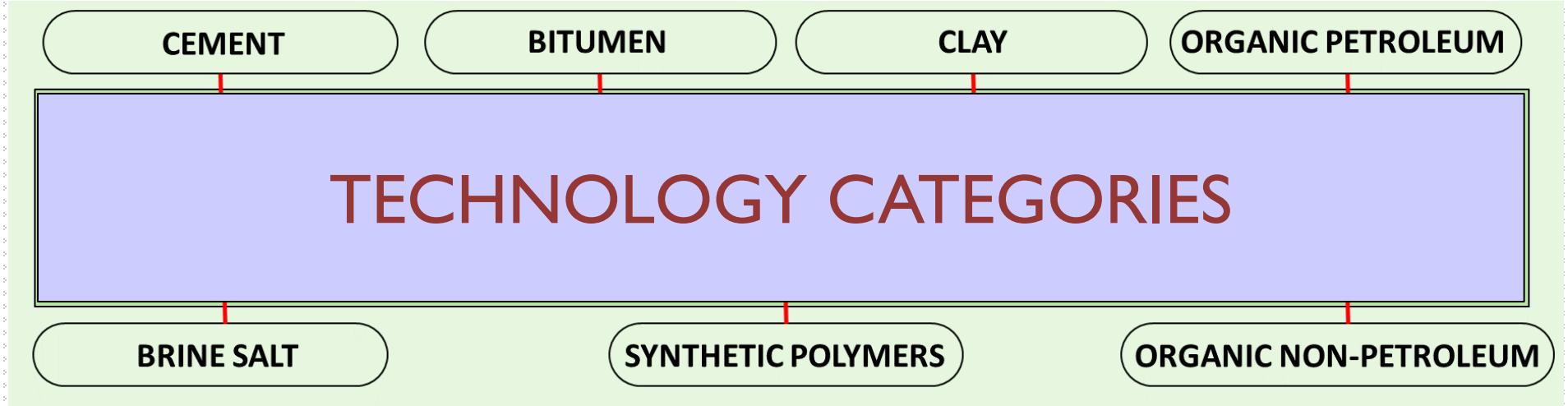
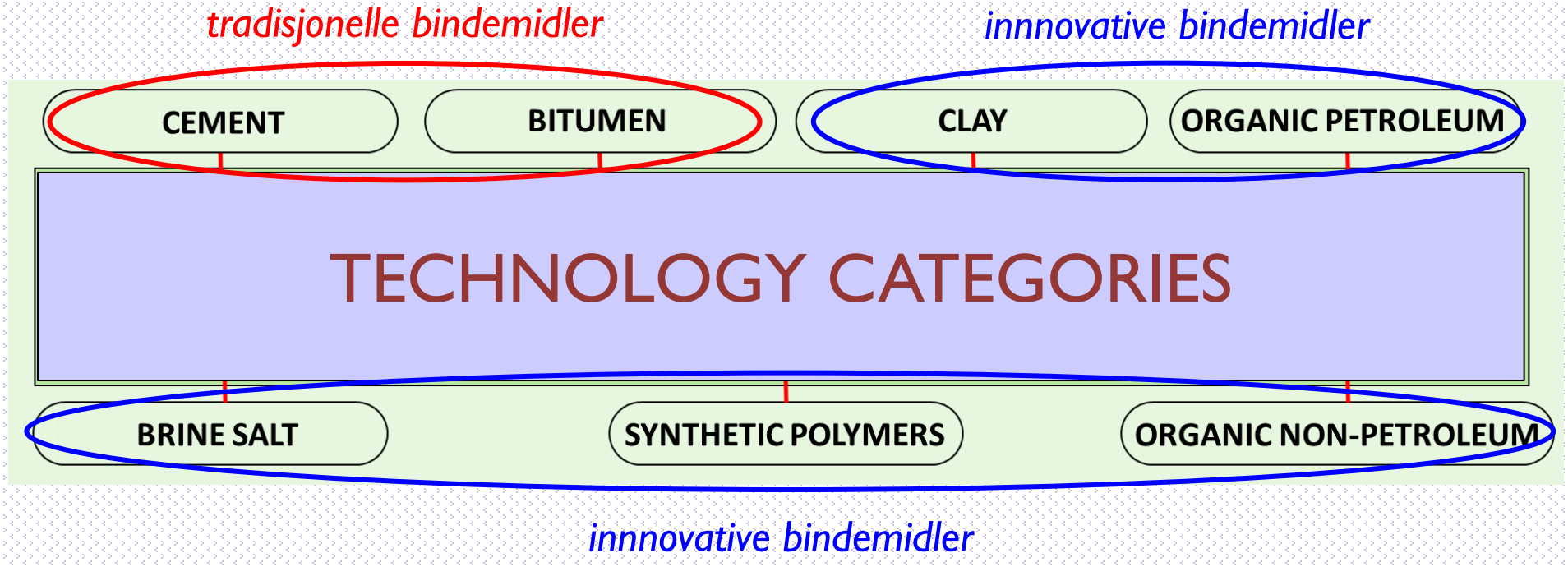
HAR VI ANDRE VALG ?

BINDEMIDLER TIL GROVT TILSLAG



BINDEMIDLER TIL GROVT TILSLAG



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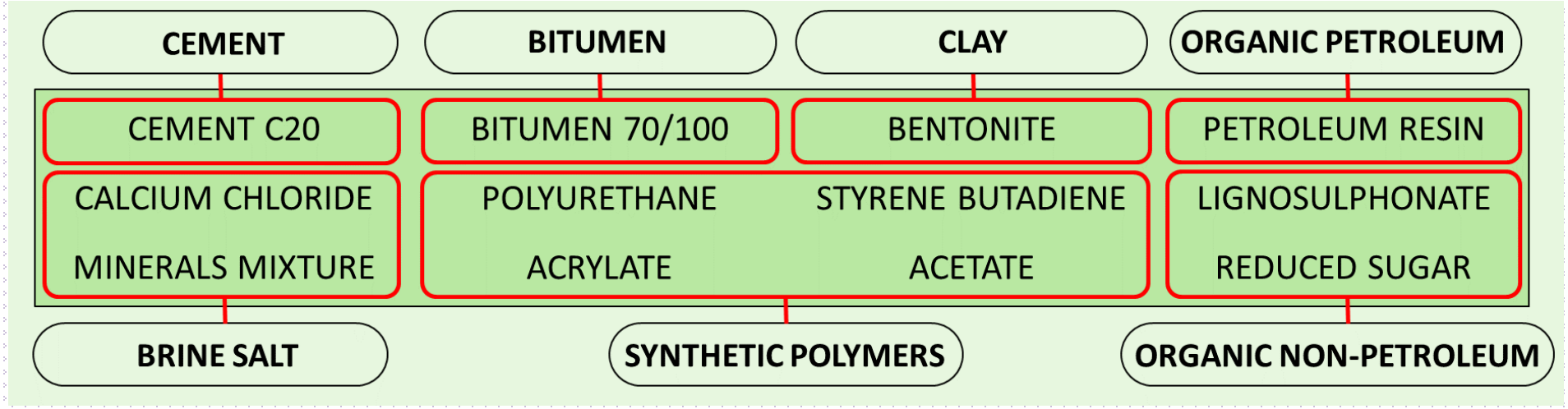


