



Statens vegvesen



Sandekvivalentmetoden for bestemmelse av finstoffkvalitet på 0/4-masse

NAMet-seminar 18. januar 2023
Radisson BLU Scandinavia Hotel, Oslo

Matias Vinje, (eks-NTNU) og Arnhild Ulvik, Statens vegvesen

Bakgrunn

- Få metodestandarder inkluderer materialer med kornstørrelse < 4 mm
- Følgelig stilles det få krav til disse kornstørrelsene, som kan utgjøre 40-50 % for enkelte asfaltresepter
- Det er ønskelig å finne analysemetoder som kan dokumentere ulike kvaliteter også for materiale < 4 mm, slik at alt tilslaget i asfaltresepter kan bli vurdert, og ikke kun det grove
- Gjennom to NTNU masteroppgaver som ble utført ved Statens vegvesens laboratorium i Trondheim i 2022, er flere analysemetoder testet ut for materialer med kornstørrelser < 4 mm, hvorav
 - micro-Devalmetoden (Simen Mathisen)
 - sandekvivalent- og metylenblåmetoden + + (Matias Vinje)



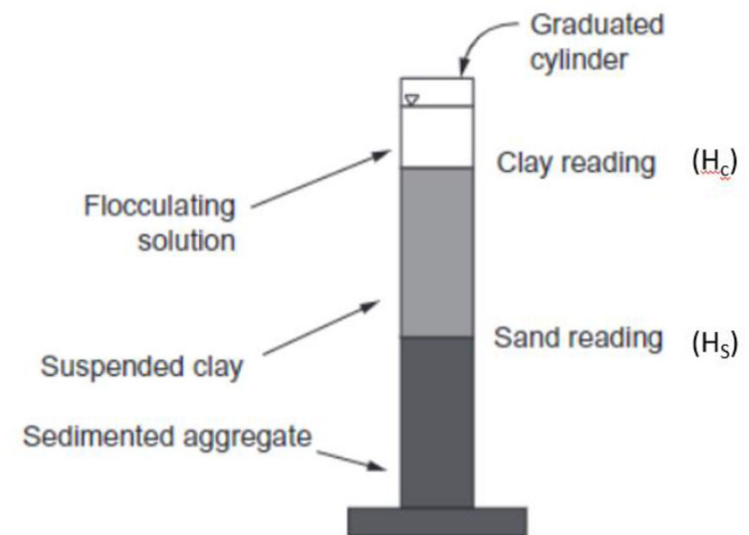
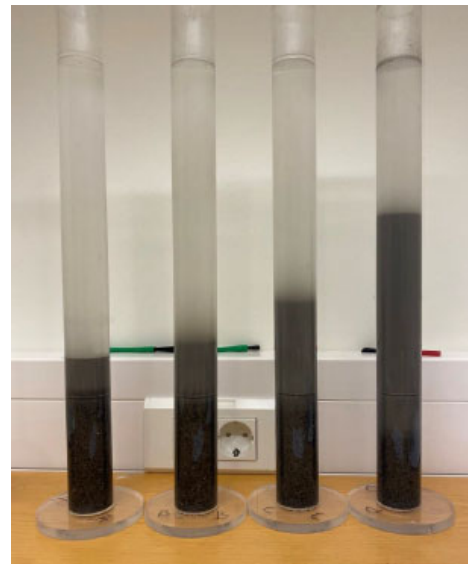
Sandekvivalentmetoden

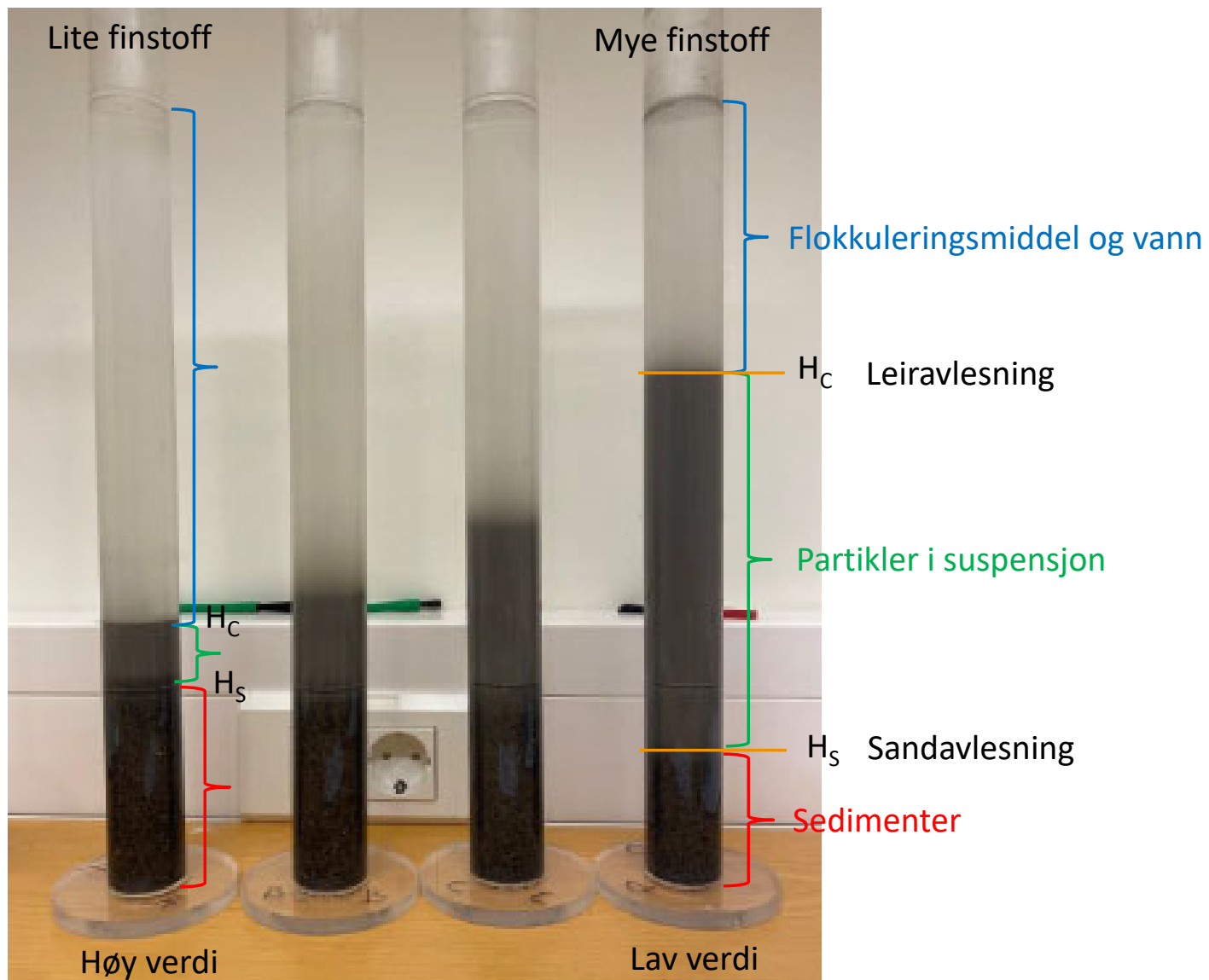
- Standardisert metode for finstoffbestemmelse, NS-EN 933-8
- Ingen krav til metoden i Norge – men andre europeiske land bruker den (også Sverige)
- Er metoden f.eks. egnet til å bestemme glimmerinnhold?



