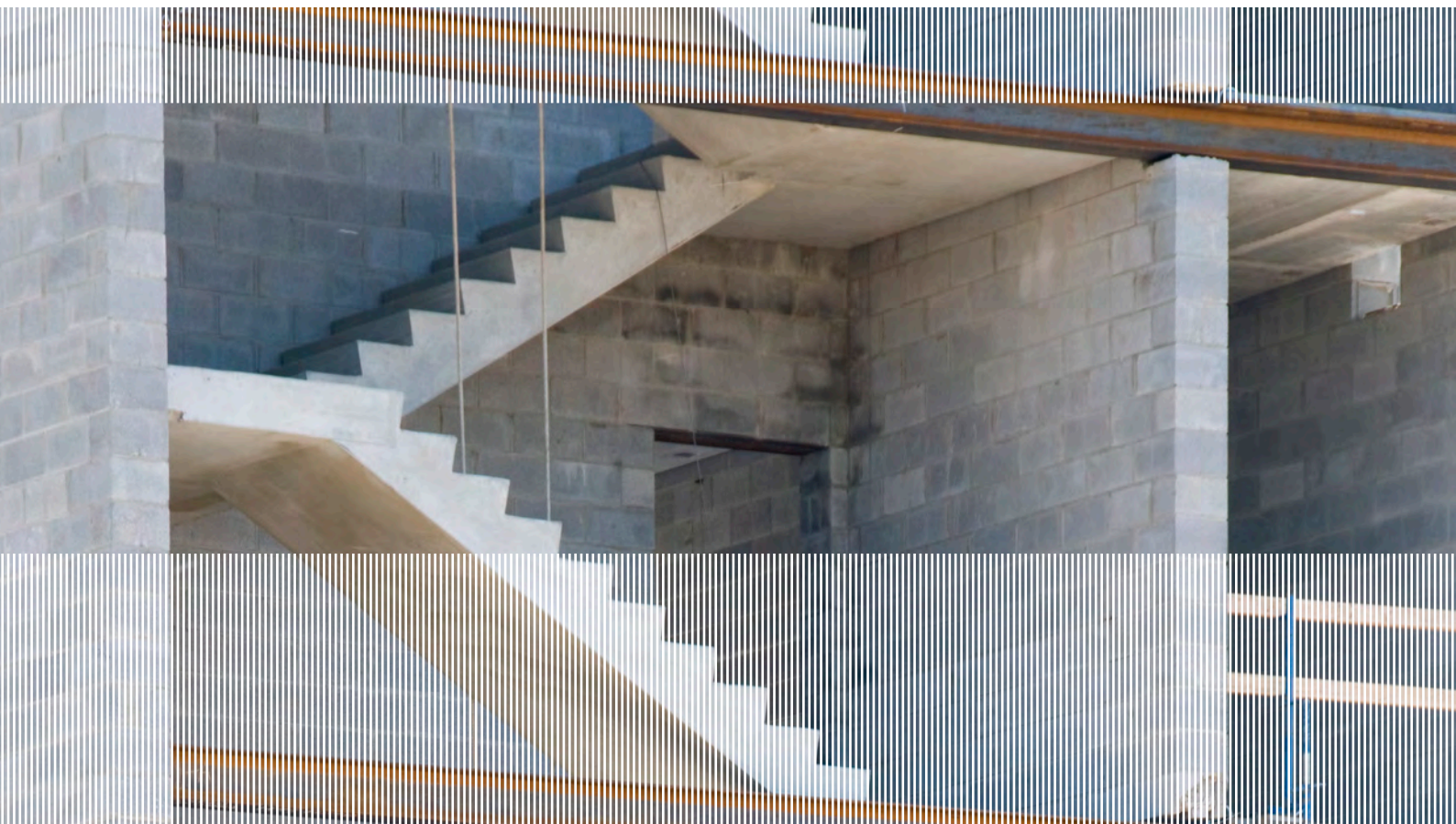


**SINTEF Building and Infrastructure** Børge Johannes Wigum (editor)

# Workshop on Manufactured Sand, Stavanger, Norway 20–21 October 2014

COIN project report 80 – 2015



SINTEF Building and Infrastructure

Børge Johannes Wigum (editor)

# **Workshop on Manufactured Sand, Stavanger, Norway 20–21 October 2014**

FA: Competitive constructions

SP 2.3 Production of high quality manufactured aggregate for concrete

COIN Project report 80 – 2015

COIN Project report no 80

Børge Johannes Wigum (editor)

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Keywords:

Concrete aggregates; manufactured sand

Project no.: 102000442-5

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[www.coinweb.no](http://www.coinweb.no)

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# MANUFACTURED SAND WORKSHOP

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STAVANGER, NORWAY,  
OCTOBER 20<sup>TH</sup> AND 21<sup>ST</sup> 2014

## *SUMMARY OF PRESENTATIONS*

COIN Version

November 2014

# MANUFACTURED SAND - SEMINAR

Stavanger, Norway, October 20<sup>th</sup> and 21<sup>st</sup> 2014



## Introduction

---

This seminar on production and use of manufactured sand as concrete aggregates, is marking an end of the sub-project 2.3 on; “*Manufactured sand*”, within the research program; COIN - Concrete Innovation Centre. The vision of COIN is creation of more attractive concrete buildings and constructions. Attractiveness in aesthetics, functionality, sustainability, energy efficiency, indoor climate, industrialized construction, improved work environment, and cost efficiency during the whole service life. The primary goal is to fulfil this vision by bringing the development a major leap forward by more fundamental understanding of the mechanisms in order to develop advanced materials, efficient construction techniques and new design concepts combined with more environmentally friendly material production.

COIN has been running for the last 8 year and is finalising this year. The program is financed by the Research Council of Norway, industrial partners, SINTEF Building and Infrastructure and Norwegian University of Science and Technology (NTNU).

The main aim of this Seminar is to create opportunity for professional development, for information sharing and dissemination. We want this Seminar to be an arena for interactive exchange of experiences between the participants, and invited speakers will present their presentations regarding one of the following topics:

- Production (extraction, crushing, sieving, washing)
- Cases of real activities
- Characterization and testing of fines
- Use of manufactured sand in concrete; mix design
- Resources, environmental issues and discussion about the future



**Front row from left:** Børge Johannes Wigum, Hernan Mujica, Sven-Henrik Norman, Berit Laanke  
**Second row, from left:** Stefan Jacobsen, Espen Rudberg, Sverre Smepllass, Svein Willy Danielsen, Rolv Magne Dahl, Knut Li  
**Back row:** Bård Dagestad, Reidar Velde, Odd Hotvedt, Marit Haugen, Rolands Cepuritis, Hans-Erik Gram, Oliver Patsch, Egil Velde, Serina Ng, Eoin Heron, Olav Hallset  
**Not present:** Brynjar Lund-Andersen & Lillian Uthus Mathisen

**Participants**

|    | Name           |                | Company            |
|----|----------------|----------------|--------------------|
| 1  | Cepuritis      | Rolands        | NTNU/Norcem        |
| 2  | Dagestad       | Bård           | NorStone           |
| 3  | Dahl           | Rolv Magne     | NGU                |
| 4  | Danielsen      | Svein Willy    | SINTEF Byggforsk   |
| 5  | Gram           | Hans-Erik      | Cementa            |
| 6  | Hallset        | Olav           | Norsk Bergindustri |
| 7  | Haugen         | Marit          | SINTEF             |
| 8  | Heron          | Eoin           | CDE Global Limited |
| 9  | Jacobsen       | Stefan         | NTNU               |
| 10 | Laanke         | Berit          | SINTEF             |
| 11 | Li             | Knut           | Franzefoss Pukk AS |
| 12 | Lund-Andersen  | Brynjar        | Franzefoss Pukk AS |
| 13 | Mujica         | Hernan         | Velde              |
| 14 | Ng             | Serina         | SINTEF             |
| 15 | Norman         | Sven-Henrik    | Sandvik            |
| 16 | Odd Hotvedt    | Odd            | Norsk Stein        |
| 17 | Oliver Patsch  | Oliver         | Norsk Stein        |
| 18 | Rudberg        | Espen          | Rescon Mapei       |
| 19 | Smepllass      | Sverre         | Skanska/NTNU       |
| 20 | Uthus Mathisen | Lillian        | Kolo Veidekke      |
| 21 | Velde          | Reidar         | Velde AS           |
| 22 | Velde          | Egil           | Velde AS           |
| 23 | Wigum          | Børge Johannes | NTNU/Norcem        |

## Content of Presentations:

Børge Johannes Wigum, NTNU/Norcem: Introduction

Rolands Cepuritis, NTNU/Norcem:

“Engineered sand production with Vertical Shaft Impact (VSI) crushers and static air-classifiers”.

Tero Onnela, Metso:

Sand solution equipment

Sven-Henrik Norman, Sandvik:

Manufactured sand solutions by Sandvik

Odd Hotvedt, Norsk Stein, Jelsa:

Yearly production of 10 mill. tons aggregate. Challenges and possibilities regarding the sand production.

Eoin Heron, CDE Global Limited:

Washing Manufactured Sands.

Egil Velde, Velde Pukk:

An integrated concept of aggregate production and use.

Sverre Smeplass, Skanska:

Filler composition, a new tool to control concrete workability

Hans-Erik Gram, Cementa:

Sustainable production of fine particles from rock materials – a 2 year project in Sweden

Rolands Cepuritis, NTNU/Norcem:

“Methods for characterization of crushed filler properties and principles of proportioning concrete with these materials”.

Hans-Erik Gram, Cementa:

How to determine the influence of aggregate fillers on the yield stress and plastic viscosity of micromortar.

Bård Dagestad, NorStone:

Sustainable concrete aggregate in perspective of the resources situation.

Rolv Dahl, NGU:

Current and future consumption and supply of building materials in Norway.

Olav Hallset, Norwegian Mineral Industry:

Public Management of Geological Resources





# MANUFACTURED SAND - SEMINAR

Stavanger, Norway, October 20<sup>th</sup> and 21<sup>st</sup> 2014



| Monday 20 <sup>th</sup> October  | Tuesday 21 <sup>st</sup> October  |
|--|---|
|  | <b>3. Session - Classification of fines – standardization concrete mix design</b><br>Chair: <i>Børge Johannes Wigum</i><br>08:40 - 10:00                            |
|  | <b>Sverre Smeplass, Skanska:</b><br>Filler composition, a new tool to control concrete workability  |
|  | <b>Hans-Erik Gram, Cementsa:</b><br>Sustainable production of fine particles from rock materials – a 2 year project in Sweden.                                      |
|  | <b>Rolands Cepuritis, NTNU/Norcem :</b><br>Methods for characterization of crushed filler properties and principles of proportioning concrete with these materials. |
|  | <b>Hans-Erik Gram, Cementsa:</b><br>How to determine the influence of aggregate fillers on the yield stress and plastic viscosity of micromortar.                   |
|  | <b>Coffee/discussion</b>  |
|  | <b>4. Session - Resources – Environmental issues – The future</b><br>Chair: <i>Svein-Willy Danielsen</i><br>10:30 - 12:00   |
|  | <b>Bård Dagestad, NorStone:</b><br>Sustainable concrete aggregate in perspective of the resources situation.  |
|  | <b>Rolv Dahl, NGU:</b><br>Current and future consumption and supply of building materials in Norway.  |
|  | <b>Olav Hallset, Norwegian Mineral Industry :</b><br>Public management of geological resources  |
| Summary and discussion   |   |
| <b>Lunch</b>   | <b>Lunch</b>  |
| <b>1. Session - Crushing and screening of manufactured sand</b><br>Chair: <i>Børge Johannes Wigum</i><br>13:00 - 14:10                               |   |
| <b>Børge Johannes Wigum, NTNU/Norcem :</b> Introduction  |   |
| <b>Rolands Cepuritis, NTNU/Norcem :</b><br>Engineered sand production with Vertical Shaft Impact (VSI) crushers and static air-classifiers.          |   |
| <b>Sven-Henrik Norman, Sandvik:</b><br>Manufactured sand solutions by Sandvik.   |   |
| <b>Coffee/discussion</b>   |   |
| <b>2. Session - Real cases</b><br>Chair: <i>Svein-Willy Danielsen</i><br>14:30 - 15:30   |   |
| <b>Odd Hotvedt, Norsk Stein, Jelsa:</b><br>Yearly production of 10 mill. tons aggregate. Challenges and possibilities regarding the sand production. |   |
| <b>Eoin Heron, CDE Global Limited :</b><br>Washing Manufactured Sands.   |   |
| <b>Egil Velde, Velde Pukk :</b><br>An integrated concept of aggregate production and use.  |   |
| <b>Excursion to Velde</b><br>15:30 - 18:00   |   |
| <b>Dinner</b>  |   |



# MANUFACTURED SAND - SEMINAR

## Stavanger, Norway - October 20<sup>th</sup> and 21<sup>st</sup> 2014

### Concrete Innovation Centre (COIN)

- A centre for research based innovation

### 2007 – 2014; Closure Seminar

Marit Haugen – SINTEF  
Svein Willy Danielsen – SINTEF  
Rolands Cepuritis – NTNU/Norcem  
Børge J Wigum – NTNU/Norcem



## COIN - Concrete Innovation Centre



- COIN - one of 14 Centres for Research-based Innovation (CRI)
- The Research Council of Norway's tool to stimulate the industry to further innovation by creating close alliances between research-intensive enterprises and prominent research groups
- SINTEF leading this 8 year centre (2007 – 2014) with a budget of more than 25 mill EUR, in cooperation with NTNU and industrial partners with their subcontractors, represent the whole value chain



COIN

## Focus Areas



- 1) Environmental friendly concrete structures
- 2) Competitive construction
- 3) Technical performance