GRUNDIG UNDERSØKELSE

PÅ LABORATORIET

UTFØRTE TESTER

INVESTIGATED PROPERTIES

STIFFNESS

DEFORMATION

STRIPPING

REPEATED LOAD TRIAXIAL TEST

MODIFIED ROLLING BOTTLE TEST

MICROSCOPE ANALYSIS

UTFØRTE TESTER

REPEATED LOAD TRIAXIAL TESTS

STIFFNESS

PERMANENT DEFORMATION

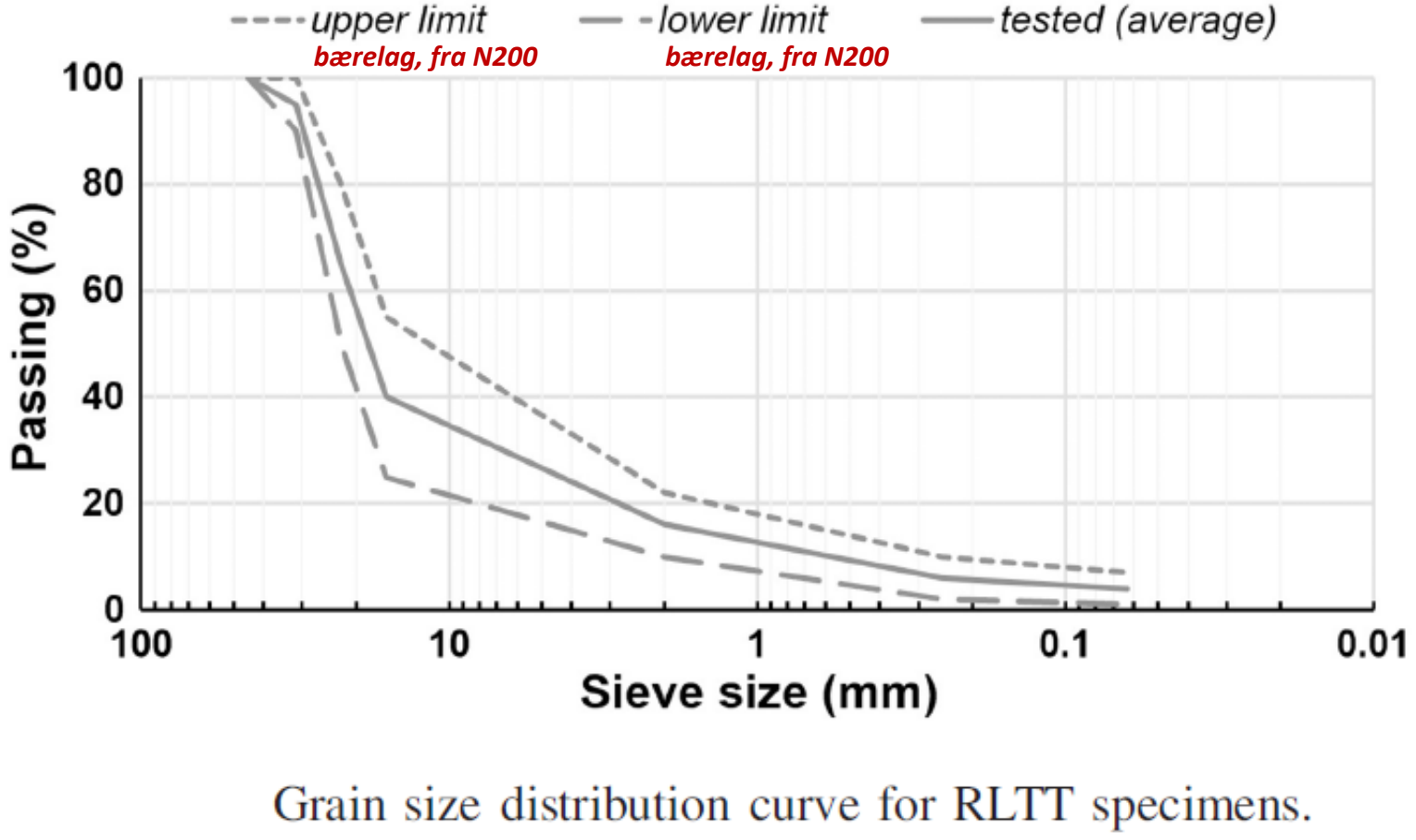
10 FREEZE-THAW CYCLES

REPEATED LOAD TRIAXIAL TESTS

STIFFNESS

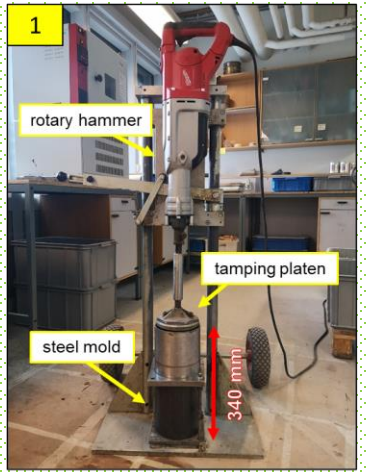
PERMANENT DEFORMATION

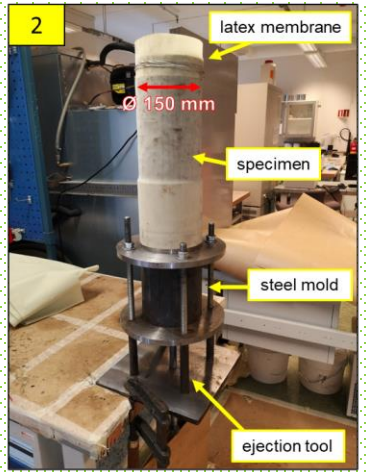
SYKLISKE TREAKSIALE FORSØK

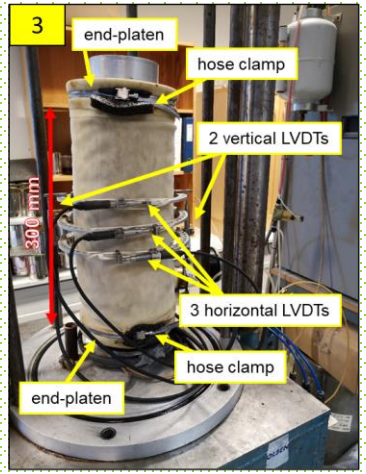


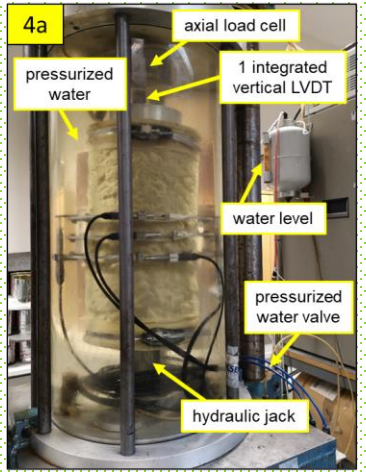
Grain size distribution curve for RLTT specimens.

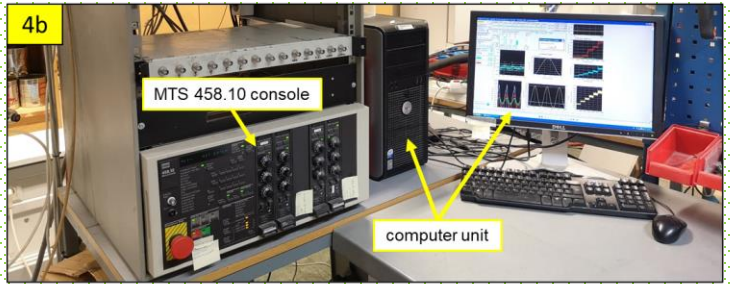
SYKLISKE TREAKSIALE FORSØK









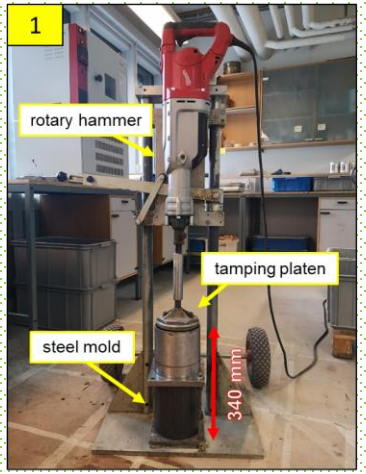


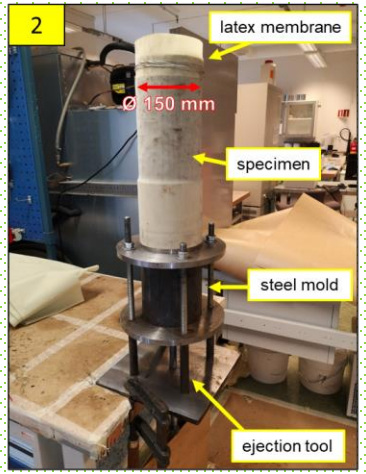
1. Hammer compaction of five layers inside the steel mold
2. Extraction of the specimen from the steel mold
3. Sealing and instrumentation of the specimen with LVTDs

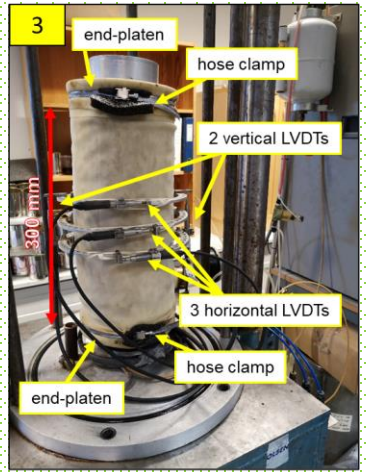
4a. Testing inside chamber filled with pressurized water

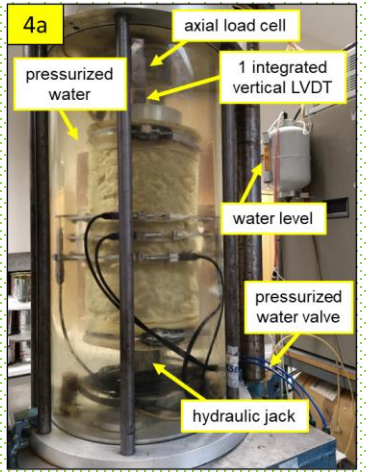
4b. Control unit and test data acquisition system