Sandekvivalentmetoden

- Litt likhetstrekk med hydrometeranalyse/slemmeanalyse
- Utføres på 0-2 mm eller 0-4 mm (Annex A)
- Materiale i suspensjon med avlesning (leir og sand) etter 20 min setningstid
- Beregning av sandekvivalentverdier



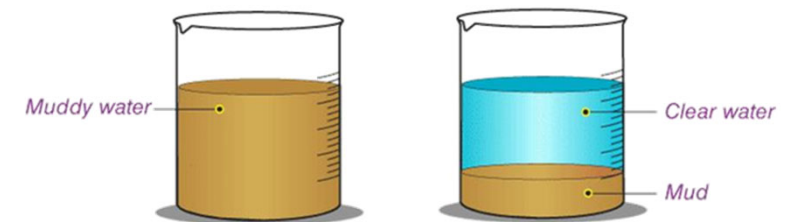


$$SE = \frac{H_s}{H_c} * 100$$

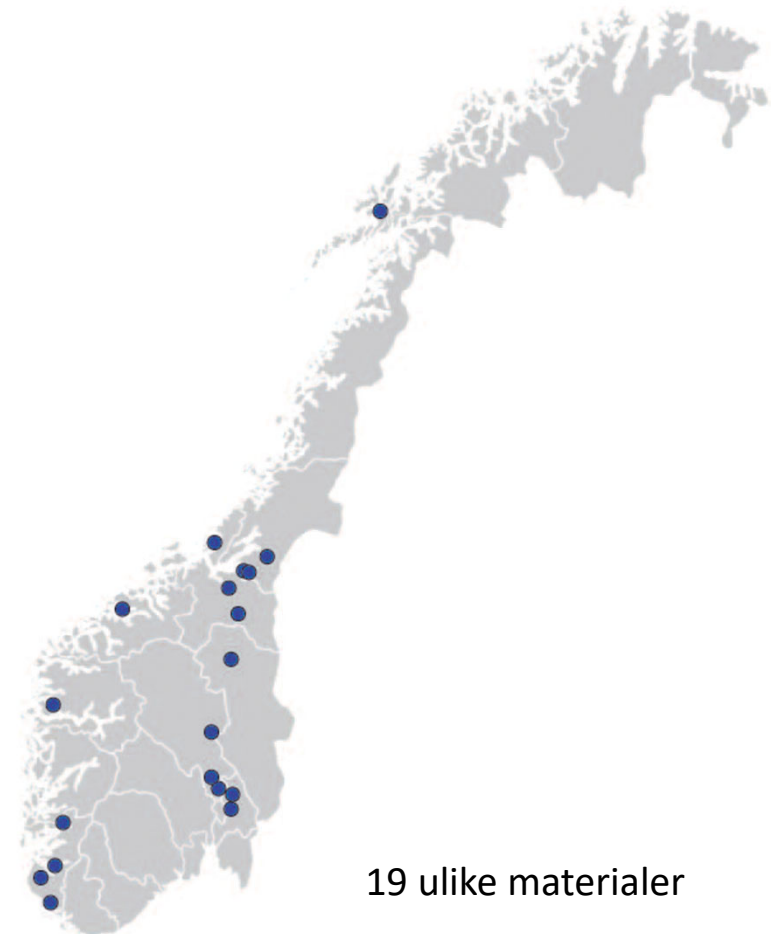
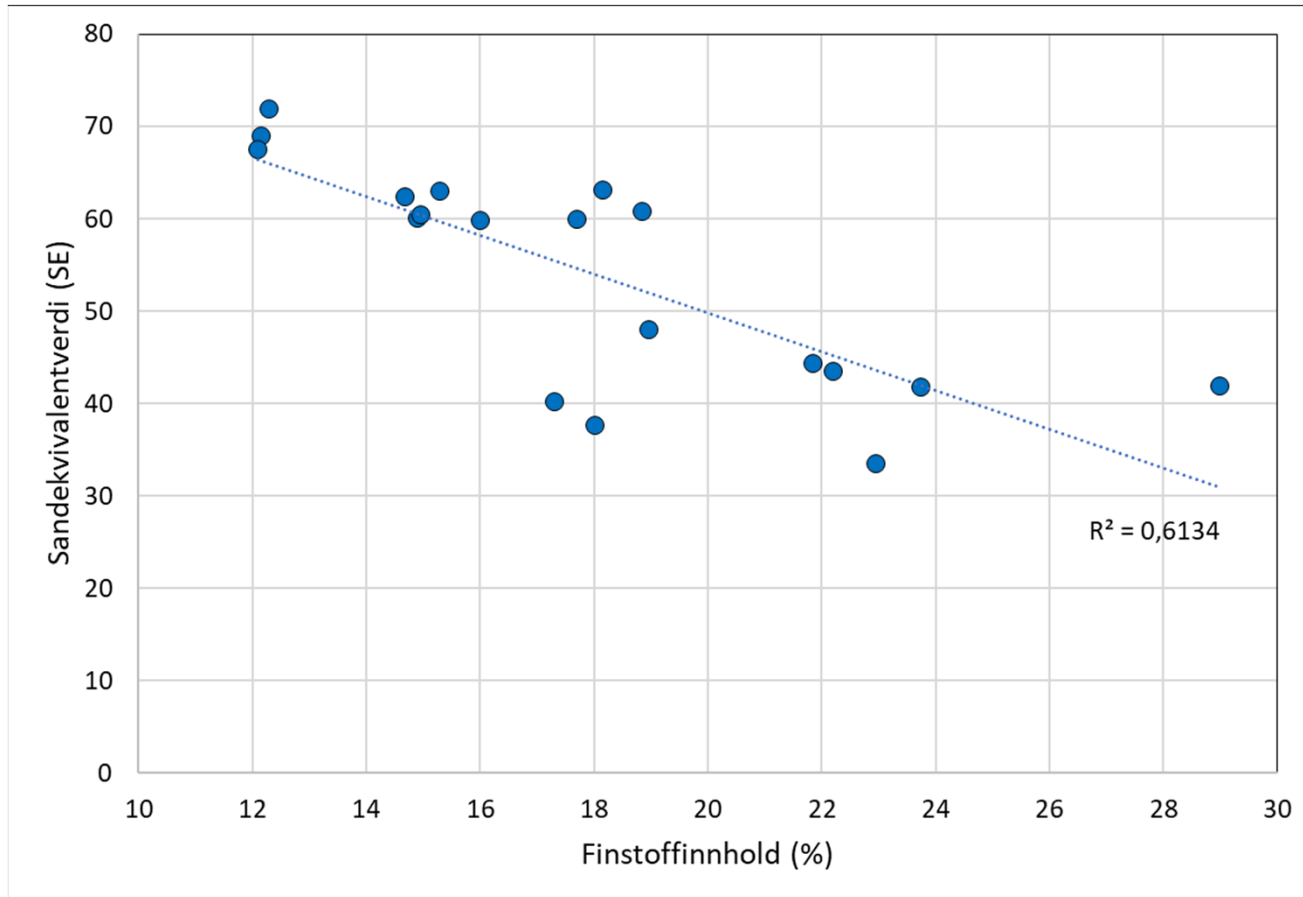
SE_{10} for 0-2 mm
 SE_4 for 0-4 mm