COIN

## 2) Competitive construction

2.3 High quality manufactured sand for concrete



Stavanger 30.-31. Oktober 2008



**COIN**

## 2) Competitive construction

### 2.3 High quality manufactured sand for concrete



Nordic Concrete Rheology Workshop &  
Nordic SCC Net Meeting, 3-4 October 2011, Trondheim



**COIN**

## 2) Competitive construction


### 2.3 High quality manufactured sand for concrete



**COIN**


## 2) Competitive construction

### 2.3 High quality manufactured sand for concrete



COIN Project report 32 - 2011


COIN Project report 33 - 2011




**COIN**

## 2) Competitive construction

### 2.3 High quality manufactured sand for concrete



COIN Project report 34 - 2011



COIN

## 2) Competitive construction

### 2.3 High quality manufactured sand for concrete




Rolands Cepuritis  
Master's thesis  
Effects of Concrete Aggregate Crushing on Rheological Properties of Concrete and Matrix  
NTNU  
Norwegian University of Science and Technology  
Department of Building and Architecture  
Faculty of Architecture and Design




COIN


## 2) Competitive construction

### 2.3 High quality manufactured sand for concrete




COIN  
SWED Building and Infrastructure - Science Center for Green Buildings  
A preliminary study on using manufactured sand from Jelsa Quarry for the production of plastic concrete mixes  
COIN Project report 42 - 2012





## 2) Competitive construction

### 2.3 High quality manufactured sand for concrete


## Participants

|    | Name           |                | Company            |
|----|----------------|----------------|--------------------|
| 1  | Onnela         | Tero           | Metso              |
| 2  | Cepuritis      | Rolands        | NTNU/Norcem        |
| 3  | Dagestad       | Bård           | NorStone           |
| 4  | Dahl           | Rolv Magne     | NGU                |
| 5  | Danielsen      | Svein Willy    | SINTEF Byggforsk   |
| 6  | Gram           | Hans-Erik      | Cementa            |
| 7  | Hallset        | Olav           | Norsk Bergindustri |
| 8  | Haugen         | Marit          | SINTEF             |
| 9  | Heron          | Eoin           | CDE Global Limited |
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| 16 | Norman         | Sven-Henrik    | Sandvik            |
| 17 | Odd Hotvedt    | Odd            | Norsk Stein        |
| 18 | Oliver Patsch  | Oliver         | Norsk Stein        |
| 19 | Pedersen       | Bård           | Statens vegvesen   |
| 20 | Rudberg        | Espen          | Rescon Mapei       |
| 21 | Smeplass       | Sverre         | Skanska/NTNU       |
| 22 | Uthus Mathisen | Lillian        | Kolo Veidekke      |
| 23 | Velde          | Reidar         | Velde AS           |
| 24 | Velde          | Egil           | Velde AS           |
| 25 | Wigum          | Børge Johannes | NTNU/Norcem        |



## Manufactured Sand - Workshop

| COIN  |   |
|---|---|
| 12:00 - 13:00   | Lunch   |
| 1. Session - Crushing and screening of manufactured sand<br>Chair: Børge Johannes Wigum |   |
| 13:00 - 13:10   | <u>Børge Johannes Wigum</u> , NTNU/Norcem: Introduction   |
| 13:10 - 13:30   | <u>Rolands Cepuritis</u> , NTNU/Norcem:<br>"Engineered sand production with Vertical Shaft Impact (VSI) crushers and static air-classifiers".         |
| 13:30 - 13:50   | <u>Tero Onnela</u> , Metso:<br>Sand solution equipment  |
| 13:50 - 14:10   | <u>Sven-Henrik Norman</u> , Sandvik:<br>Manufactured sand solutions by Sandvik  |
| 14:10 - 14:30   | Coffee/discussion   |
| 2. Session - Real cases<br>Chair: Svein-Willy Danielsen                                 |   |
| 14:30 - 14:50   | <u>Odd Hotvedt</u> , Norsk Stein, Jelsa:<br>Yearly production of 10 mill. tons aggregate. Challenges and possibilities regarding the sand production. |
| 14:50 - 15:10   | <u>Foin Heron</u> , CDE Global Limited:<br>Washing Manufactured Sands.  |
| 15:10 - 15:30   | <u>Egil Velde</u> , Velde Pukk:<br>An integrated concept of aggregate production and use.   |
| 15:30 - 18:00   | Excursion to Velde  |
| 19:00   | Dinner  |

| COIN  |   |
|---|---|
| 3. Session - Classification of fines – standardization concrete mix design<br>Chair: Børge Johannes Wigum |   |
| 08:40 - 09:00   | <u>Sverre Smeglass</u> , Skanska:<br>Filler composition, a new tool to control concrete workability   |
| 09:00 - 09:20   | <u>Hans-Erik Gram</u> , Cementsa:<br>Sustainable production of fine particles from rock materials – a 2 year project in Sweden  |
| 09:20 - 09:40   | <u>Rolands Cepuritis</u> , NTNU/Norcem:<br>"Methods for characterization of crushed filler properties and principles of proportioning concrete with these materials". |
| 09:40 - 10:00   | <u>Hans-Erik Gram</u> , Cementsa:<br>How to determine the influence of aggregate fillers on the yield stress and plastic viscosity of micromortar.                    |
| 10:00 - 10:30   | Coffee/discussion   |
| 4. Session - Resources – Environmental issues – The future<br>Chair: Svein-Willy Danielsen                |   |
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| 10:50 - 11:10   | <u>Rolv Dahl</u> , NGU:<br>Current and future consumption and supply of building materials in Norway.   |
| 11:10 - 11:30   | <u>Olav Hallset</u> , Norwegian Mineral Industry:<br>Public Management of Geological Resources  |
| 11:30 - 12:00   | Summary and discussion  |
| 12:00 - 13:00   | Lunch   |









COIN [www.coinweb.no](http://www.coinweb.no) NTNU Norwegian University of Science and Technology [www.ntnu.no](http://www.ntnu.no)

**Engineered sand production with Vertical Shaft Impact (VSI) crushers and static air-classifiers**

[www.norcem.no](http://www.norcem.no)  
**NORCEM**  
 HEIDELBERGCEMENT Group

Manufactured sand seminar, Stavanger, Norway, October 20<sup>th</sup> and 21<sup>st</sup>, Rolands Cepuritis

**How to "crush sand"**

| Sieve size [mm] | Crushed sand (South Africa) | Crushed sand (Israel) | Crushed sand (India) | Natural sand (Sweden) |
|-----------------|-----------------------------|-----------------------|----------------------|-----------------------|
| 0.075           | ~15                         | ~12                   | ~10                  | ~2                    |
| 0.15            | ~35                         | ~25                   | ~20                  | ~5                    |
| 0.3             | ~60                         | ~45                   | ~35                  | ~15                   |
| 0.6             | ~85                         | ~65                   | ~55                  | ~40                   |
| 1.2             | ~95                         | ~85                   | ~75                  | ~65                   |
| 2.5             | ~100                        | ~95                   | ~90                  | ~85                   |
| 5.0             | ~100                        | ~100                  | ~95                  | ~95                   |
| 7.5             | ~100                        | ~100                  | ~100                 | ~100                  |

20-30 NOK/t

0-8 mm

**NORCEM**  
 HEIDELBERGCEMENT Group

Slide 2 - 20.10.2014  
 Rolands Cepuritis

## How to "crush sand"

**Materials technology**  
- the use of aggregates

**Aggregate technology**  
- the basic interdependency

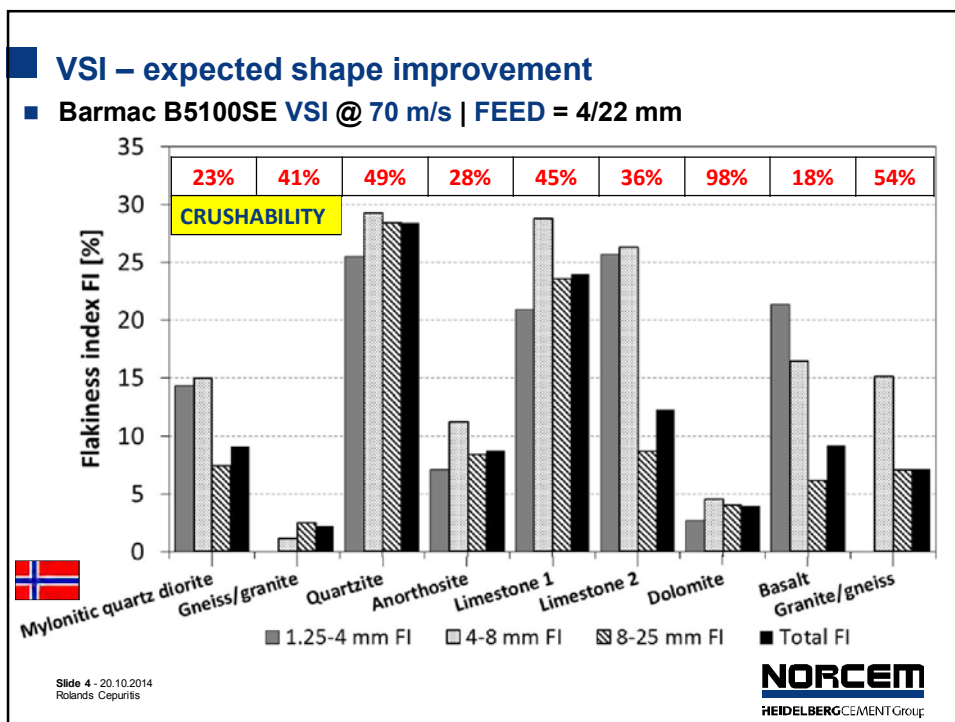
**Technical sales**

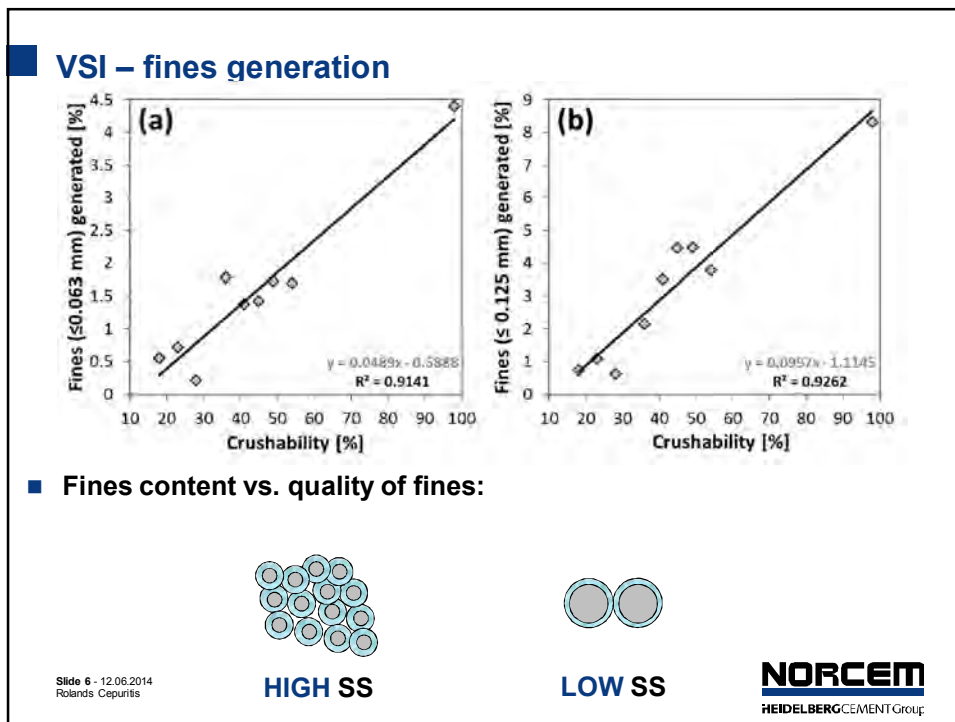
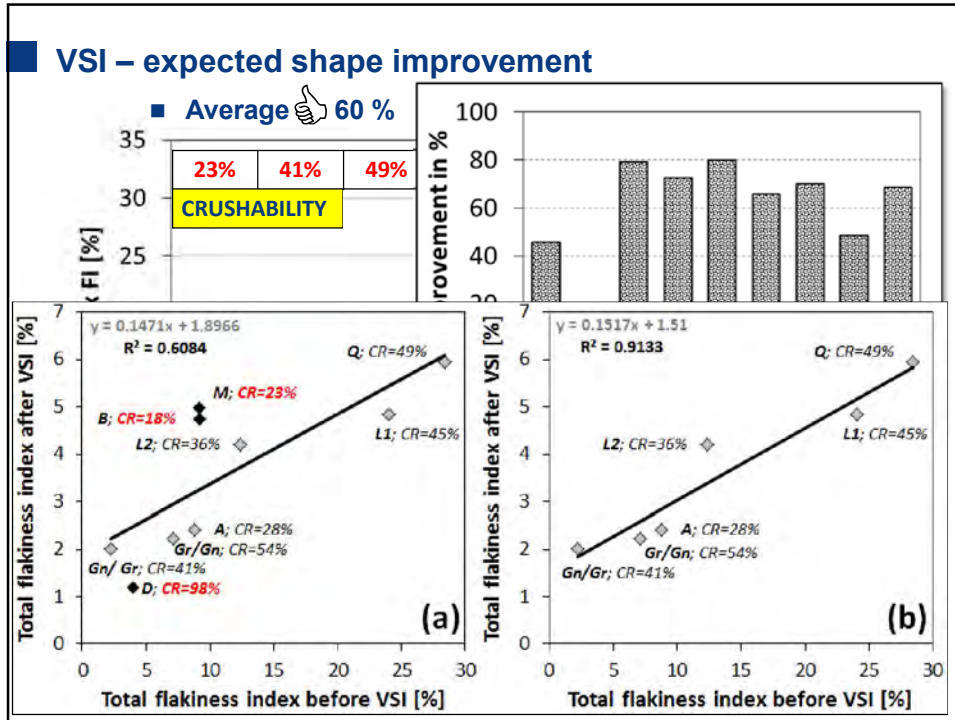
**Geology**  
- the basis for aggregate resources