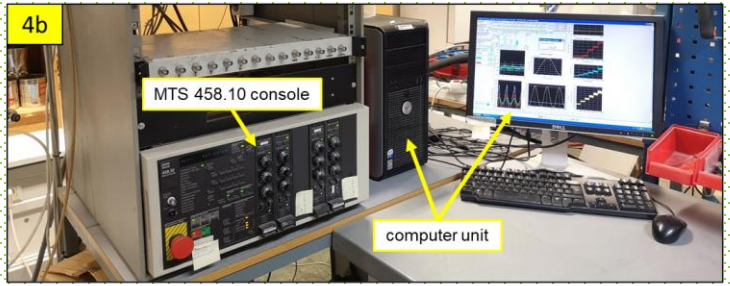
SYKLISKE TREAKSIALE FORSØK











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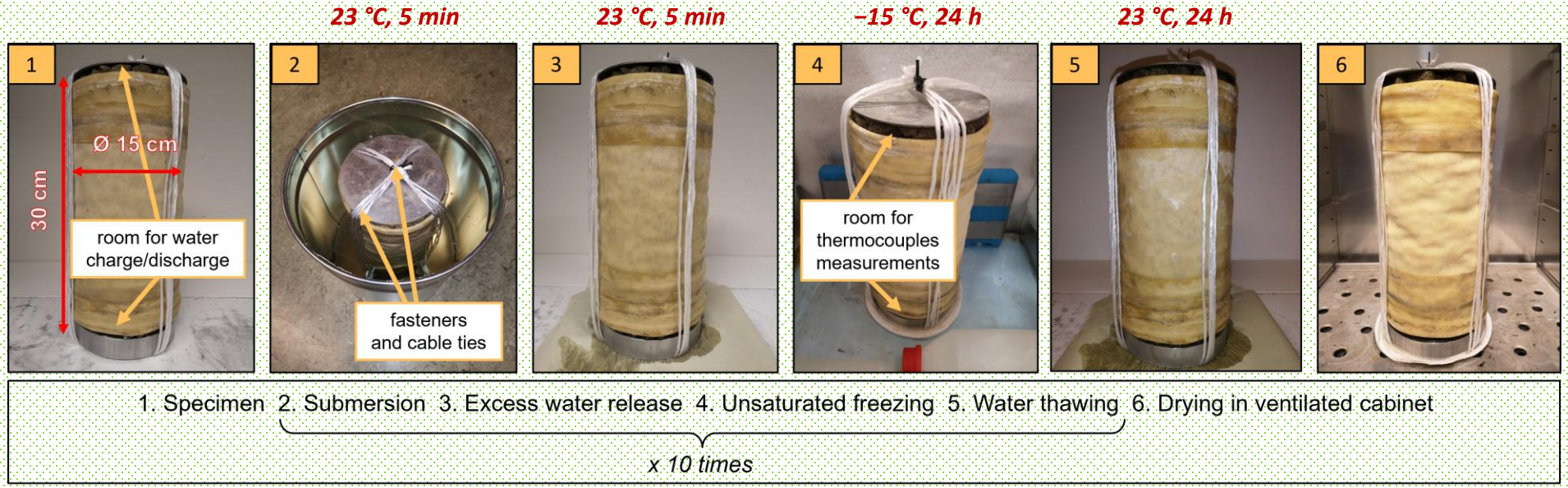
GJENNOMFØRELSE AV FRYSE-TININGSSYKLER



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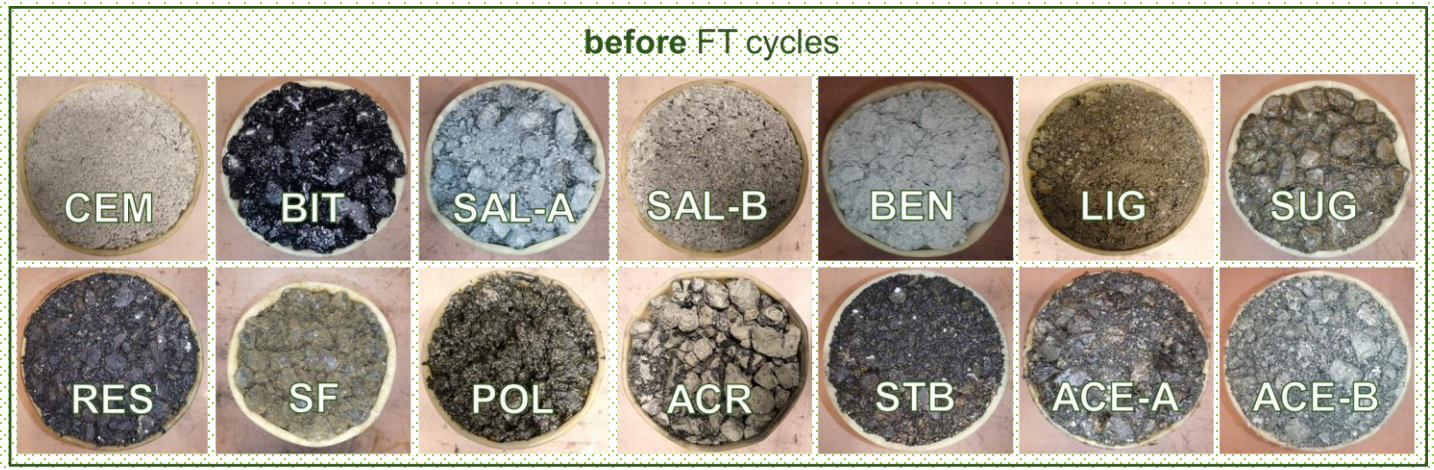