Målsetning og utførelse

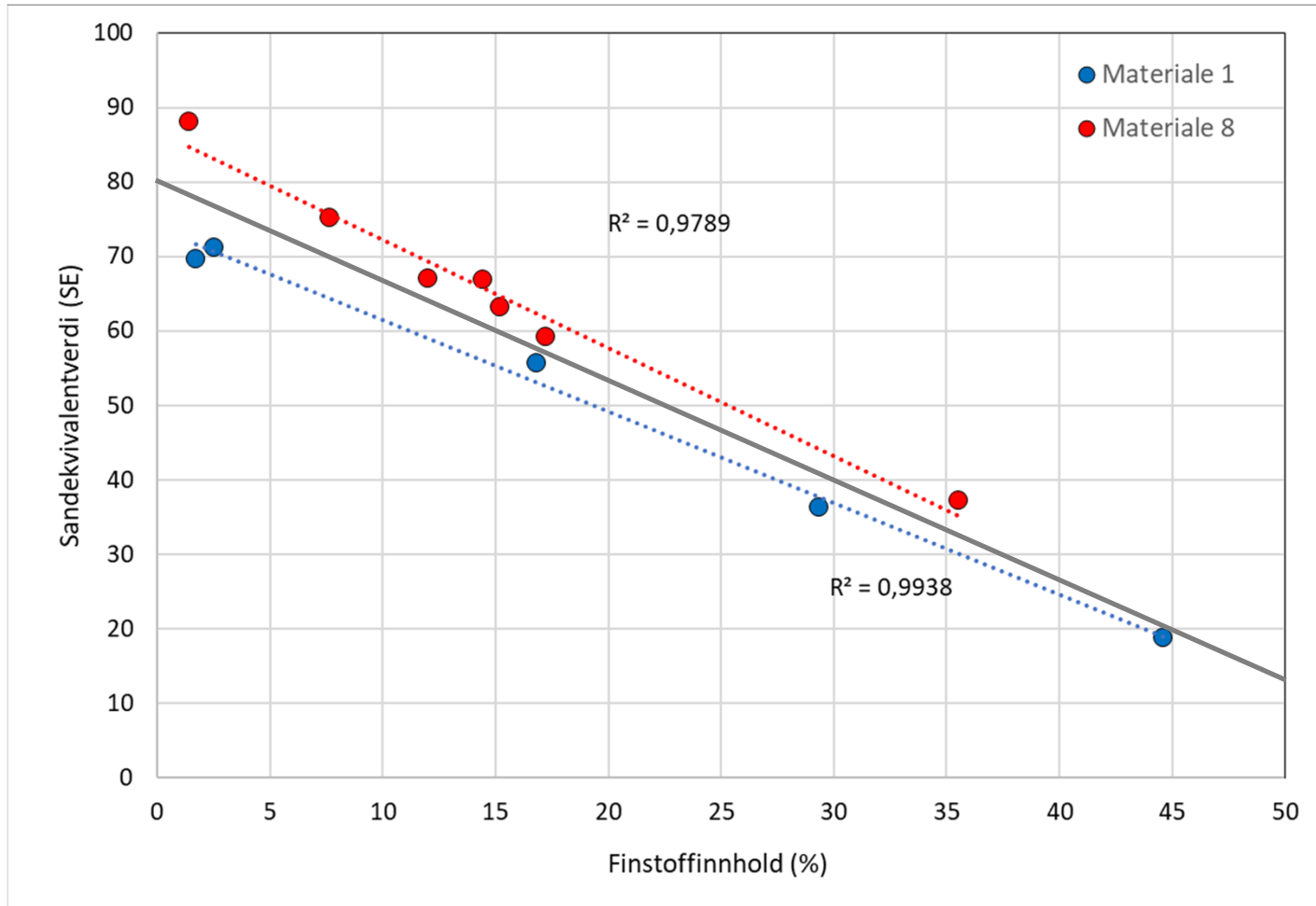
- Finne ut mest mulig om metodens egnethet for kvalitetsvurdering av finstoff
- Avvik fra standard – ingen begrensning på finstoffinnhold (dvs. mer enn 10 %) – det må være mulig å teste produktet slik det leveres
- Systematisk test av ulike blandingsforhold med finstoff
- Modellering basert på finstoffinnholdanalyser – omregning til 10 % finstoff
- Ulike blandinger med glimmer
- Sammenligning av europeisk og amerikansk standard mht. setningstid