**Production technology**  
- the processing of aggregates

Slide 3 - 20.10.2014  
Rolands Cepuritis

**NORCEM**  
HEIDELBERGCEMENT Group





### Static air-classification - principles

**NORCEM**  
HEIDELBERGCEMENT Group

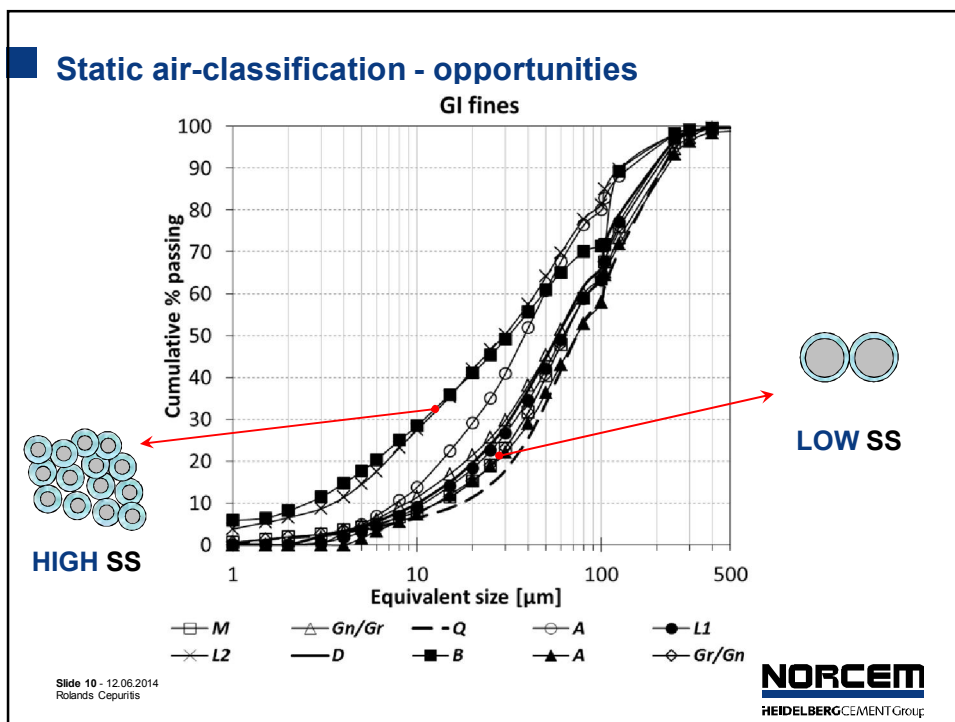
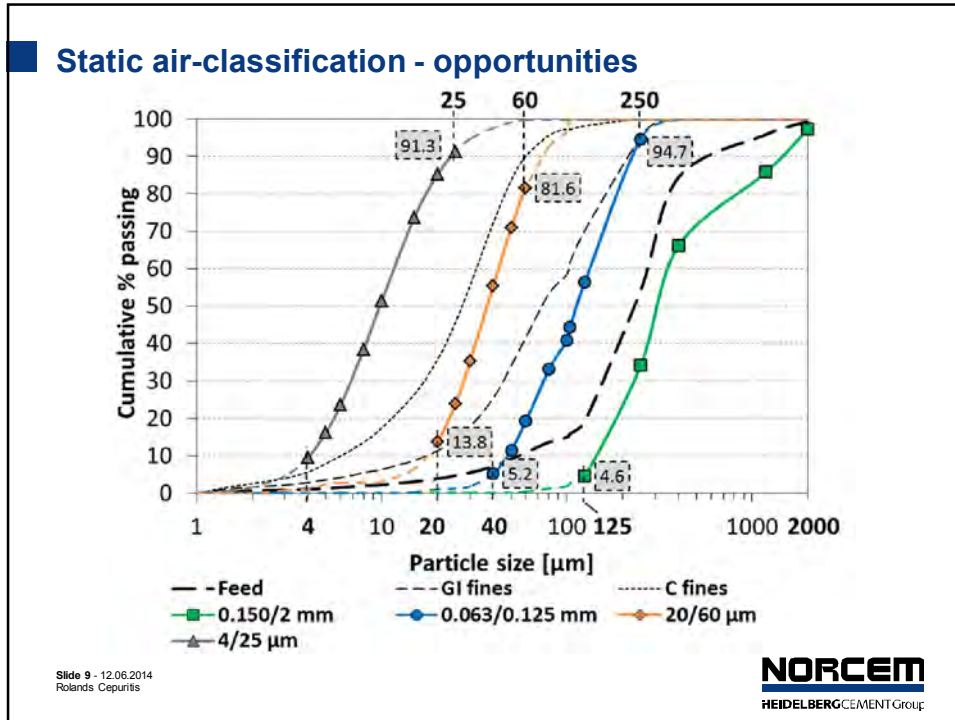
### Static air-classification - opportunities

FEED=0/2 mm

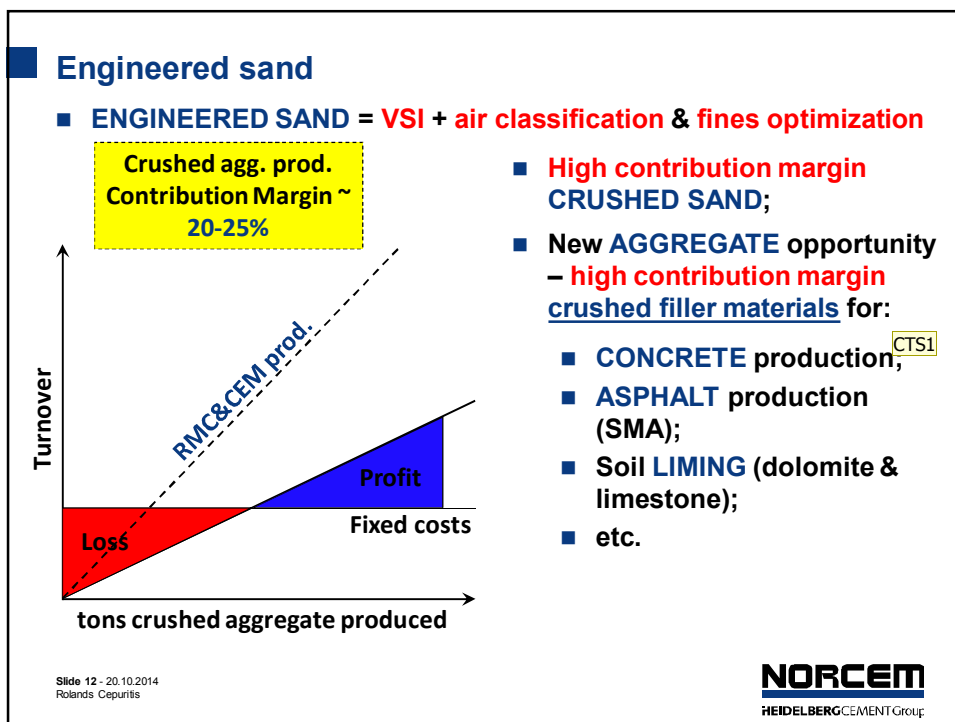
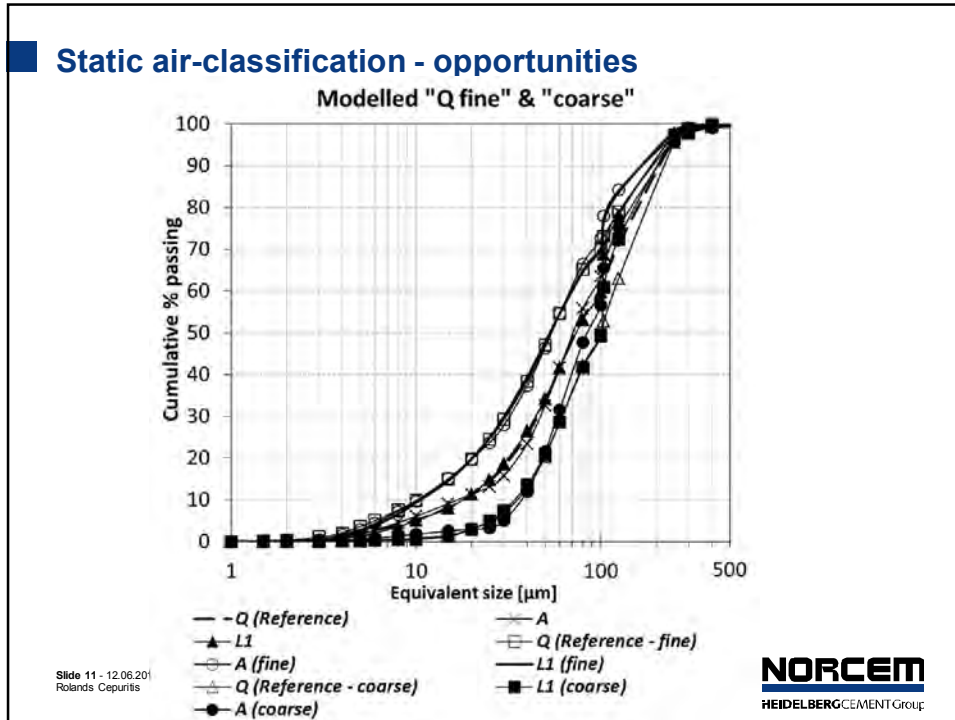
1 0.250/2 mm      2 40/0.250 mm      3 0.020/0.060 mm      4 0/0.020 mm

Slide 8 - 20.10.2014  
Rolands Cepuritis

**NORCEM**  
HEIDELBERGCEMENT Group









## Sandvik Sand Solutions

Sven-Henrik Norman  
Sales manager

COIN seminar Oct 20-21  
2014

1 Välkommen till Sandvik Construction



## Manufactured sand 2009-present

**Globally:**  
Shortage of natural sand in some markets  
Australia  
India  
Brazil

**Sweden:**  
Shift towards manufactured sand  
Main players, NCC, Skanska, Swerock all use or produce manufactured sand in concrete  
South of Sweden, marine dredged sand from the Baltic sea still available  
Government is being very restrictive towards allowing new natural sand & gravel pits

**In common:**  
Concrete industry more positive towards alternatives to natural sand today than 2009  
More knowledge through research?  
Better additives?  
Good marketing?

2





## Sandvik Sand Solutions

### Mobile or Stationary solutions?

|                          |                             |
|--------------------------|-----------------------------|
| <b>Stationary</b>        | <b>Mobile</b>               |
| Process control          | Flexibility                 |
| Rock properties          | Close to source or end user |
| Multiple crushing stages | Lower investment            |
| Dry process              | Re-sale value               |

3 Welcome to Sandvik 

## Sandvik Sand

### Mobile solution

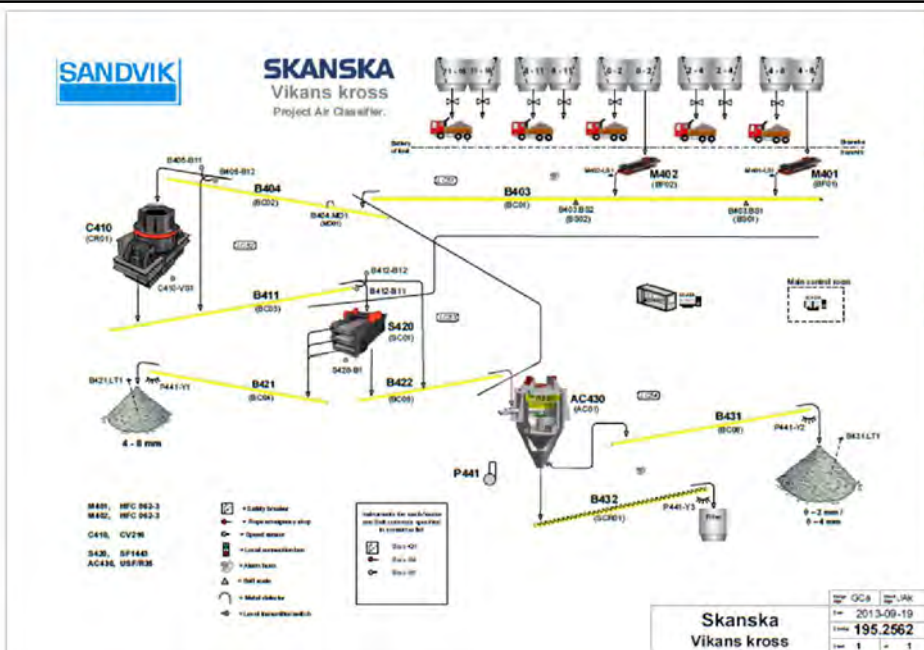






5


Welcome to Sandvik



6




7 Welcome to Sandvik Construction

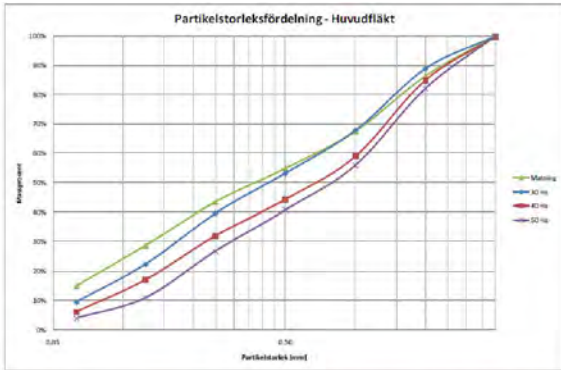


8

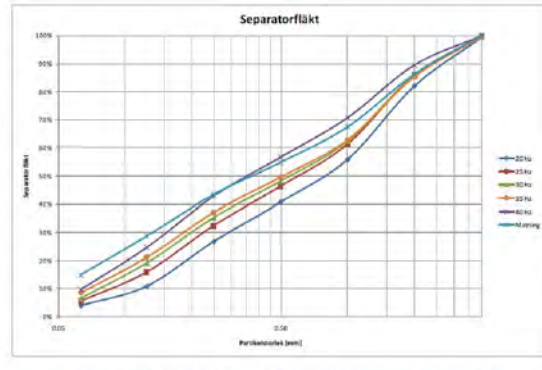
- Main fan
- Regulator fan
- Dispersing disc
- Movement pattern fine particles
- Movement pattern rejected particles
- Movement pattern coarse particles