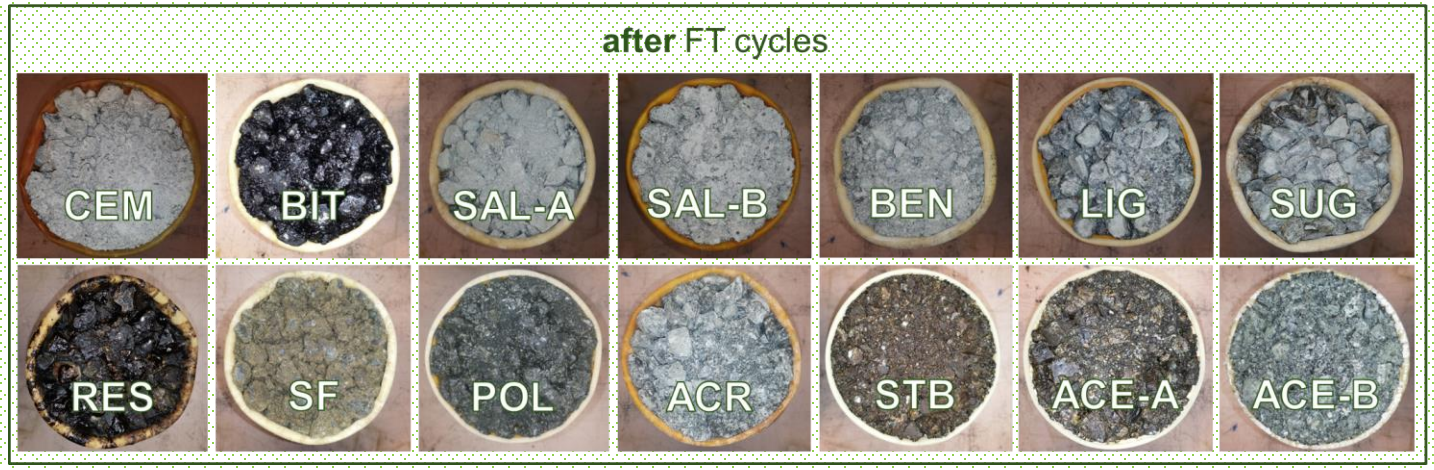

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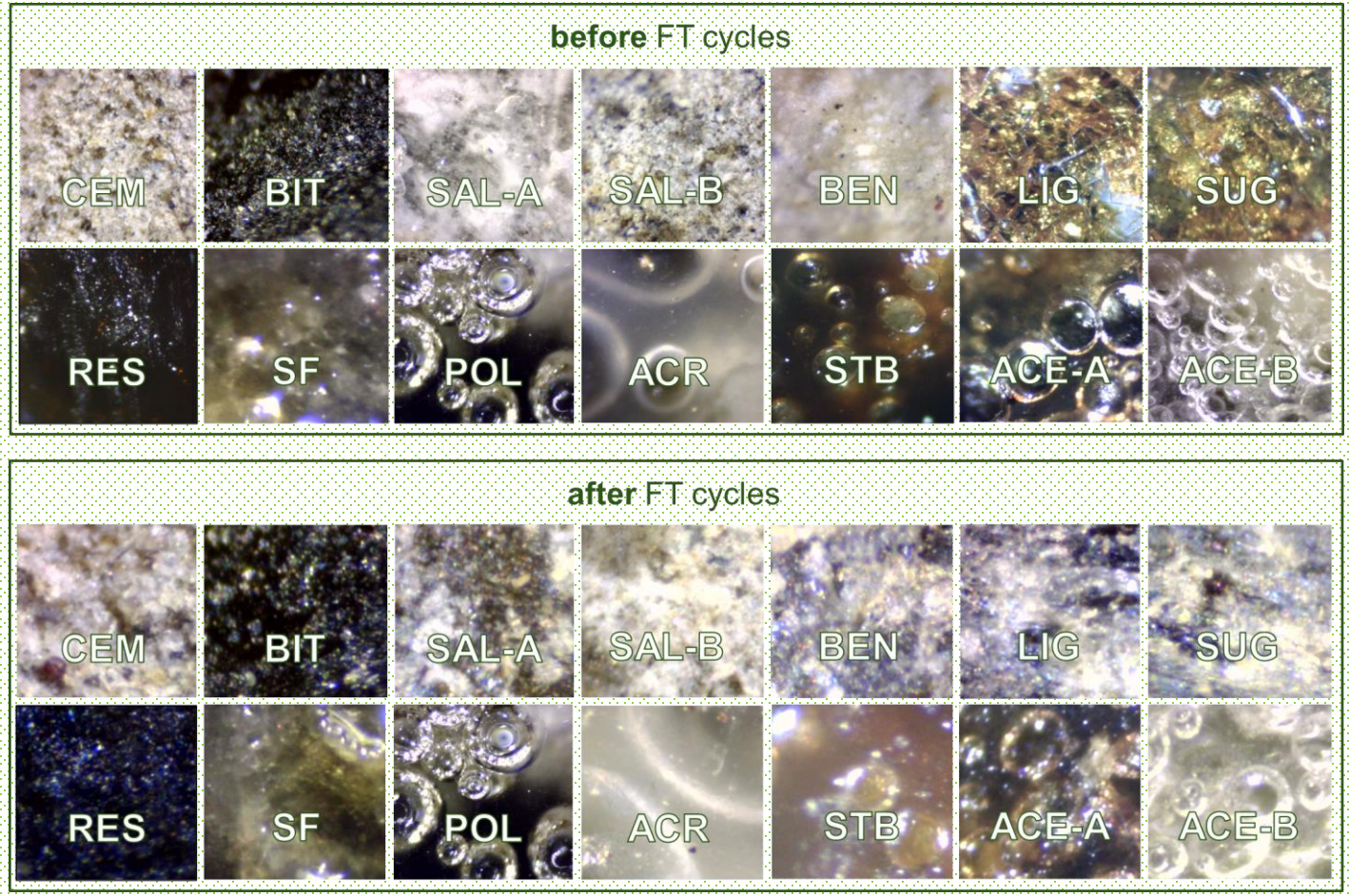
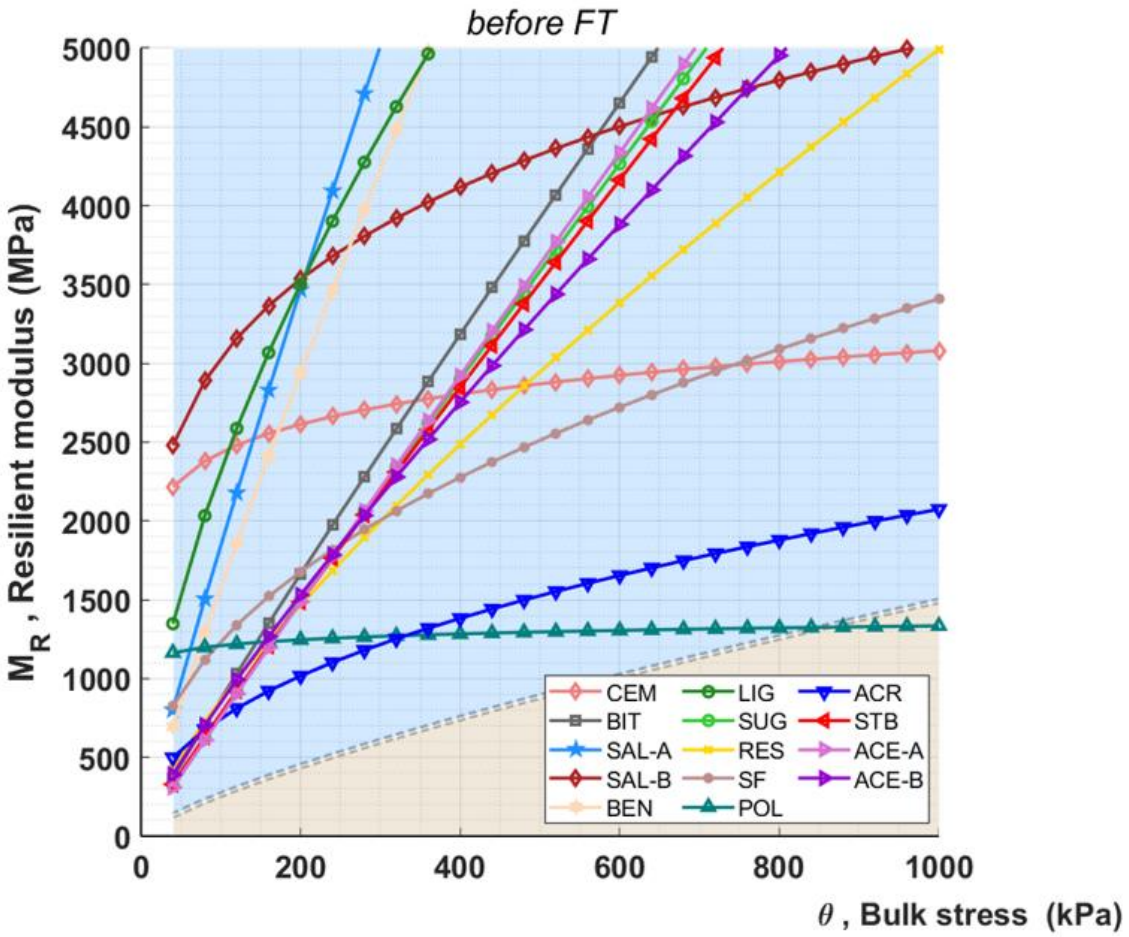
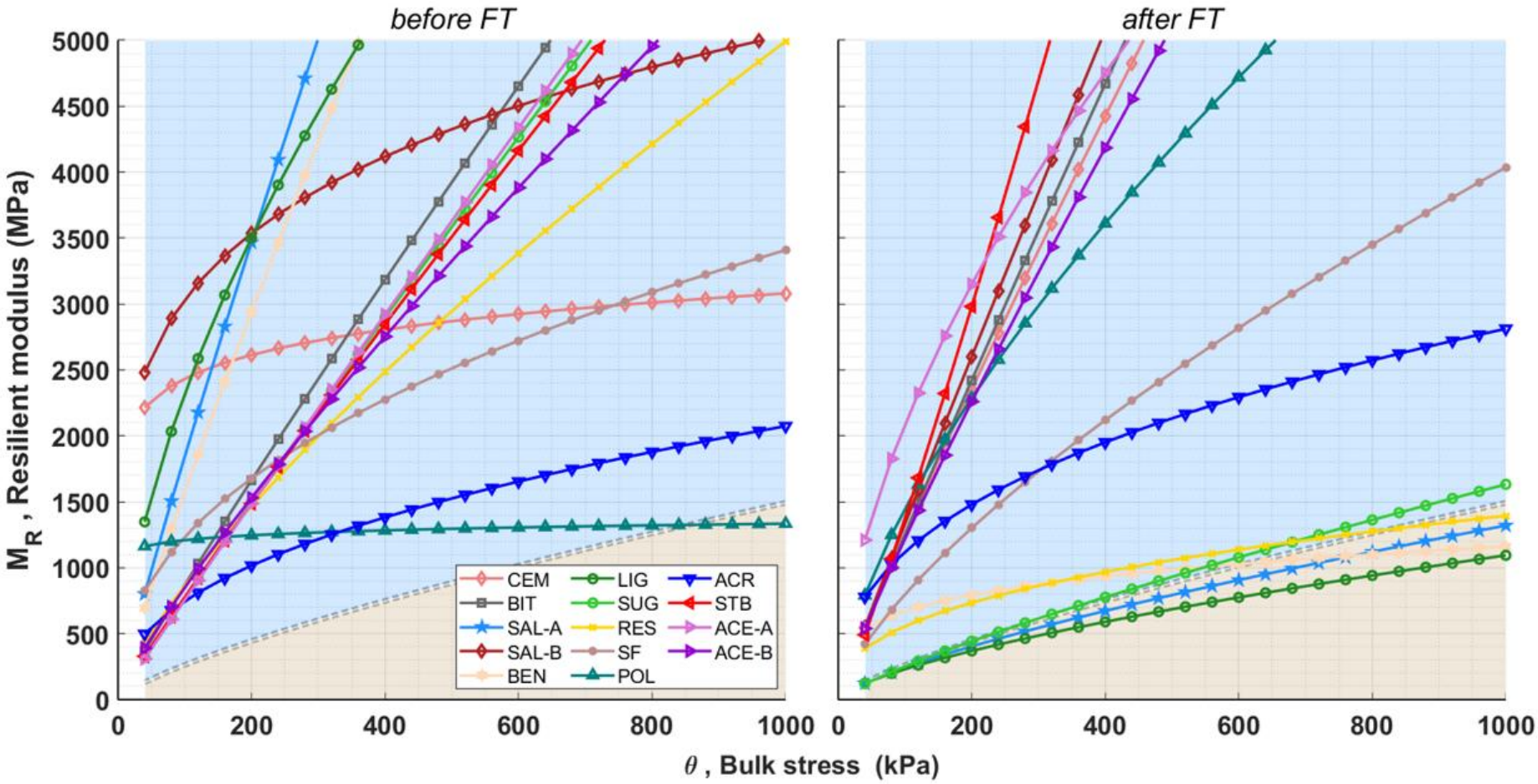