Sandekvivalentmetoden – resultater



Sammenheng mellom sandekvivalent og finstoff for to materialer

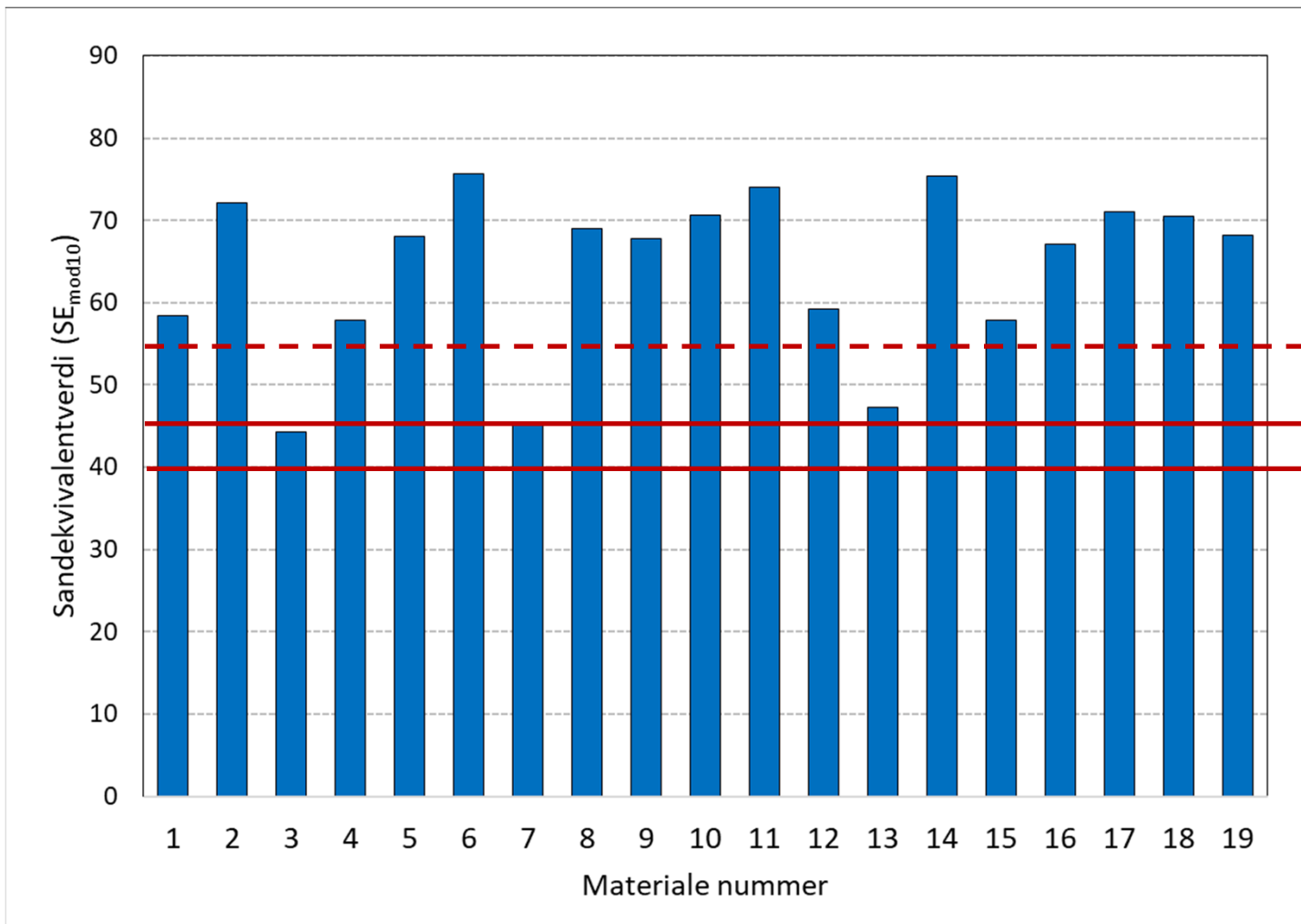


Materiale 1 = skifer

Materiale 8 = sandstein

$$(f_{10} = -1.35 \times \text{finstoffinnhold} + 80)$$

Sandekvivalentresultater (0-2 mm) - modificert



Forsterkningslag Sverige (≥ 40)

Bærelag i Sverige (≥ 45)

Tilslag i asfaltdekker (≥ 55 ?)

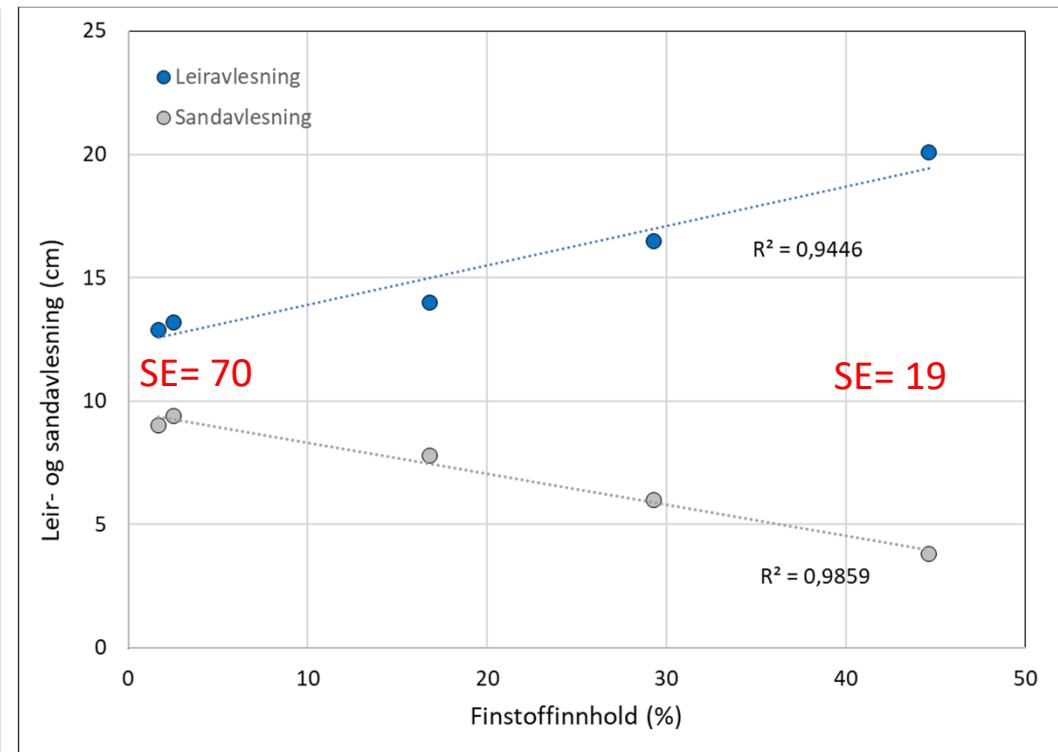
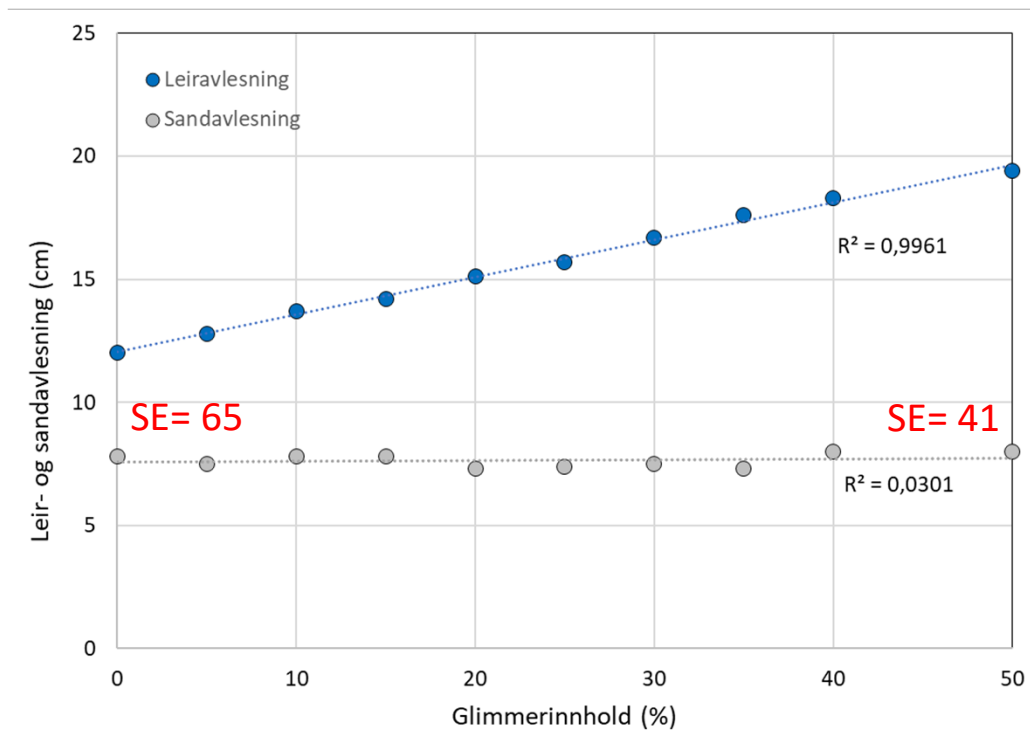
Fra prEN 17555-1