## Classification



Variation of sand product size distribution by different frequencies of the main fan



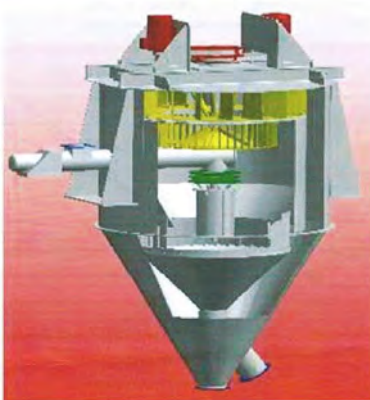
Variation of sand product size distribution by different frequencies of the separator fan (Main fan speed constant)

9

Welcome to Sandvik Construction



## Schmidt Air Classifier range



| Capacity figures for Air Classifier types USF/ R |                           |                         |             |                   |                      |
|--|---------------------------|-------------------------|-------------|-------------------|----------------------|
| Size model                                       | separation capacity (tph) | Max feed capacity (tph) | Weight (kg) | Cylinder diameter | Installed Power (kW) |
| USF 25   | 5                         | 40 - 50                 | 6000        | 2500 mm           | 25                   |
| USF 28   | 8                         | 50 - 60                 | 8000        | 2800 mm           | 30                   |
| USF 32   | 12                        | 65 - 75                 | 12000       | 3200 mm           | 30                   |
| USF 35   | 16                        | 80 - 90                 | 15000       | 3500 mm           | 37                   |
| USF 37   | 20                        | 100 - 110               | 19000       | 3700 mm           | 45                   |
| USF 42   | 26                        | 120 - 130               | 25000       | 4200 mm           | 52                   |
| USF 45   | 30                        | 150 - 160               | 29500       | 4500 mm           | 75                   |
| USF 50   | 40                        | 180 - 200               | 38000       | 5000 mm           | 90                   |

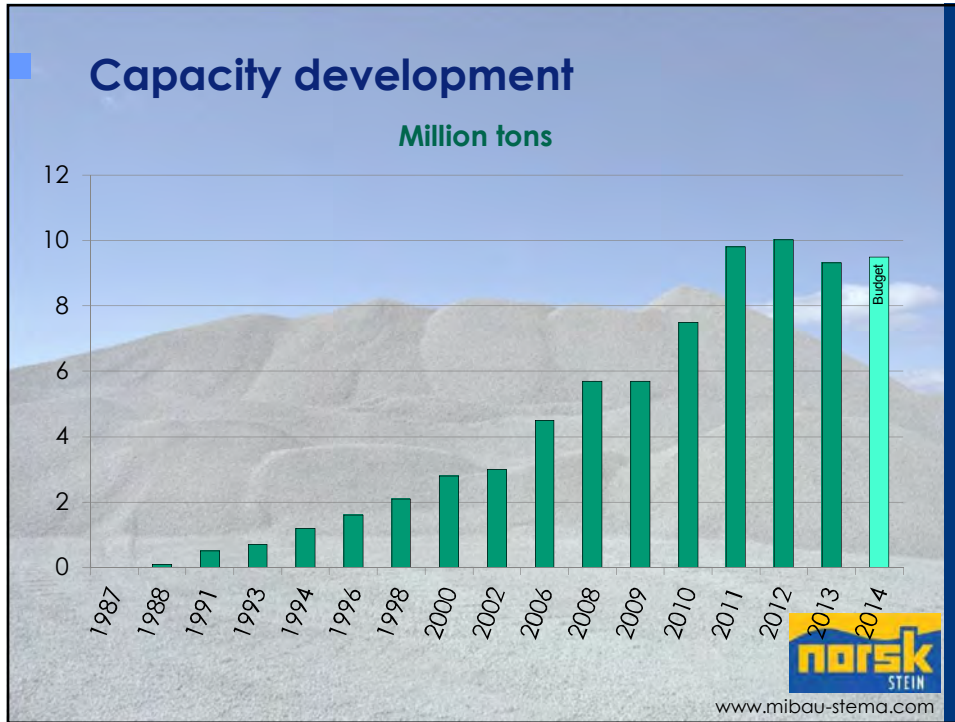
*NOTE! Figures calculated with feed 0/4 mm and separation at 90µm and ca 4% <90 µm in the coarse product.*

10

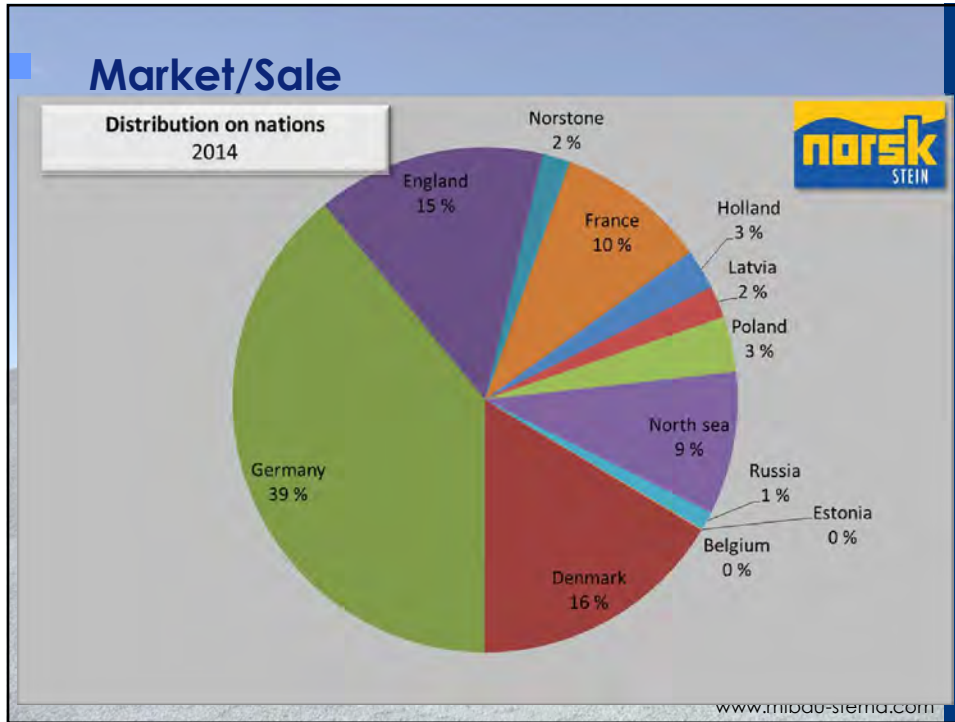
Welcome to Sandvik Construction

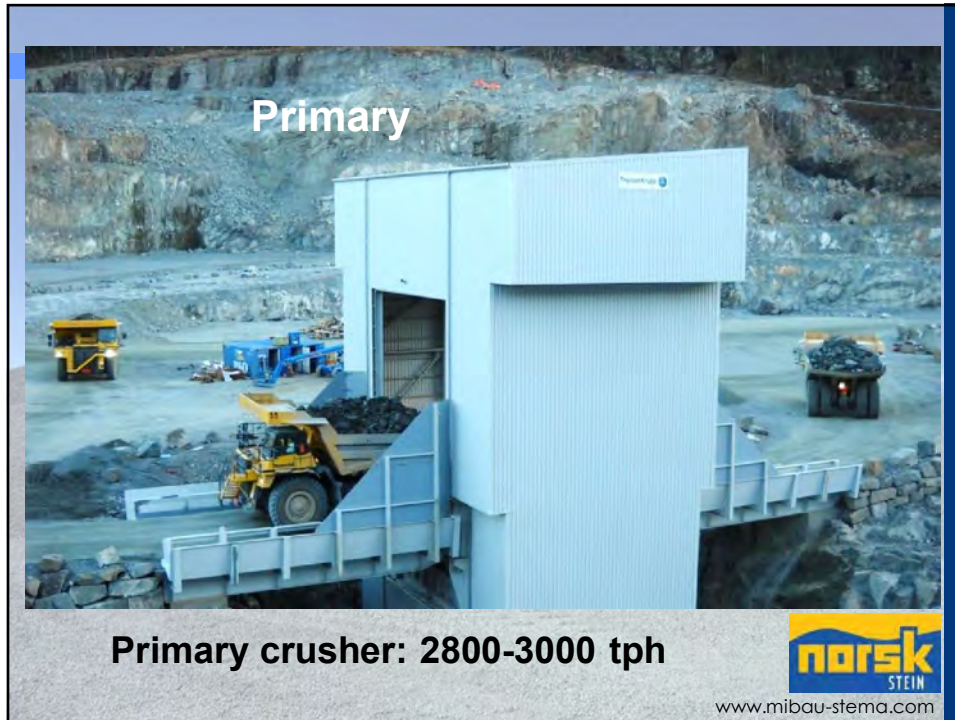


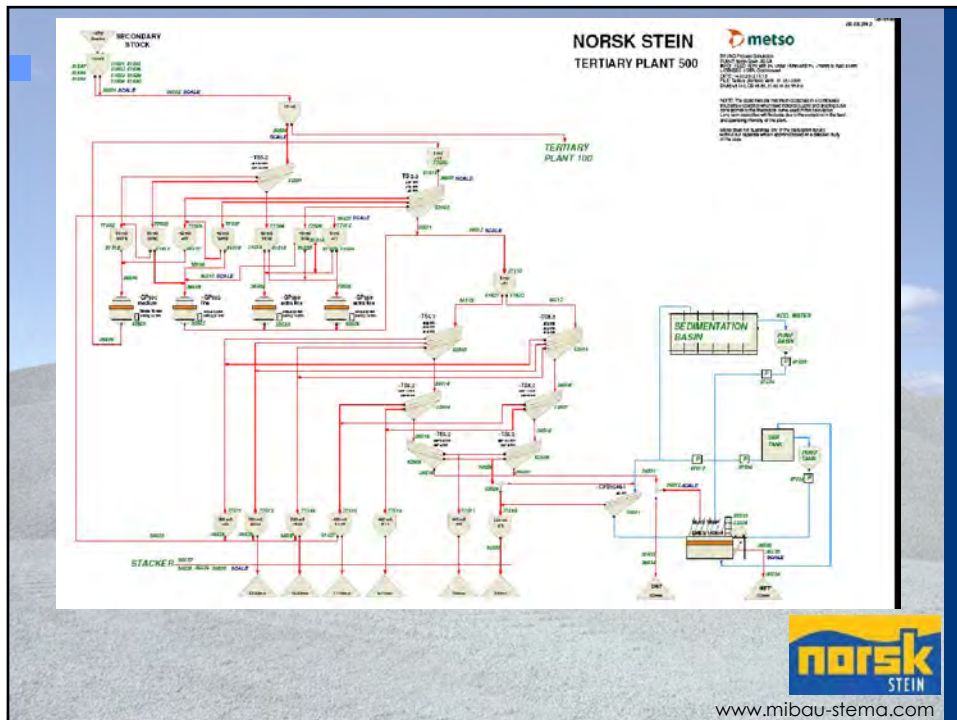
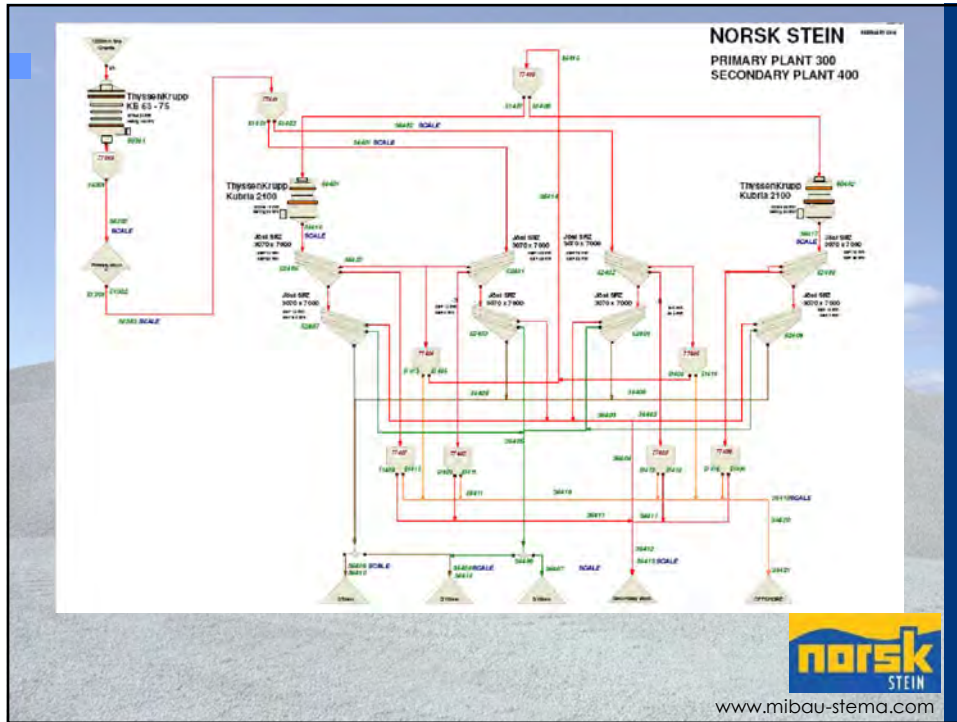