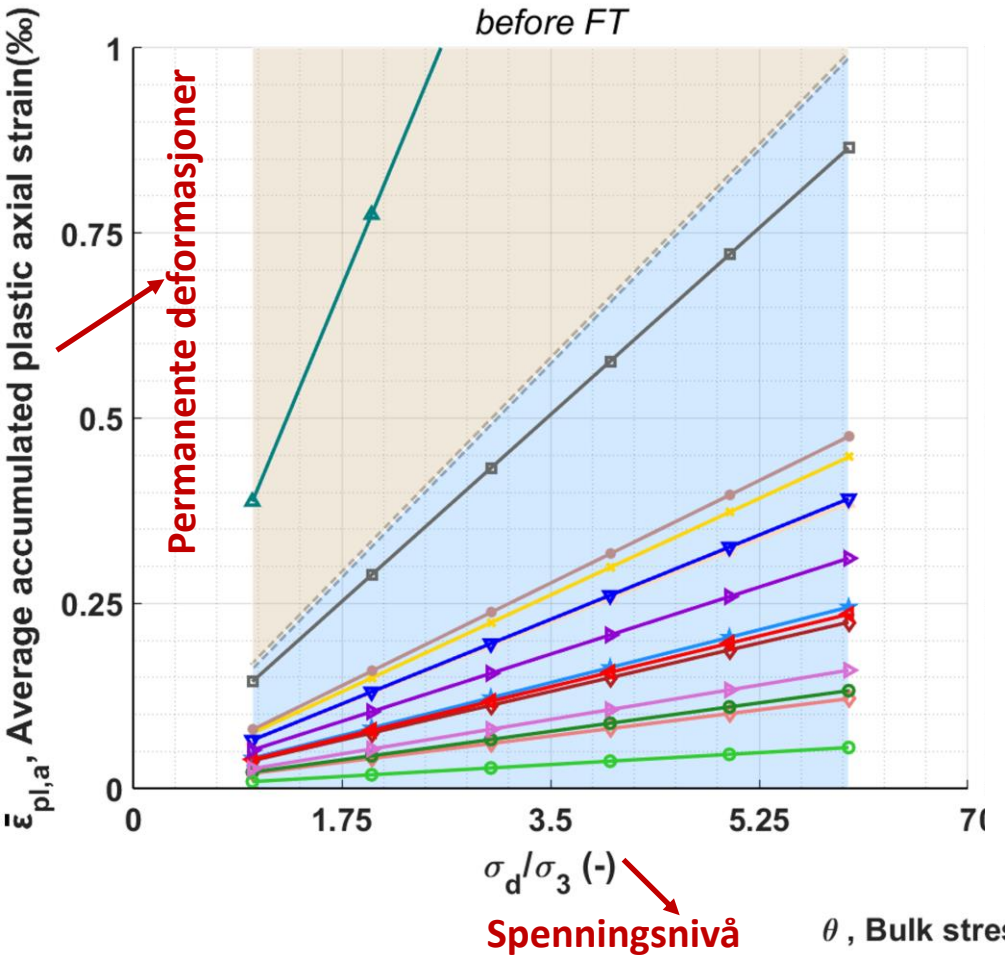
STIVHET, E-MODUL



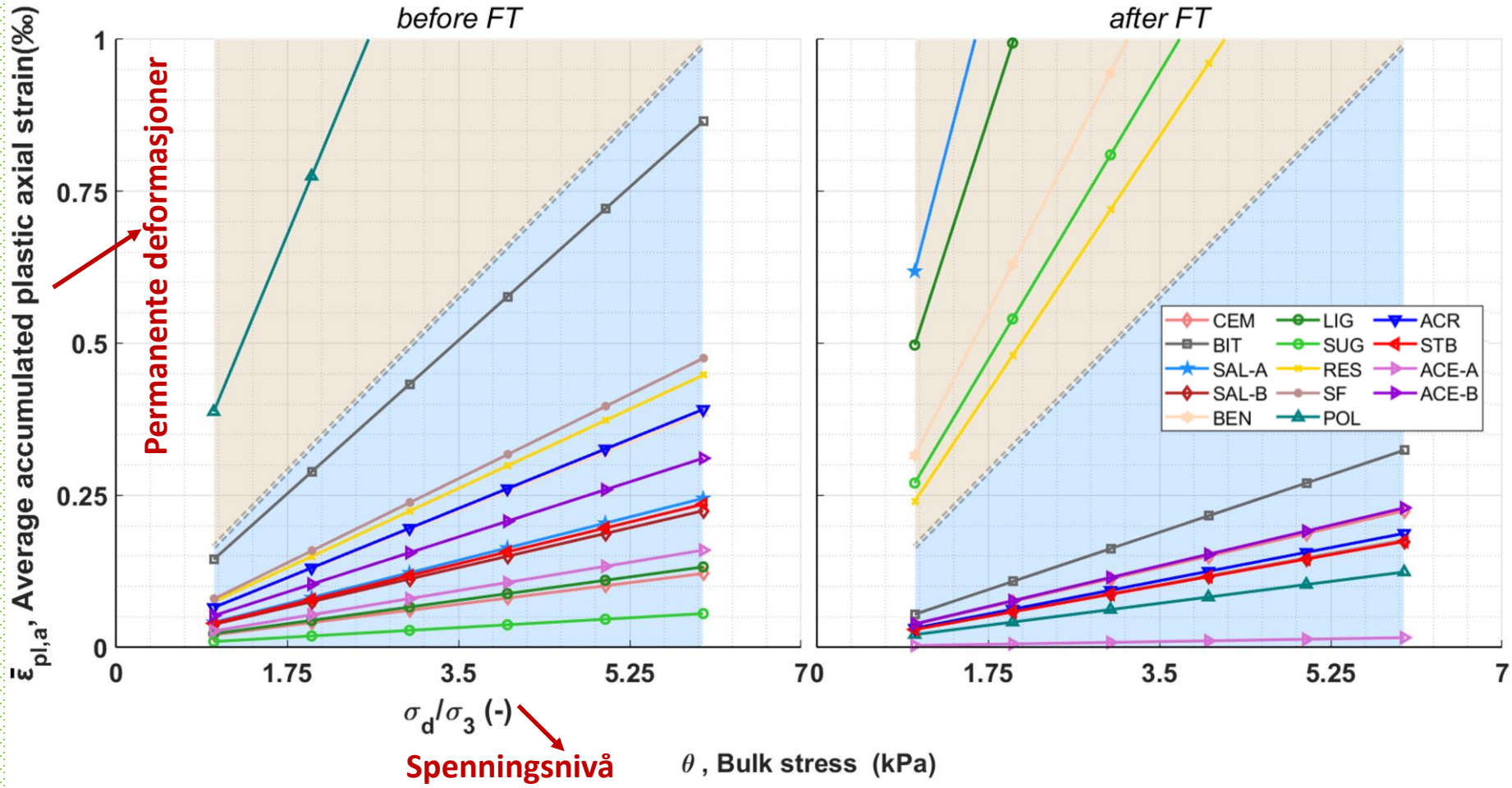
STIVHET, E-MODUL



PERMANENTE DEFORMASJONER

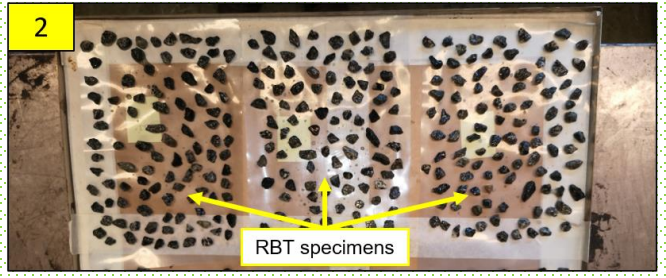


PERMANENTE DEFORMASJONER

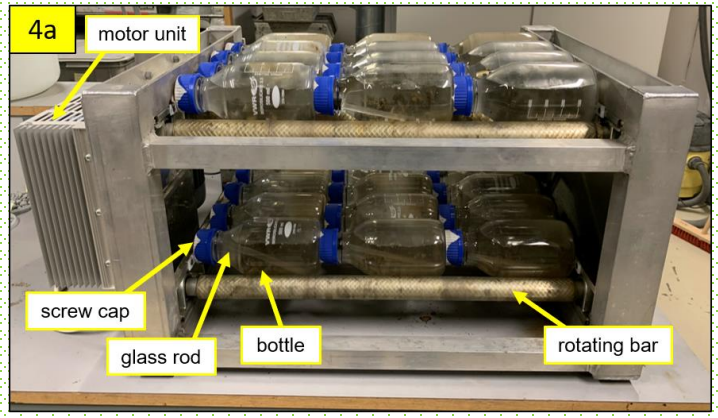


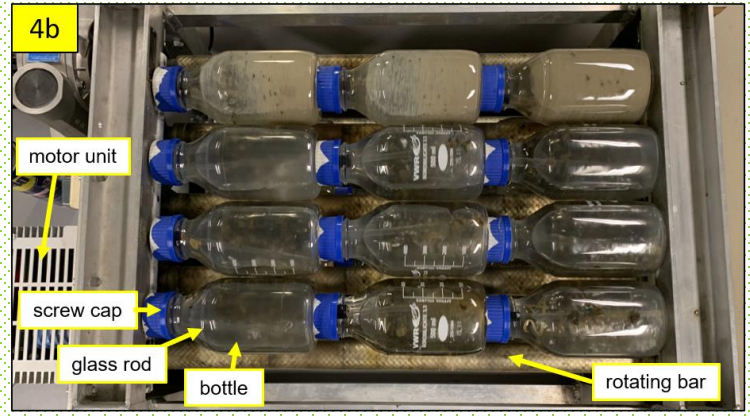