Table13 — Classes for sand equivalent values SE_{10}

Sand Equivalent values	Class SE_{10}
≥ 85 to 100	SE_{10} 85
≥ 80 to 100	SE_{10} 80
≥ 75 to 100	SE_{10} 75
≥ 70 to 100	SE_{10} 70
≥ 65 to 100	SE_{10} 65
≥ 60 to 100	SE_{10} 60
≥ 55 to 100	SE_{10} 55
≥ 50 to 100	SE_{10} 50
≥ 45 to 100	SE_{10} 45
≥ 40 to 100	SE_{10} 40
≥ 35 to 100	SE_{10} 35
≥ 30 to 100	SE_{10} 30
$\geq X$ to 100, where $X < 30$	SE_{10} Stated X

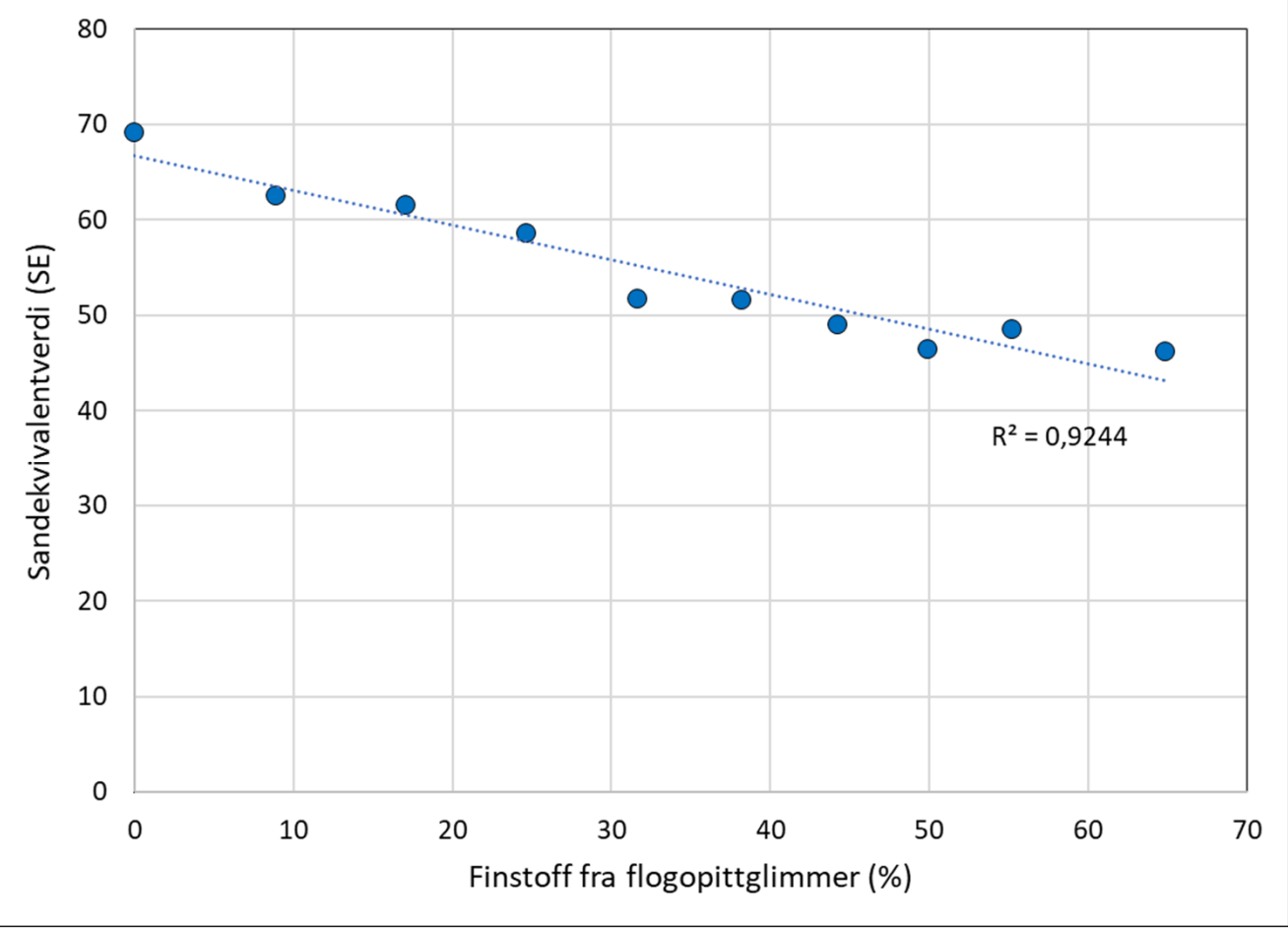
Leir- og sandavlesninger mht. glimmer- og finstoffinnhold

- Hva innvirker mest på SE-verdien?