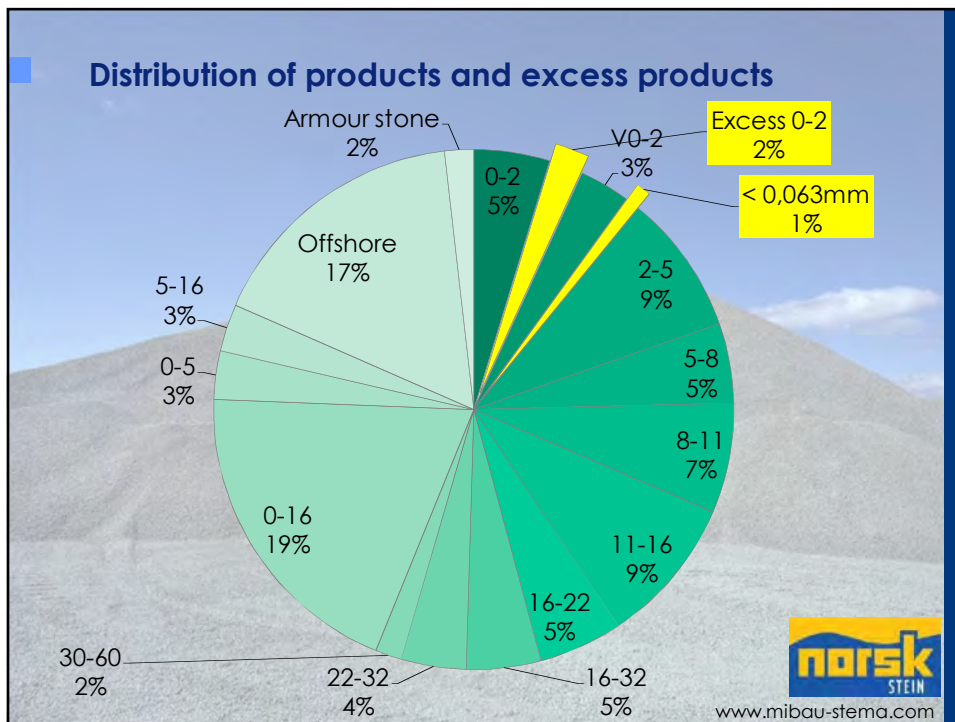


## Products

- 0/16
  - 0/5
  - 5/32
  
  - 25/125 ( 6 inch offshore)
  - 50/200 ( 8 inch offshore)
  
  - **Bedstone**  
(Separate production)
- 0/2
  - 0/2 washed (0,06/2)
  - 2/5
  - 5/8
  - 8/11
  - 11/16
  - 16/22
  - 22/32
  - 16/32
  - 30/60



www.mibau-stema.com



## Challenges related to fine material and market:

### Large share of fine material products:

- 0/16 from blasting, primary-and secondary crusher steps
  - About 27 % of total production,
  - Main market: 0/32 ( have to add 16/32)
  - Low price product
- 0/2 from tertiary plant. washed and unwashed
  - About 5 % of total production (500.000 t)
  - Low price product and too small market
  - Have to deposit the excess
  - **Limit in discharge volume: 150.000 t/year**



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## Challenges related to the processing of the fine material:

### 1. Water and moisture !

- High and fluctuating moisture content in 0/16 from blasting, primary-and secondary crusher steps, from
  - Rain at the blast and the intermediate stock
  - Dust fighting
- Challenging screening
  - Splitting of 0/16 from primary plant in 0/5 and 5/16 not possible at high moisture content
  - Screening in tertiary plant, in particular the split at 2 mm.
  - Fines sticking to coarser particles.



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## Dust fighting



[www.mibau-stema.com](http://www.mibau-stema.com)

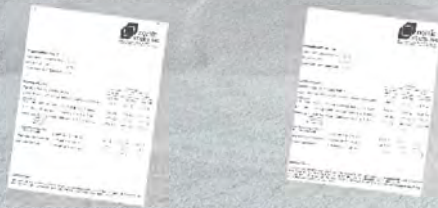
## Concrete production with 100% crushed materials 20 years ago

### Aggregate

- Unwashed 0/2, High filler content 18-20 % < 0,063 mm, From cone crusher, poor shape
- Step graded curve, no 2/5 mm.  $D_{maks}$  22 mm

### Typical precriptions

- C65, v/c < 0,60 310 kg cement 4 I P
- C65, v/c < 0,45, 420 kg cement 2,5 I P + 5 I SP



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## Possibilities related to fine material

The 0/16 from blasting, primary-and secondary plants ( 2,5 mill tons per year):

- Improve the particle shape of 0/16 by a VSI crusher
- Split into standard gradings by wet screening and wet sand processing. Control the grading of 0/2 precisely.

### Produce:

- High value products (like from the tertiary plant)
- Manufactured sand



[www.mibau-stema.com](http://www.mibau-stema.com)

## Possibilities related to fine material

### The 0/2 from tertiary plants (0,5 mill tons pr. year)

- Improve the particle shape of 0/2 + 2/5 from tertiary plant by a VSI crusher
- Process in a dry or wet process, control the curve of 0/2 precisely

### Produce

- **Manufactured sand**



[www.mibau-stema.com](http://www.mibau-stema.com)

## Challenges related to the possibilities:

- The market for manufactured sand
- Winter time with freezing, material, products and processing equipment
- Find production equipment that manage the product requirements, moisture content, wearing of the material etc.
- Integrate additional process in a running plant
- Logistic: Additional gradings at stock
- Dust problems?



[www.mibau-stema.com](http://www.mibau-stema.com)





# CDE – Washing Manufactured Sands

Stavanger 2014



Welcome to CDE Global.



4 Sectors  
7 Regions



## Washed M-Sand: A Realistic Alternative to Natural Sand



### Washing Crushed Sands, Why?

- Reduced availability of Natural Sand
- Potential Tax of Natural Sand
- Turn a Waste product into €'s and develop a new revenue stream
- Lack of space to store waste crushed fines





- CDE have been washing Crushed Sands across the world for many years
- Bespoke Solution for every Application
- Different Feed Materials sizes and types
  - Different End Products Required
  - Various capacities



## Why Wash?

Before

After

| Sieve Size   | Grams Retained | % Retained | Percentage Passing Test Sample |
|--------------|----------------|------------|--------------------------------|
| 5.000        | 0              | 0          | 100                            |
| 3.360        | 10             | 1          | 99                             |
| 2.360        | 47             | 7          | 92                             |
| 1.180        | 193            | 28         | 64                             |
| 0.600        | 193            | 28         | 36                             |
| 0.300        | 124            | 18         | 18                             |
| 0.212        | 35             | 5          | 13                             |
| 0.150        | 25             | 4          | 10                             |
| 0.063        | 44             | 6          | 3                              |
| pan          | 24             | 3          | 0                              |
| <b>Total</b> | <b>695</b>     | <b>100</b> |                                |

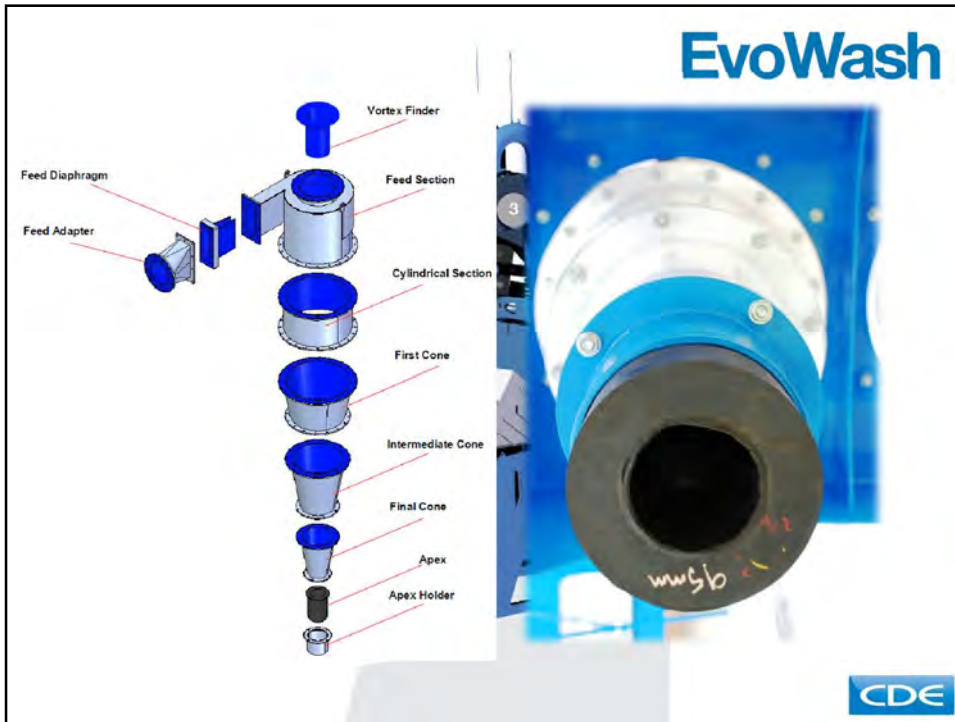


## Evowash Sand Plant



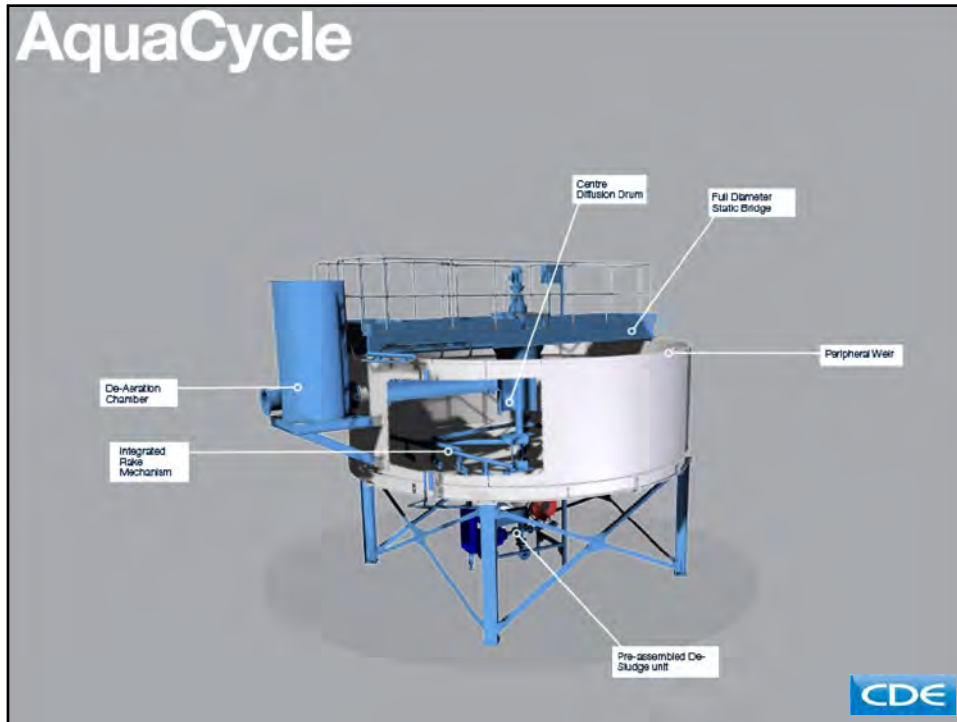
- Removes 0,063mm from raw material
- 30tph – 250tph on a single unit
- De-waters Washed Sand to typically 12-15% moisture content