fraksjon 8 -11 mm

RULLEFLASKE TEST

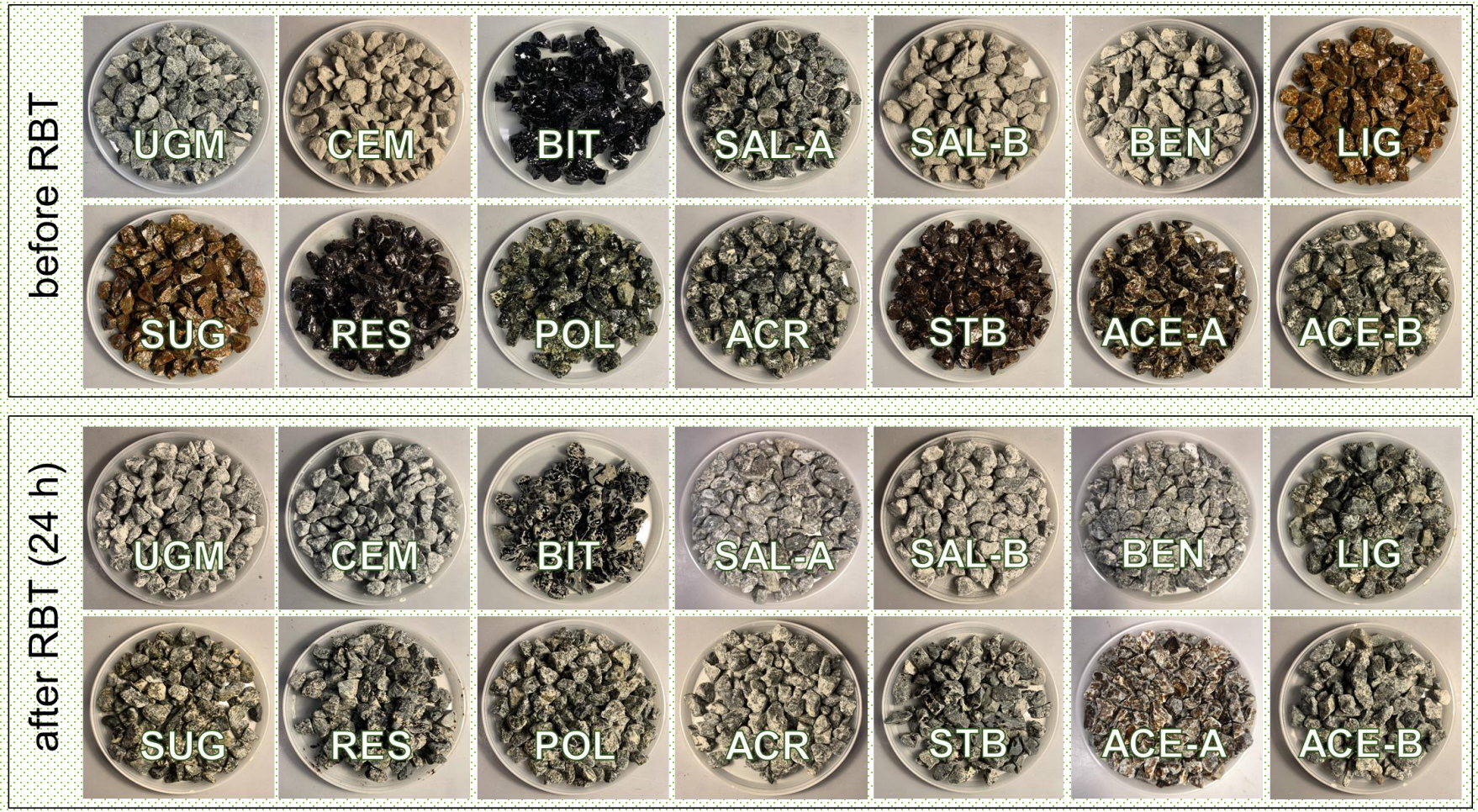


1. Loose distribution of coated aggregates
2. Positioning of RBT specimens for curing
3. Oven curing of RBT specimens
4a. Testing rolling machine with bottles (front)
4b. Testing rolling machine with bottles (above)