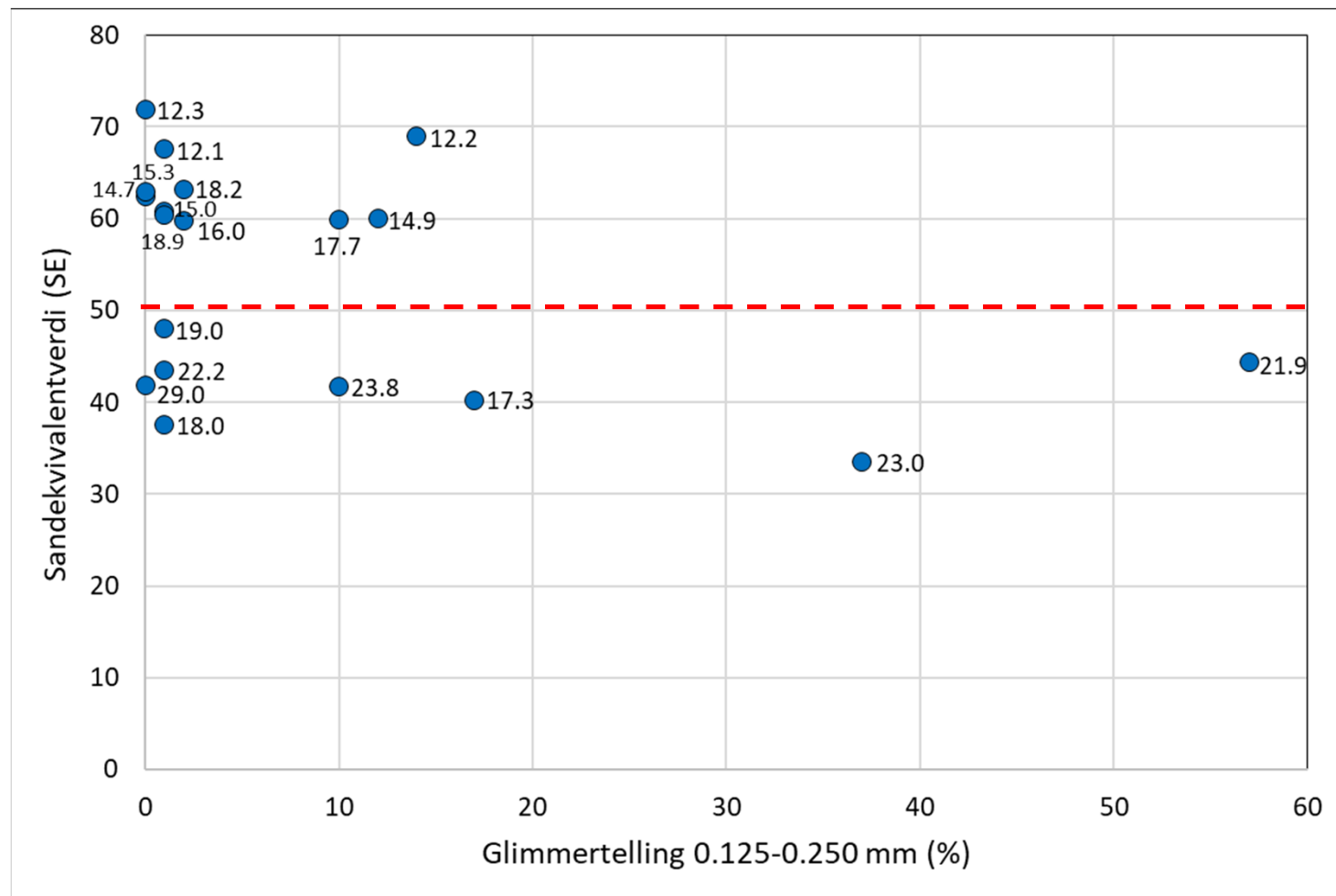
- Trolig også avhengig av hvilke mineraler som inngår i finstoffet

Innhold av både glimmer og finstoff?



- Svært god relasjon mellom finstoffglimmer og sandekvivalent

Glimmerinnhold basert på glimmertelling vs. sandekvivalentverdi



- Ikke like entydig for glimmer fordelt på ulike bergarter
- Finstoffinnhold har trolig størst betydning
- Ulik setningstid for bergartene



Europeisk versus amerikansk standard

- Forskjell i prøvesammensetning (prøvemengde og finstoff)
- Forskjell i avlesningstidspunkt (setningstid)

This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.



Designation: D2419 - 14

Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate¹

This standard is issued under the fixed designation D2419; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last approval. A superscripted epsilon (ϵ) indicates an editorial change since the last revision or approval.

This standard has been approved for use by agencies of the U.S. Department of Defense.

1. Scope

1.1 This test method is intended to serve as a rapid field-correlation test. The purpose of this test method is to indicate, under standard conditions, the relative proportions of clay-size or plastic fines and dust in granular soils and fine aggregates that pass the 4.75-mm (No. 4) sieve. The term "sand equivalent" expresses the concept that most granular soils and some fine aggregates are mixtures of desirable coarse particles, sand-size particles, and generally undesirable clay or plastic fines and dust.

*Note 1—*For fine aggregates containing clean dust of fracture (clay-size particles that are not clay minerals), test results will depend on the amount of fines present in the material. In this case other tests such as Methylene Blue Value (AASHTO T330) or X-Ray Diffraction (XRD) may be needed to determine if the fines are deleterious.

*Note 2—*Some agencies perform the test on material with a top size smaller than the 4.75-mm (No. 4) sieve. This is done to avoid trapping the clay-size or plastic fines and dust below flaky shaped 4.75 to 2.36 mm (No. 4 to 8) sized particles. Testing smaller top sized material may lower the numerical results of the test.

1.2 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.2.1 Regarding sieves, per Specification E11 Section 1.2, "the values stated in SI units shall be considered standard for the dimensions of the wire cloth openings and the diameter of the wires used in the wire cloth. The values stated in inch-pound units shall be considered standard with regard to the sieve frames." When sieve mesh sizes are referenced, the alternate inch-pound designations are provided for information purposes and enclosed in parentheses.

1.3 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

¹ This test method is under the jurisdiction of ASTM Committee D04 on Road and Paving Materials and is the direct responsibility of Subcommittee D04.51 on Aggregate Tests.