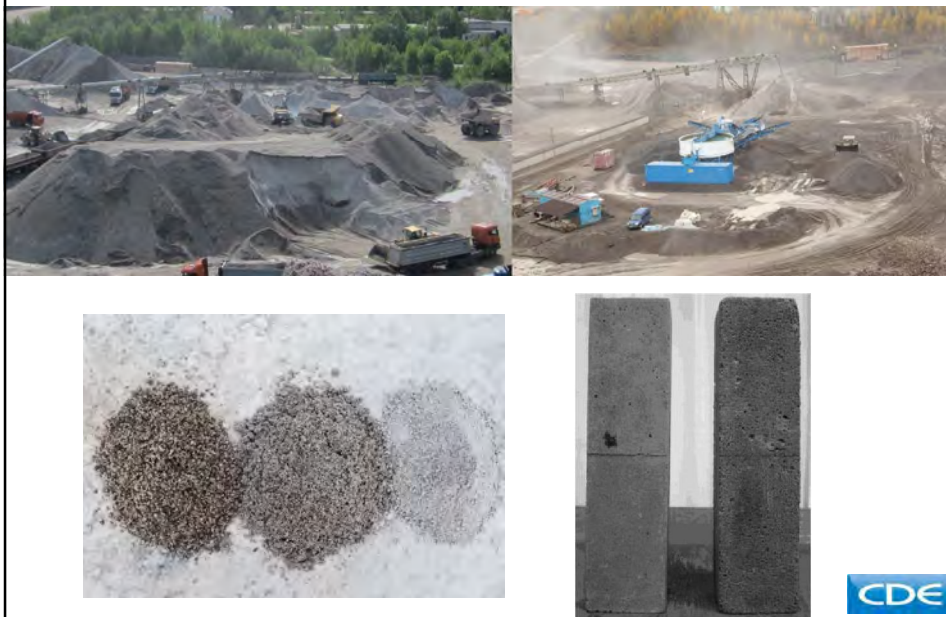




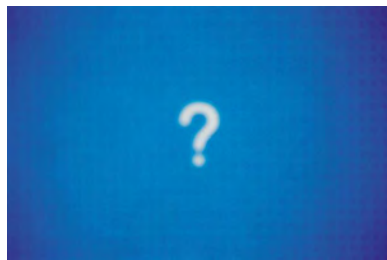
# Filter Press



# Crushed Granite - Russia



# Wet or Dry



No water required

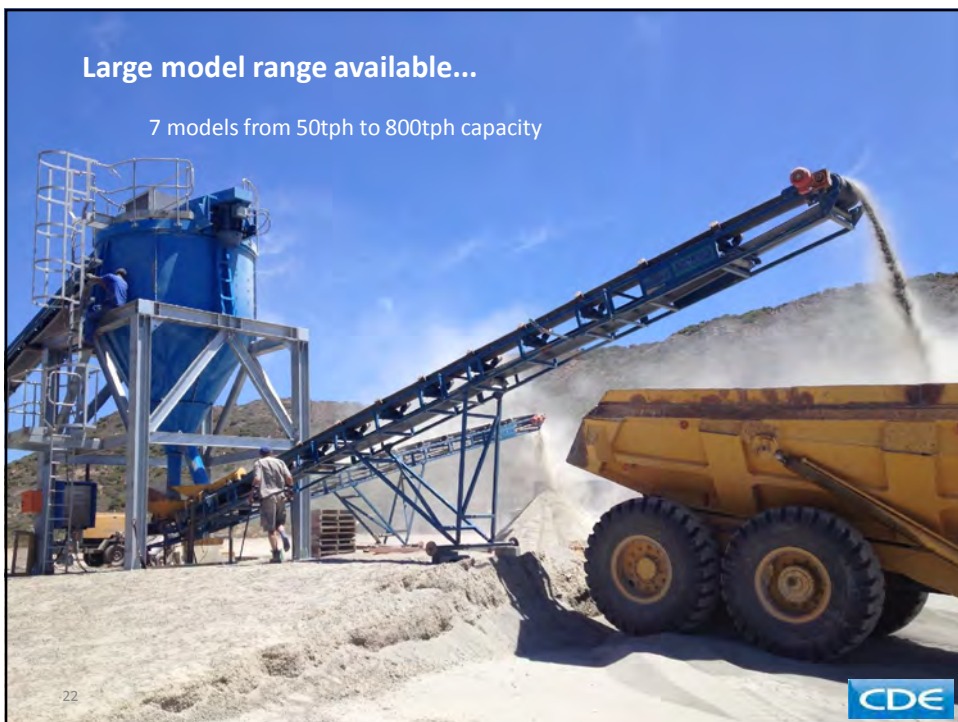
Ideal for dry loose materials

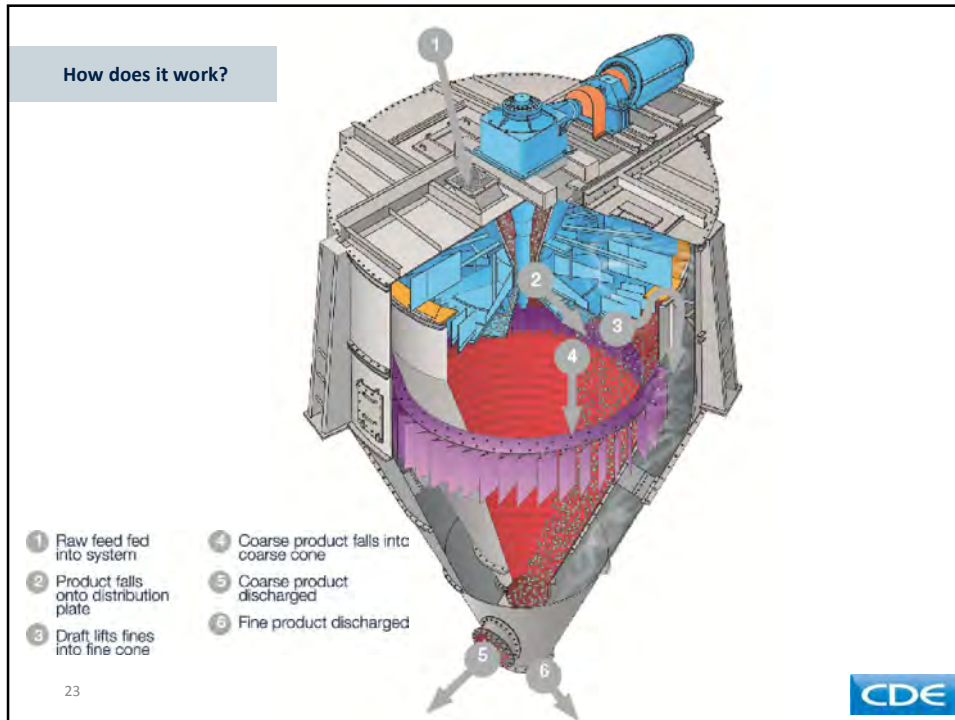
Best results with dry feed; moisture content should be <2%



**Large model range available...**

7 models from 50tph to 800tph capacity





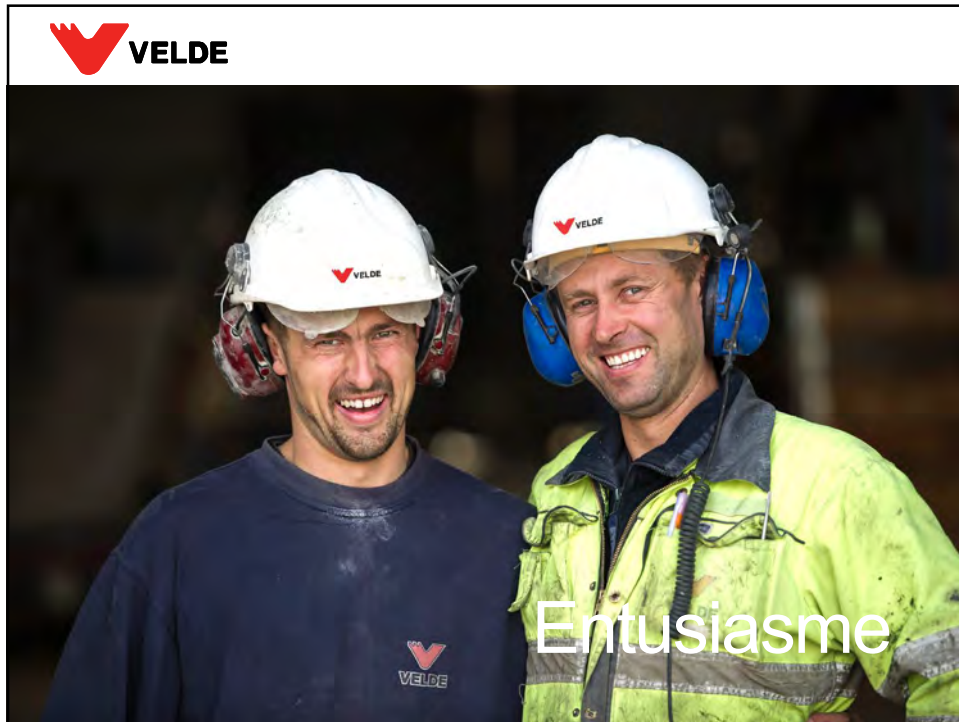
## Dry or Wet Processing?

- Both Technologies are Viable Solutions
- Wet Processing Yields Cleaner sand and with no loss of 'fine sand'
- Dry Processing requires no water but demands consistently low moisture content
- Only Wet processing can be used for the processing of 'existing stockpiles'



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**mail:** [eheron@cdeglobal.com](mailto:eheron@cdeglobal.com)  
**Web:** [www.cdeglobal.com](http://www.cdeglobal.com)



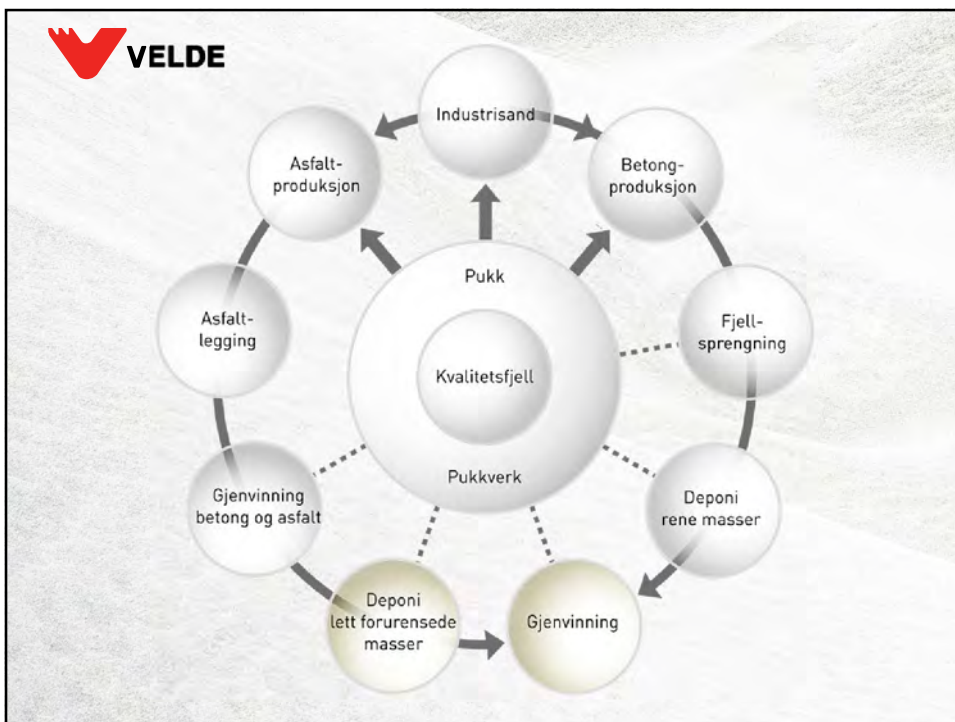
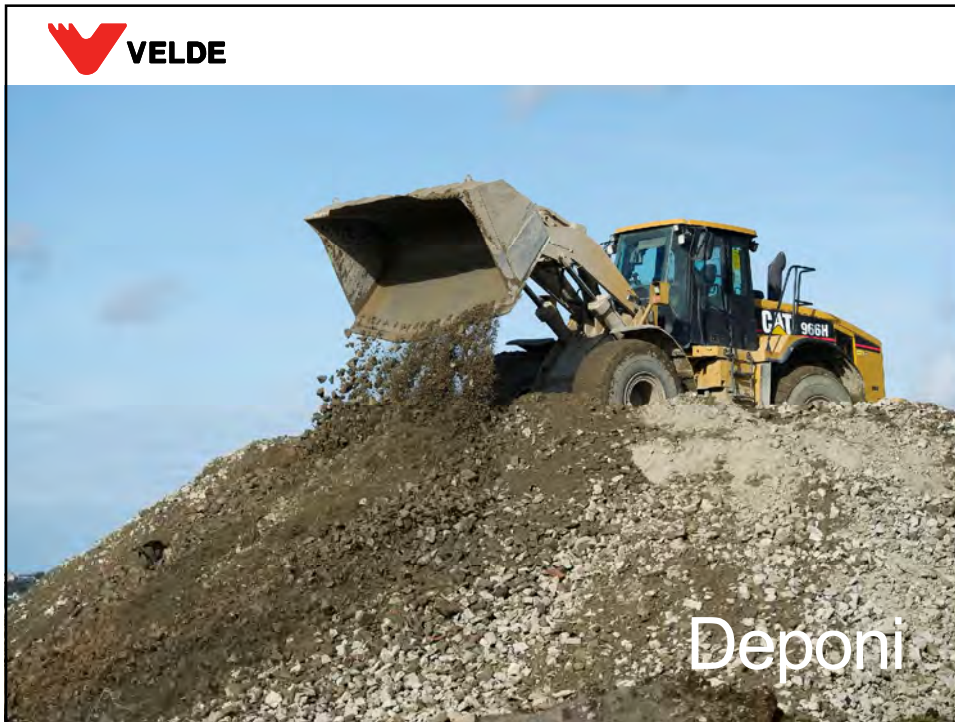