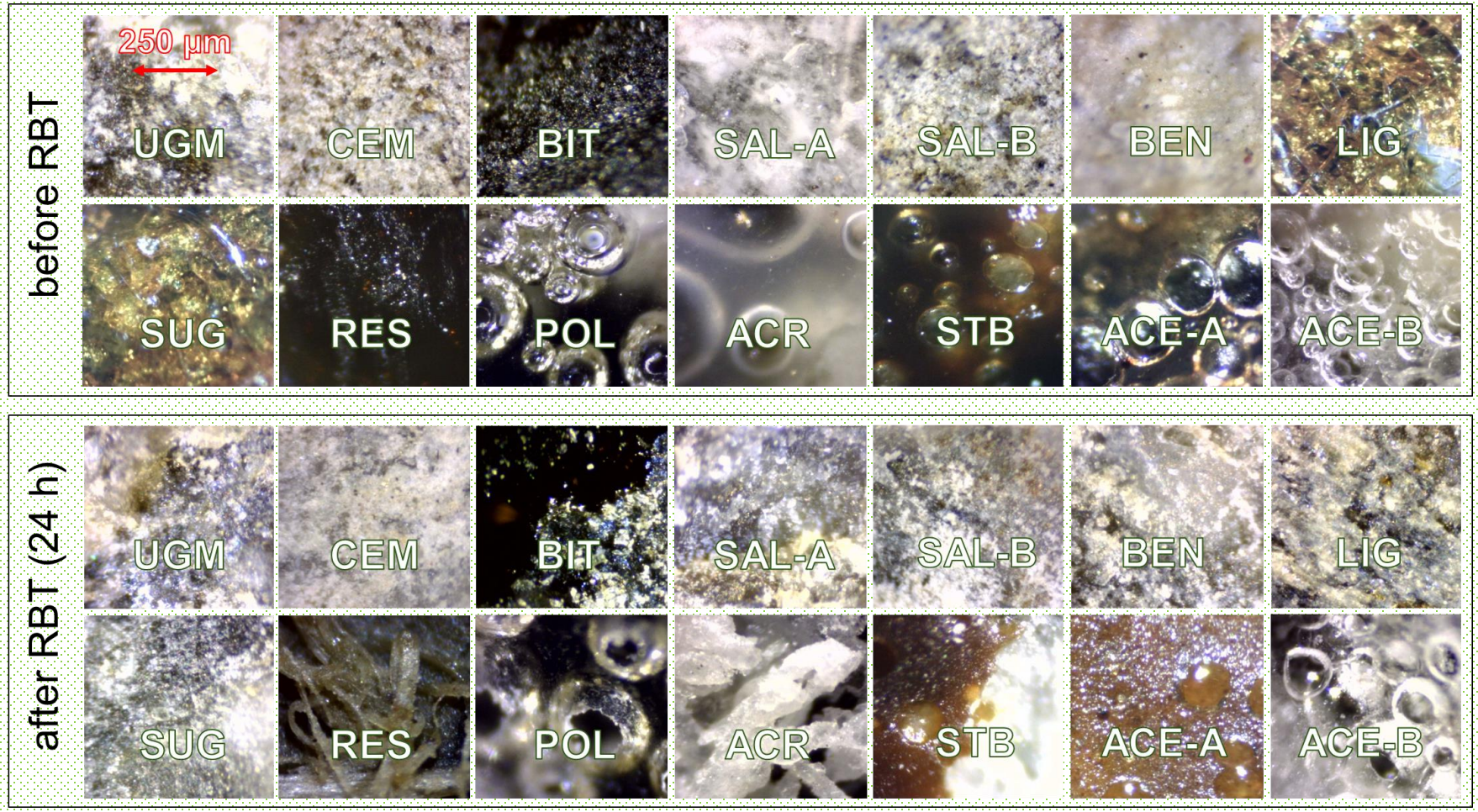




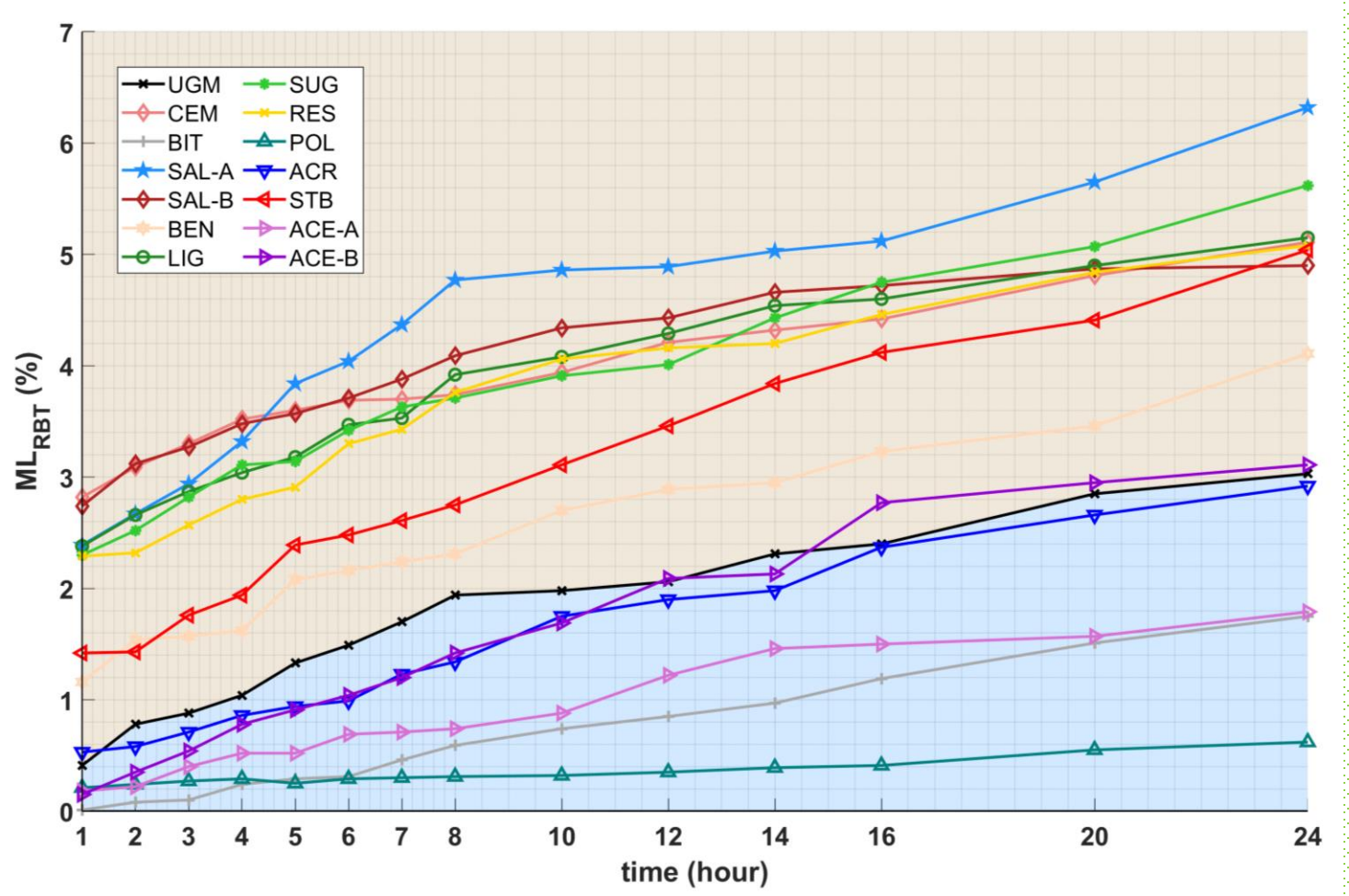
RULLEFLASKE TEST



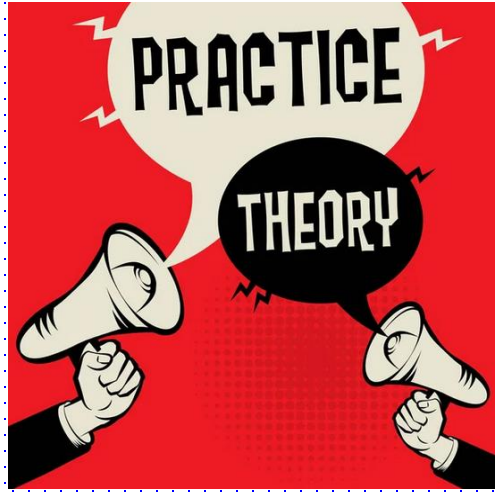
RULLEFLASKE TEST



VEDHEFT


UGM
SUG
CEM
RES
BIT
POL
SAL-A
ACR
SAL-B
STB
BEN
ACE-A
LIG
ACE-B
ML_{RBT} (%)
time (hour)
0
1
2
3
4
5
6
7
1
2
3
4
5
6
7
8
10
12
14
16
20
24

HVA BETYR ALT DETTE

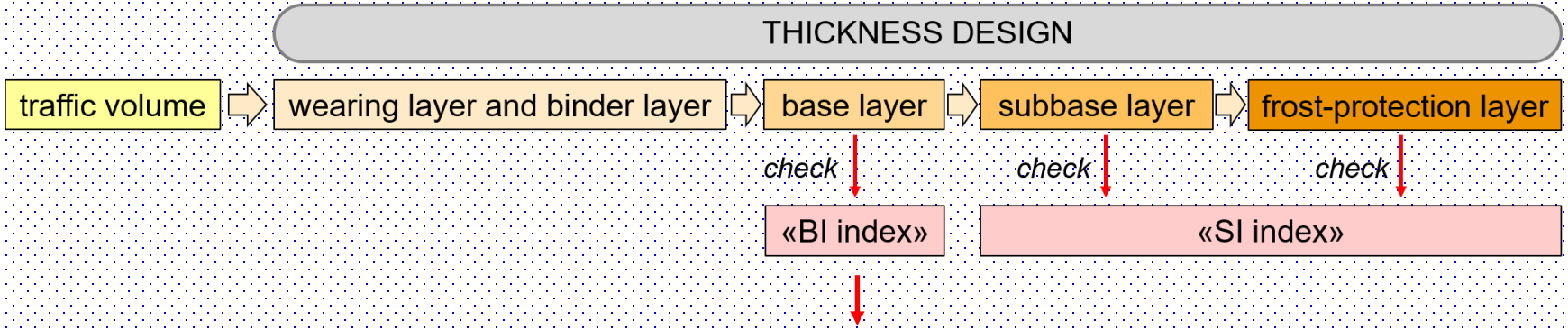


I PRAKTISK?

BYGGING AV STABILISERT BÆRELAG

“N200” PAVEMENT DESIGN CODE → THICKNESS EVALUATION OF STABILIZED BASE LAYER

FREMGANGSMÅTE I VEGDESIGN, N200



Lastfordelingskoeffisienter «a»

for å definere tykkelser for lagene i vegkroppen

De kan beregnes basert på RLTT resultater

TYKKELSE AV STABILISERT BÆRELAG, N200

Lastfordelingskoeffisienter «a»

Values of load distribution coefficients *a* and thickness of road base layers for different stabilization treatments.

Technology	E_{200} *fra RLTT* (kPa)	*a* (–)	Thickness of stabilized base (cm)	Thickness reduction compared to UGM base[a] (cm)
CEM	2614	2.10[d]	8.5	11.5
BIT	1664	2.00	10.0	10.0
SAL-B[b]	3535	2.10[d]	7.5	12.5
LIG[c]	1936	2.10	9.5	10.5
SUG[c]	969	1.70	11.5	8.5
RES[c]	1101	1.75	11.0	9.0
SF	1302	1.85	10.5	9.5
POL	1246	1.85	10.5	9.5
ACR	1017	1.70	11.5	8.5
STB	1487	1.95	10.0	10.0
ACE-A	1486	1.95	10.0	10.0
ACE-B	1530	1.95	10.0	10.0

[a] Thickness of UGM base is 20 cm.

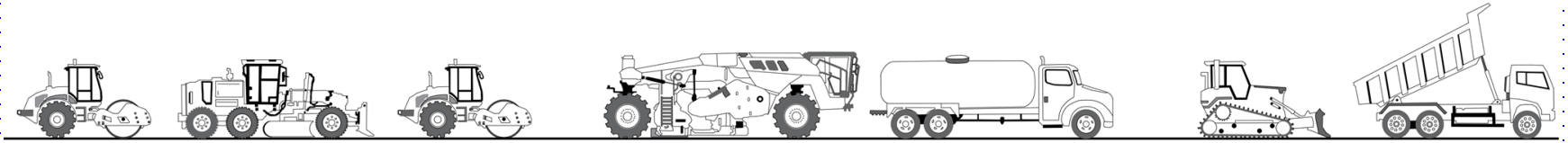
[b] Used in addition to CEM.

[c] Good stabilization with no exposure to water (e.g., proper drainage system, dry regions).