Current edition approved June 1, 2014. Published September 2014. Originally approved in 1965. Last previous edition approved in 2009 as D2419 - 09. DOI: 10.1520/D2419-14.

2. Referenced Documents

2.1 *ASTM Standards:*²

- C670 Practice for Preparing Precision and Bias Statements for Test Methods for Construction Materials
- C702 Practice for Reducing Samples of Aggregate to Testing Size
- D8 Terminology Relating to Materials for Roads and Pavements
- D75 Practice for Sampling Aggregates
- D653 Terminology Relating to Soil, Rock, and Contained Fluids
- D3666 Specification for Minimum Requirements for Agencies Testing and Inspecting Road and Paving Materials
- E11 Specification for Woven Wire Test Sieve Cloth and Test Sieves

2.2 *AASHTO Standard:*

- T 176 Standard Method of Test for Plastic Fines in Graded Aggregates and Soils by Use of Sand Equivalent Test³

3. Terminology

3.1 *Definitions:*

3.1.1 *clay size*—that portion of the soil or aggregate finer than 0.002 mm (0.005 mm in some cases) (see Terminology D653).

3.1.2 *fine aggregate*—aggregate passing the 9.5-mm (3/4-in.) sieve and almost entirely passing the 4.75-mm (No. 4) sieve and predominantly retained on the 75- μ m (No. 200) sieve (see Terminology D8).


3.1.3 *sand*—particles of rock that will pass the 4.75 mm (No. 4) sieve and be retained on the 0.075 mm (No. 200) sieve (see Terminology D653).

3.1.4 *sand equivalent*—a measure of the amount of silt, clay contamination, or clay-size aggregate particles in the fine aggregate (or soil) as determined by test (see Terminology D653). (For further explanation, see Section 4 and Section 5.)

² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For Annual Book of ASTM Standards volume information, refer to the standard's Document Summary page on the ASTM website.

³ Available from American Association of State Highway and Transportation Officials (AASHTO), 444 N. Capitol St., NW, Suite 249, Washington, DC 20001, <http://www.trasportation.org>.

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Norsk Standard

NS-EN 933-8:2012+A1:2015

ICS 91.100.15
Språk: Engelsk

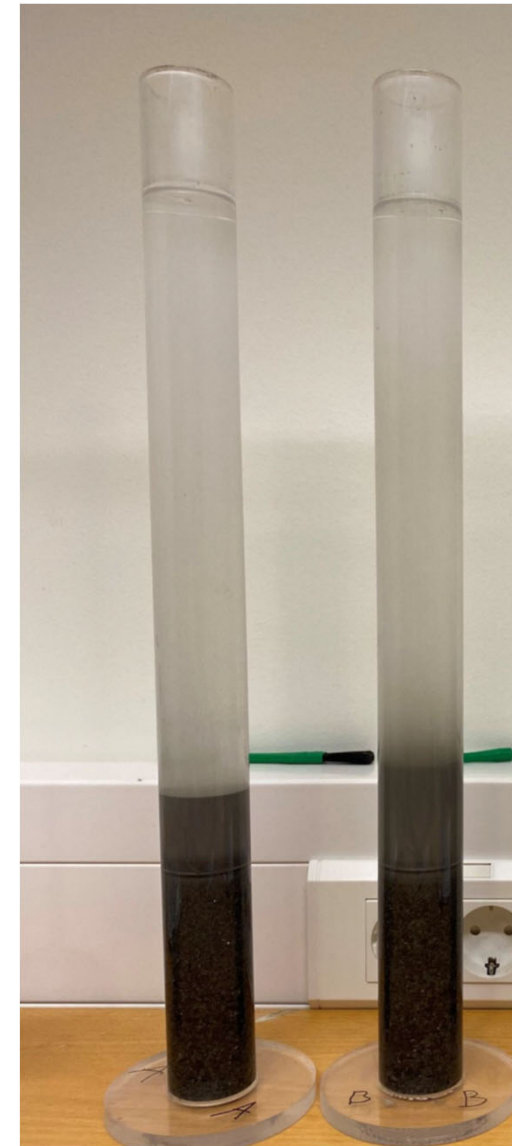
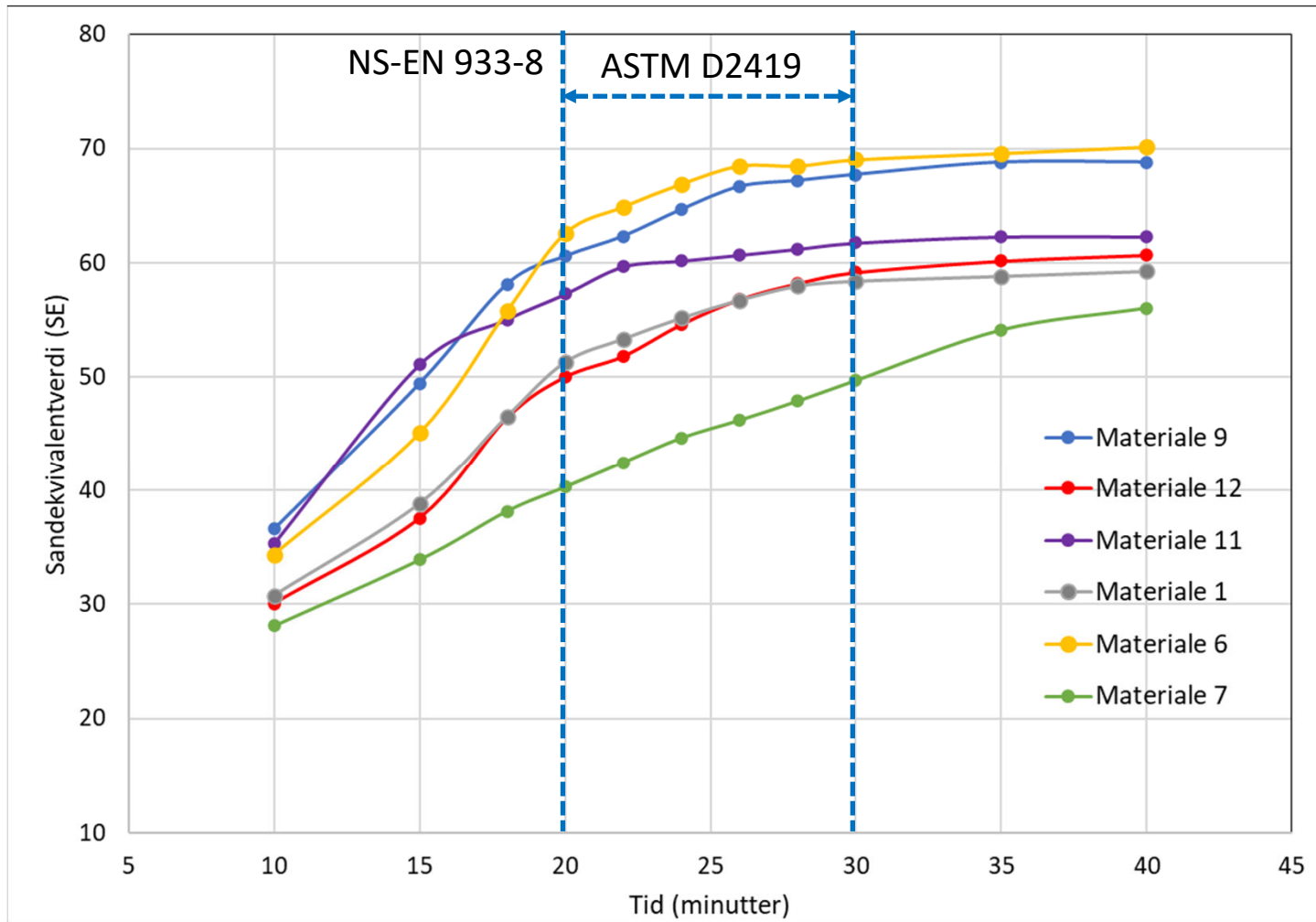
Prøvningsmetoder for geometriske egenskaper for tilslag