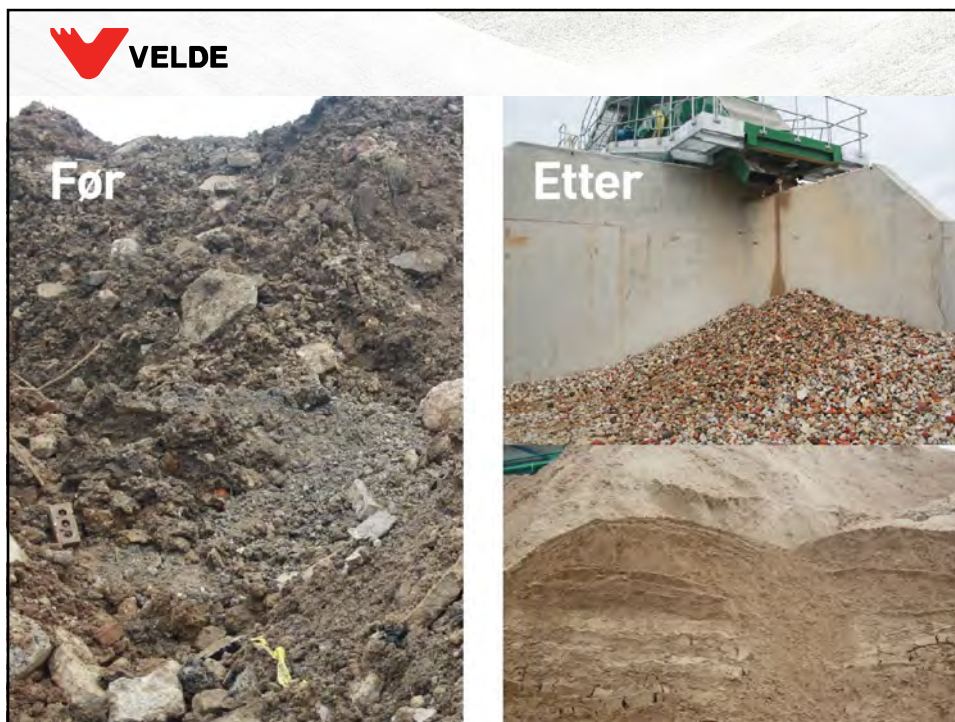
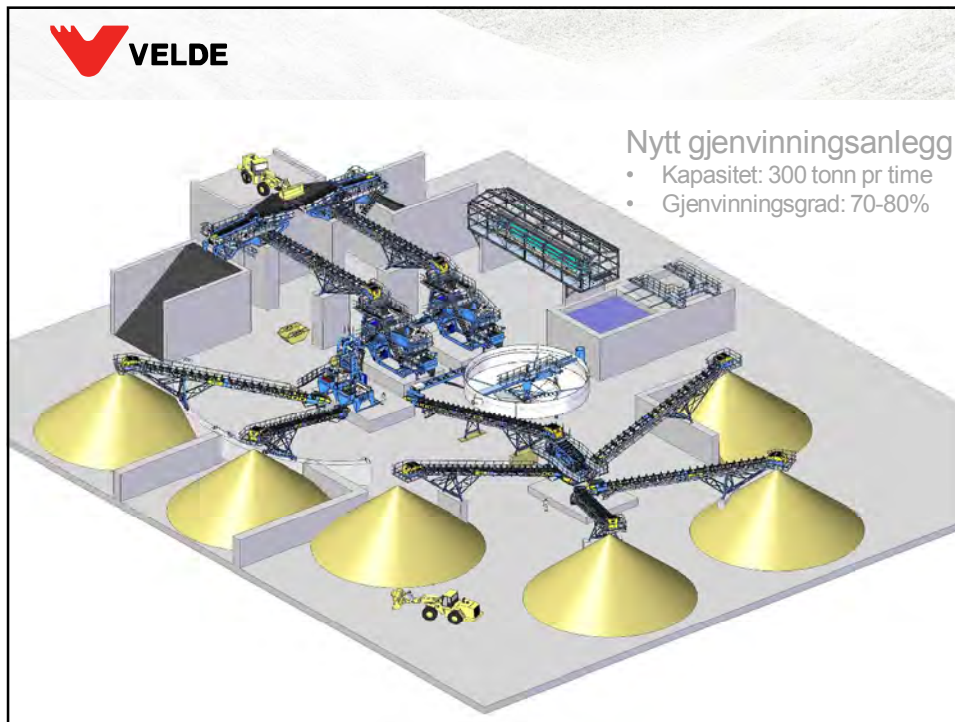


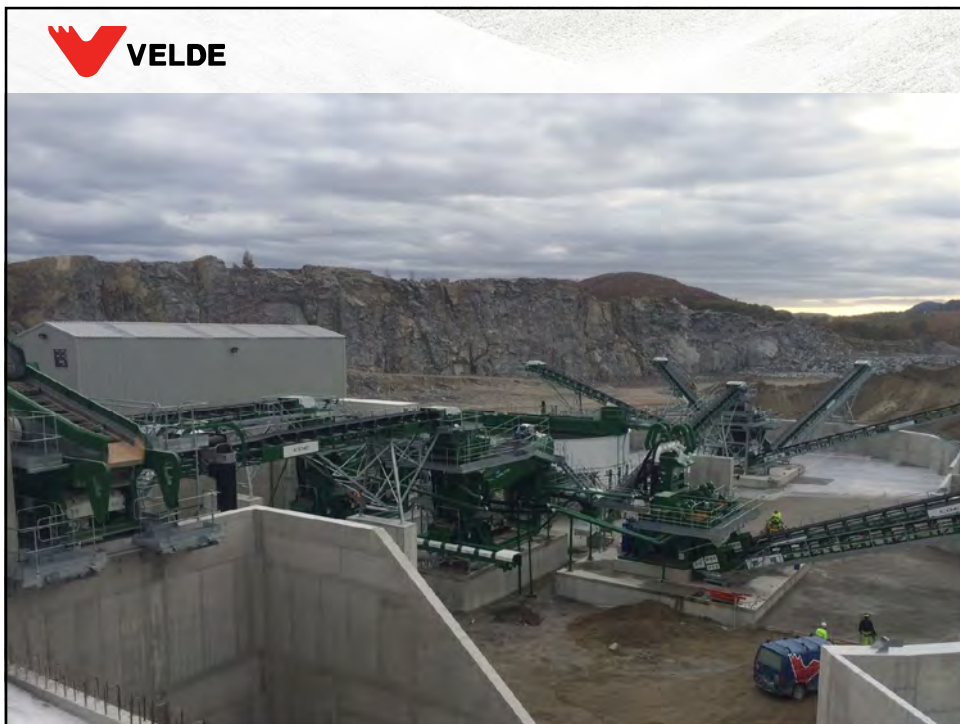


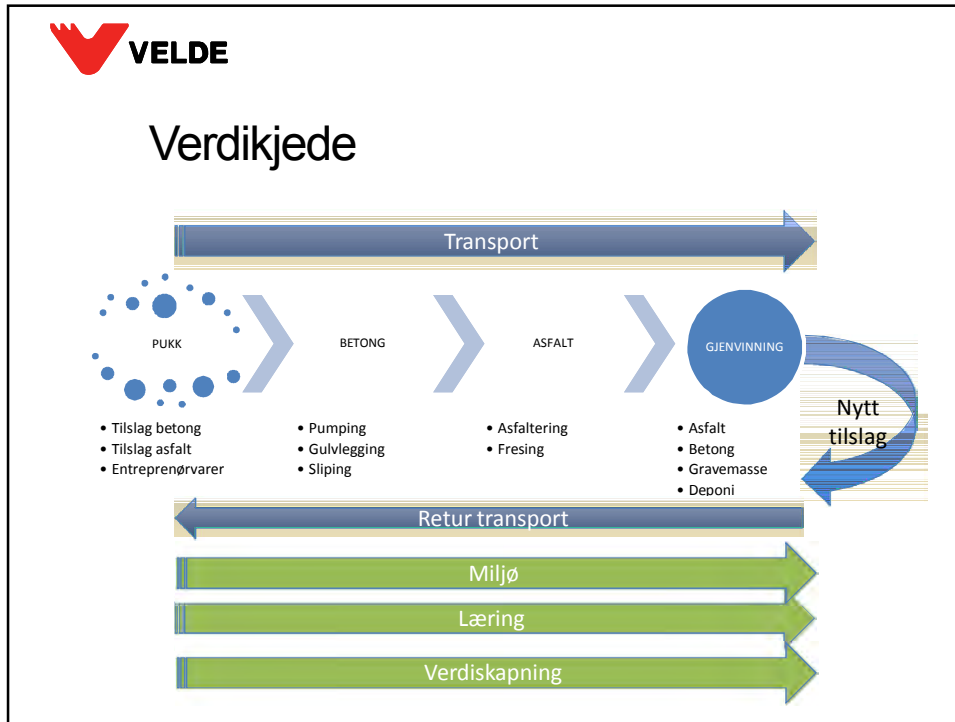


















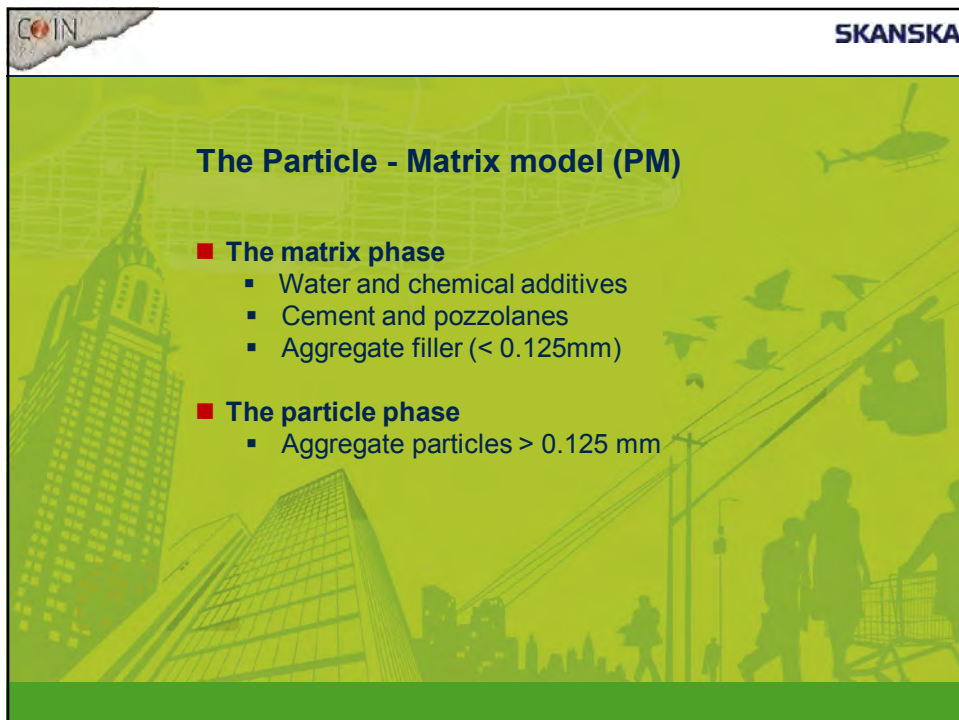
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# Concrete Mix Design with Industrial fillers

- a new approach

Sverre Smeplass, Skanska Teknikk  
Oliver Skjølsvik, Skanska Teknikk  
Hernan Mujica, Velde

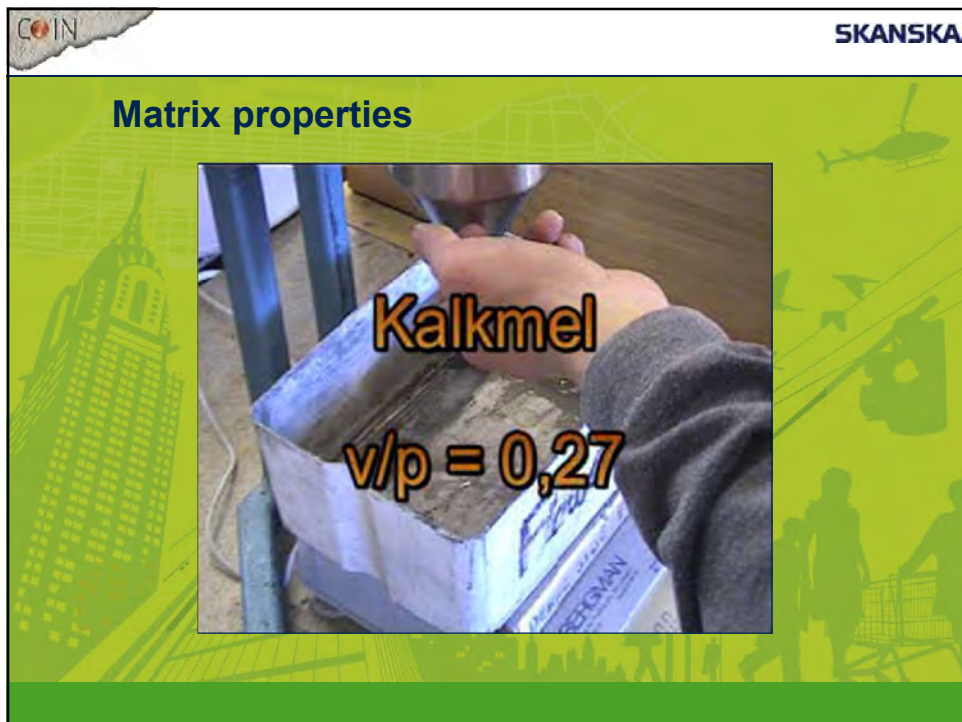
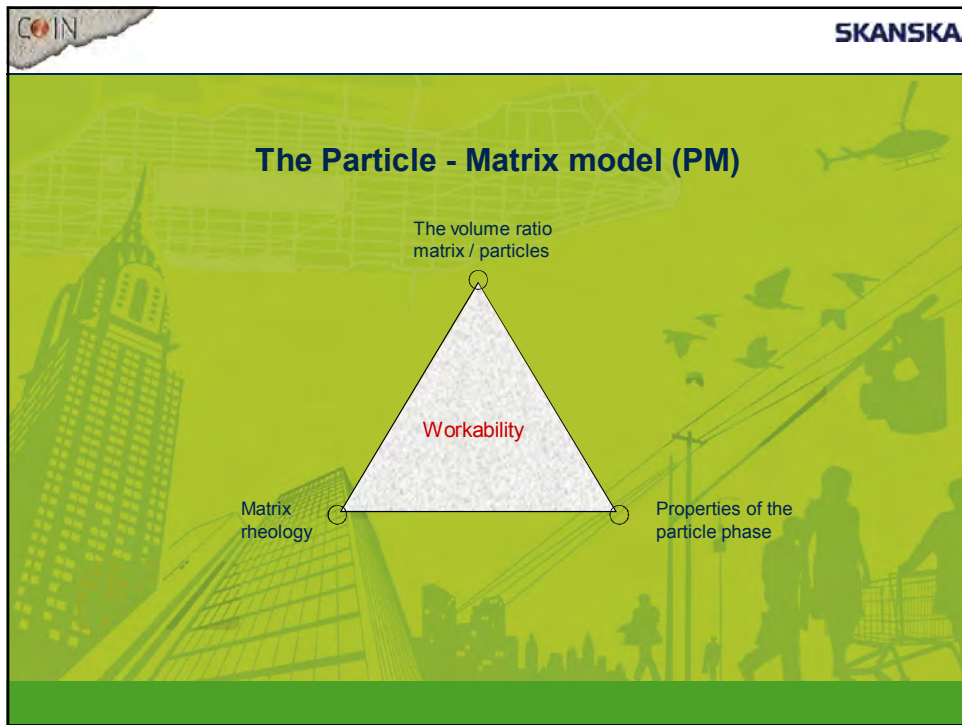
Manufactured sand, seminar, Stavanger 2014-10-21