BYGGING AV STABILISERT BÆRELAG

"N200" PAVEMENT DESIGN CODE → THICKNESS EVALUATION OF STABILIZED BASE LAYER

CONSTRUCTION OF STABILIZED BASE LAYER



"HERMES CO_2" TOOL → CARBON DIOXIDE EMISSIONS

"HERMES CO_2" TOOL → ECONOMIC COSTS

Transportation Research Interdisciplinary Perspectives
Volume 11, September 2021, 100436

Assessment of carbon dioxide emissions during production, construction and use stages of asphalt pavements

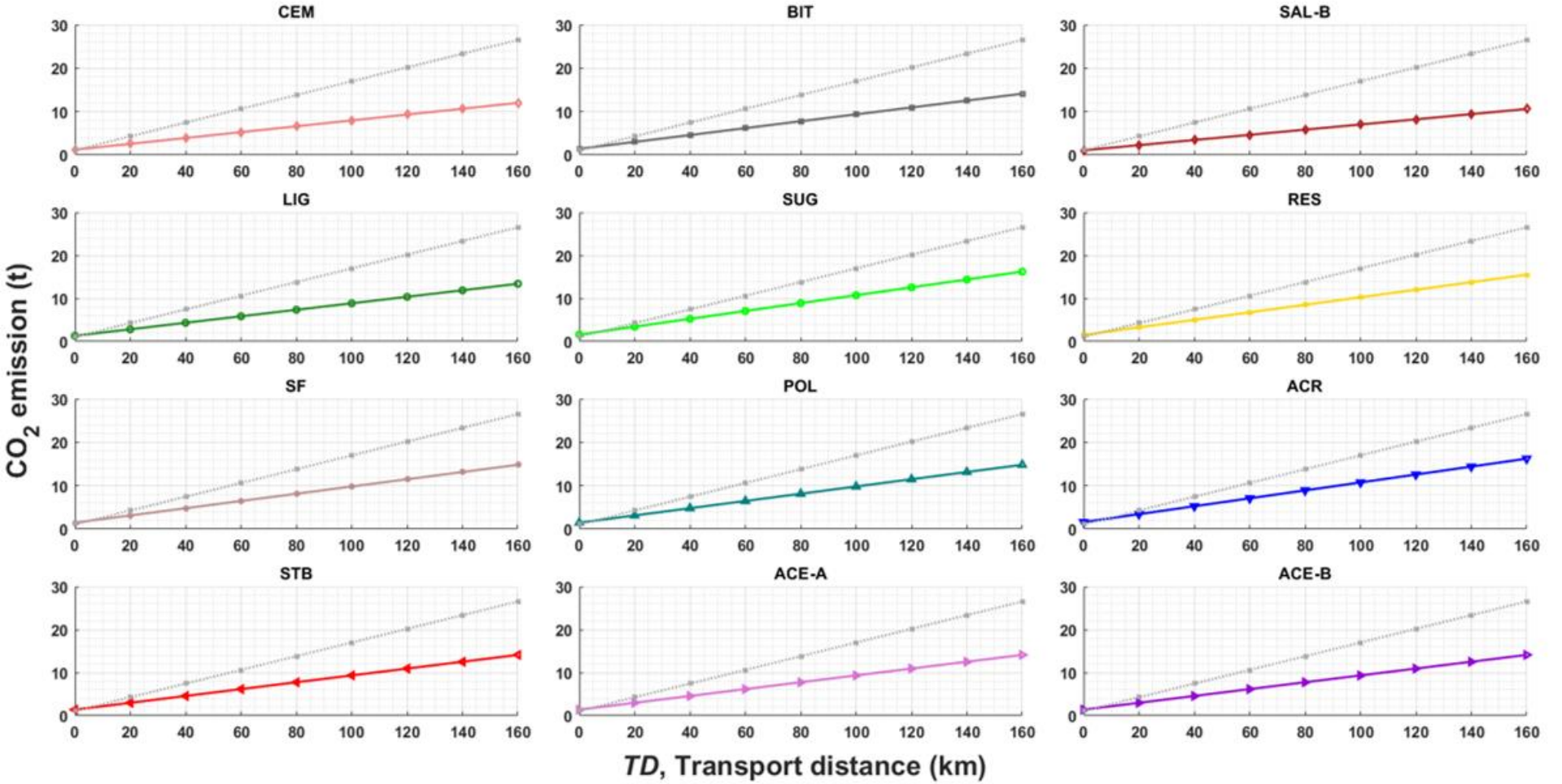
Diego Maria Barbieri [a], Baowen Lou [a], Fusong Wang [b], Inge Hoff [a], Shaopeng Wu [b], Jiashuo Li [c], Hrefna Run Vignisdottir [d], Rolf André Bohne [a], Sara Anastasio [a], Terje Kristensen [d]

https://doi.org/10.1016/j.trip.2021.100436

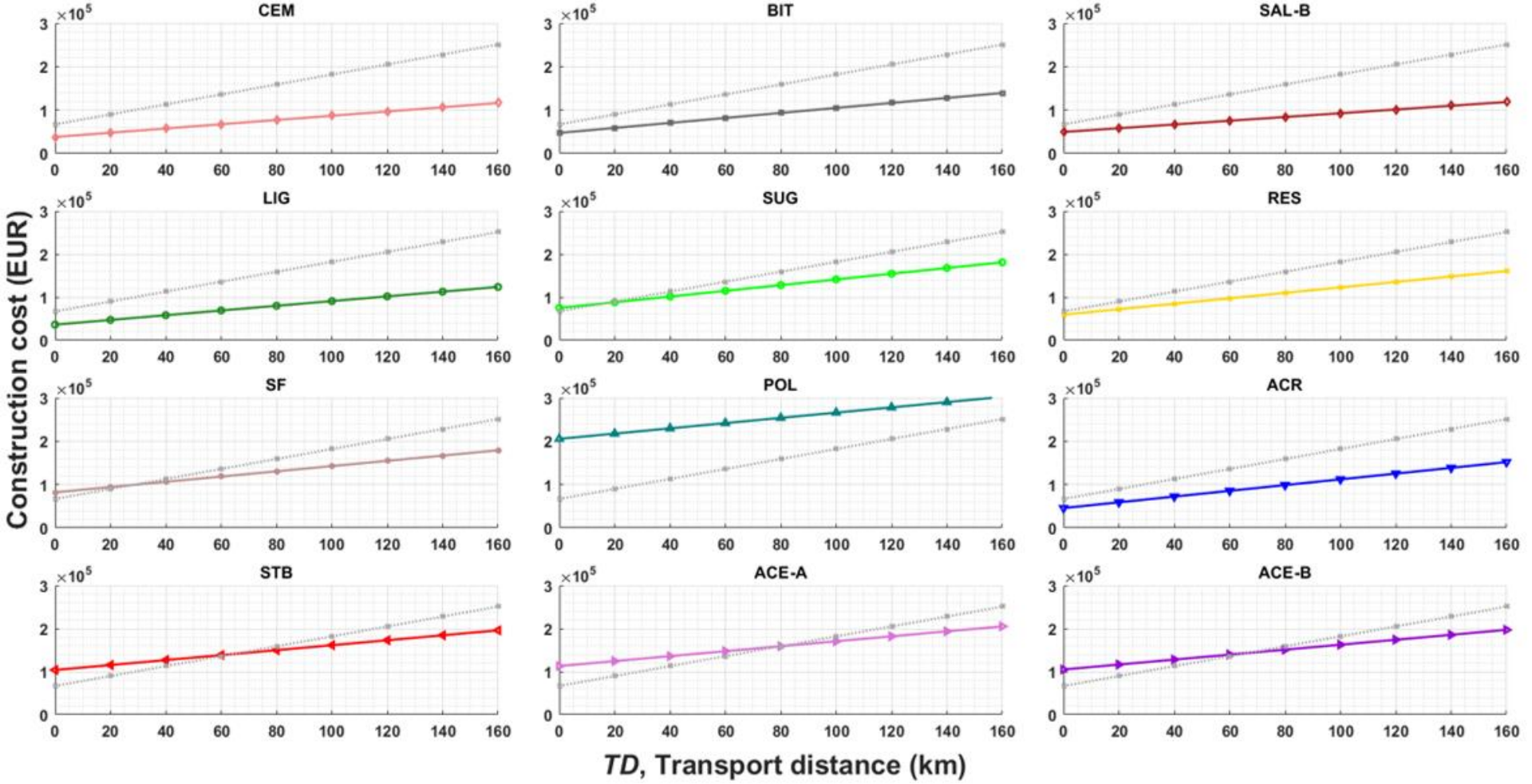
SCAN ME

BYGGING AV STABILISERT BÆRELAG

CO_2 UTSLIPP FOR Å BYGGE 1 km



PRIS FOR Å BYGGE 1 km



TUSEN TAKK FOR OPPMERKSOMHETEN

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Journal of Materials in Civil Engineering

Vol. 34, Issue 9 (September 2022)

Stabilization of Coarse Aggregates with Traditional and Nontraditional Additives

Diego Maria Barbieri, Ph.D.; Baowen Lou; Robert Jason Dyke; Hao Chen; Fusong Wang; Show less
Berthe Dongmo-Engeland, Ph.D.; Jeb S. Tingle, P.E., M.ASCE; and Inge Hoff, Ph.D.

https://doi.org/10.1061/(ASCE)MT.1943-5533.0004406

ELSEVIER

Journal of Cleaner Production
Volume 372, 20 October 2022, 133752

Design and sustainability analyses of road base layers stabilized with traditional and nontraditional additives

Diego Maria Barbieri [a], Baowen Lou [a, b], Robert Jason Dyke [c], Xueting Wang [b], Hao Chen [a], Benan Shu [d], Uneb Gazder [e], Suksun Horpibulsuk [f, g], Jeb S. Tingle [h], Inge Hoff [a]

https://doi.org/10.1016/j.jclepro.2022.133752

ELSEVIER

Data in Brief
Available online 24 November 2022, 108781
In Press, Uncorrected Proof

Data Article

Dataset of mechanical properties of coarse aggregates stabilized with traditional and nontraditional additives: Stiffness, deformation, resistance to freezing and stripping

Diego Maria Barbieri [a], Baowen Lou [a, b], Robert Jason Dyke [c], Hao Chen [a], Umesh Chandra Sahoo [d], Jeb S Tingle [e], Inge Hoff [a]

https://doi.org/10.1016/j.dib.2022.108781