Del 8: Bedømmelse av finstoffinnhold Sandekvivalent-metoden

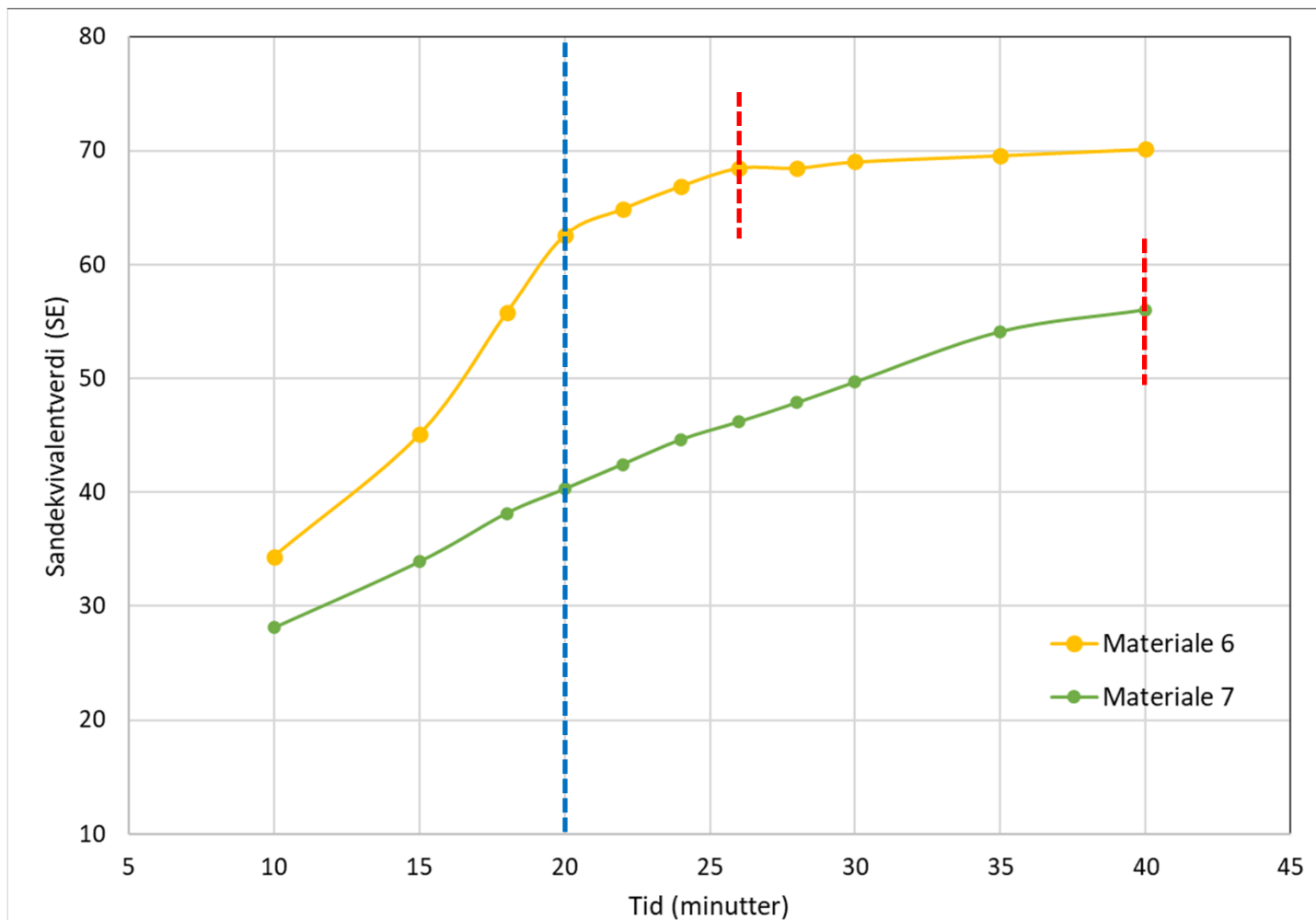
Tests for geometrical properties of aggregates
Part 8: Assessment of fines
Sand equivalent test

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Setningstid



To materialer med ulikt setningsforløp



Materiale 6 (trondhemitt)
ferdig satt etter 26 min.

Forlenget setningstid
medfører endring i SE-verdi
med ca. 6 enheter

18% finstoff
2% fritt glimmer

Materiale 7 (gråvakke)
ferdig satt etter 40 min?

Forlenget setningstid
medfører endring i SE-verdi
med 16 enheter

23% finstoff
57% fritt glimmer

Sandekvivalent – oppsummering

- God relasjon mellom finstoffinnhold og SE-verdi
- Nokså god relasjon mellom glimmerinnhold og SE-verdi
- Kan regne tilbake til 10 % finstoffinnhold
- Amerikansk standard hensyntar ulik sedimentasjonshastighet
- Gi innspill til SN/K 5 Tilslag
- Vanskelig å sette krav foreløpig
- Bør følge opp med videre undersøkelser
 - teste andre typer glimmer og flere ulike bergarter, og evt. natursand
 - asfaltrelaterte funksjonstester (Wheel-Track, Prall, vändskak)