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## The Particle - Matrix model (PM)


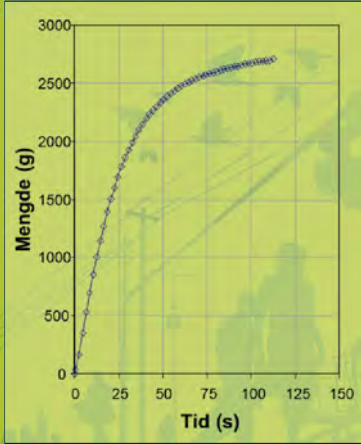
- **The matrix phase**
  - Water and chemical additives
  - Cement and pozzolanes
  - Aggregate filler (< 0.125mm)
- **The particle phase**
  - Aggregate particles > 0.125 mm



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## Matrix properties

The *FlowCyl* test determines the *Flow Resistance*,  $\lambda_Q$ , of the matrix

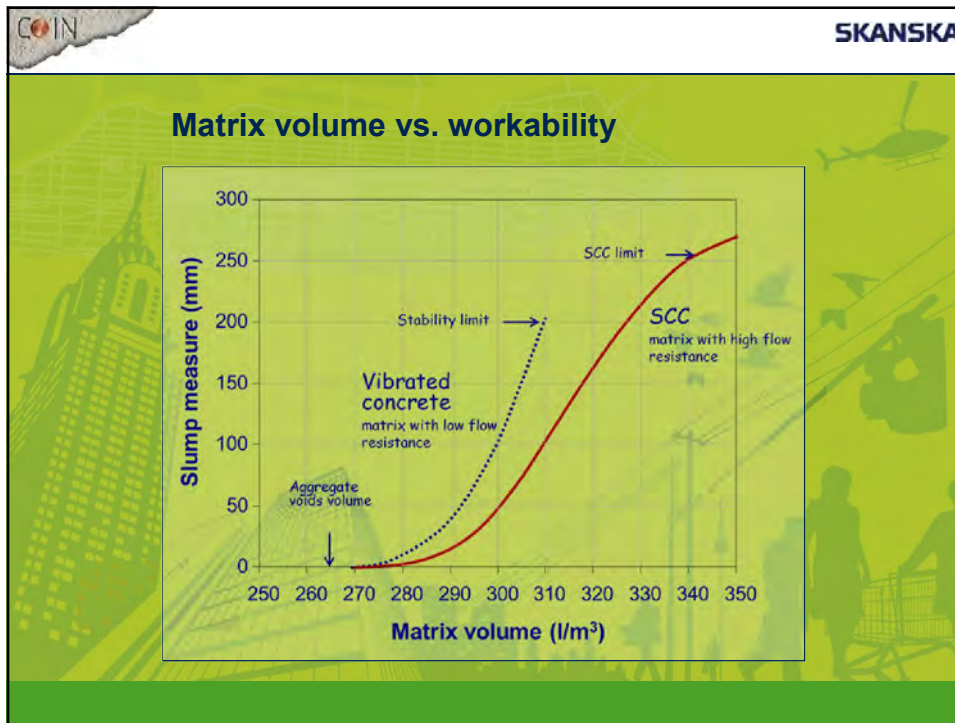



| Tid (s) | Mængde (g) |
|---------|------------|
| 0       | 0          |
| 10      | 500        |
| 20      | 1200       |
| 30      | 1800       |
| 40      | 2200       |
| 50      | 2450       |
| 60      | 2600       |
| 70      | 2700       |
| 80      | 2750       |
| 90      | 2780       |
| 100     | 2800       |
| 110     | 2800       |
| 120     | 2800       |
| 130     | 2800       |
| 140     | 2800       |
| 150     | 2800       |

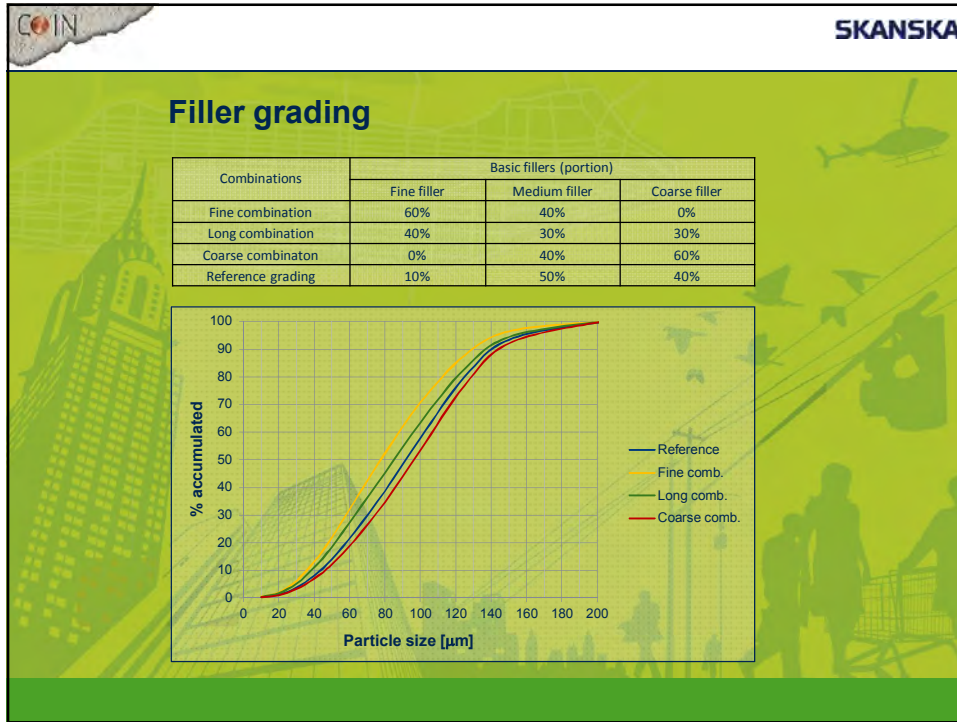
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## Flow resistance of the concrete

| Concrete type     | Vibrated  | SCC       |
|-------------------|-----------|-----------|
| B30 M60 (housing) | 0.20-0.40 | 0.35-0.55 |
| B45 M40 (civil)   | 0.40-0.55 | 0.50-0.65 |

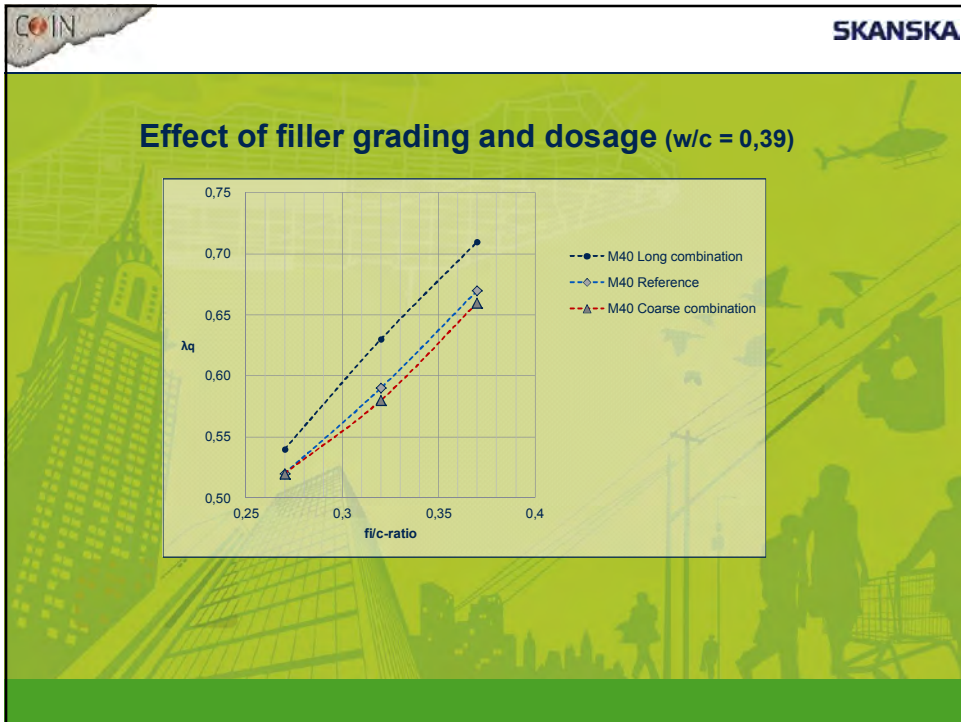
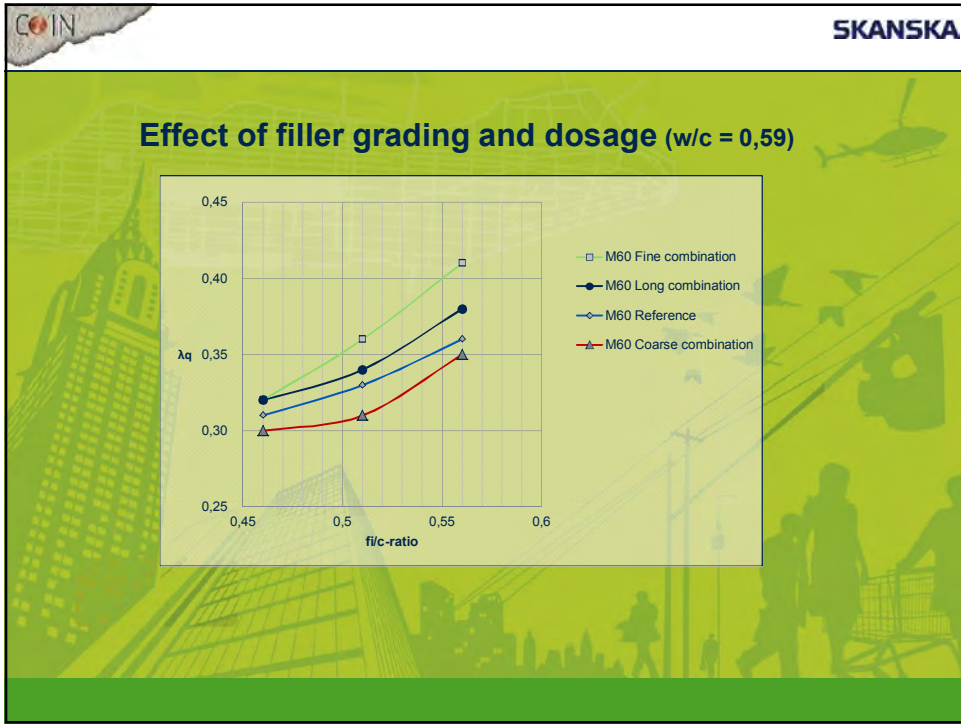


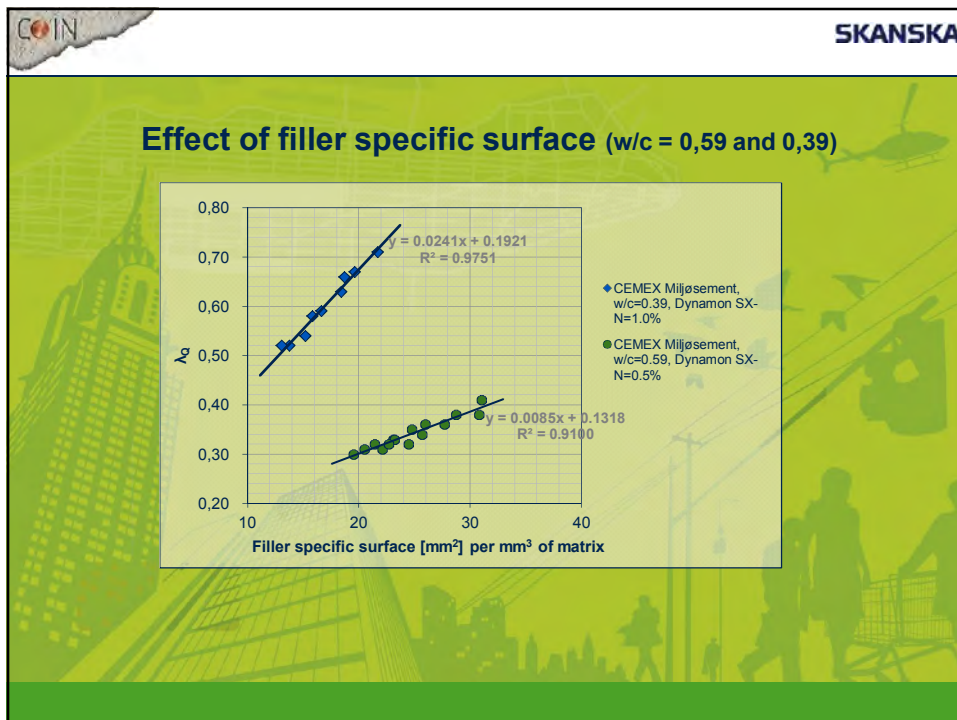
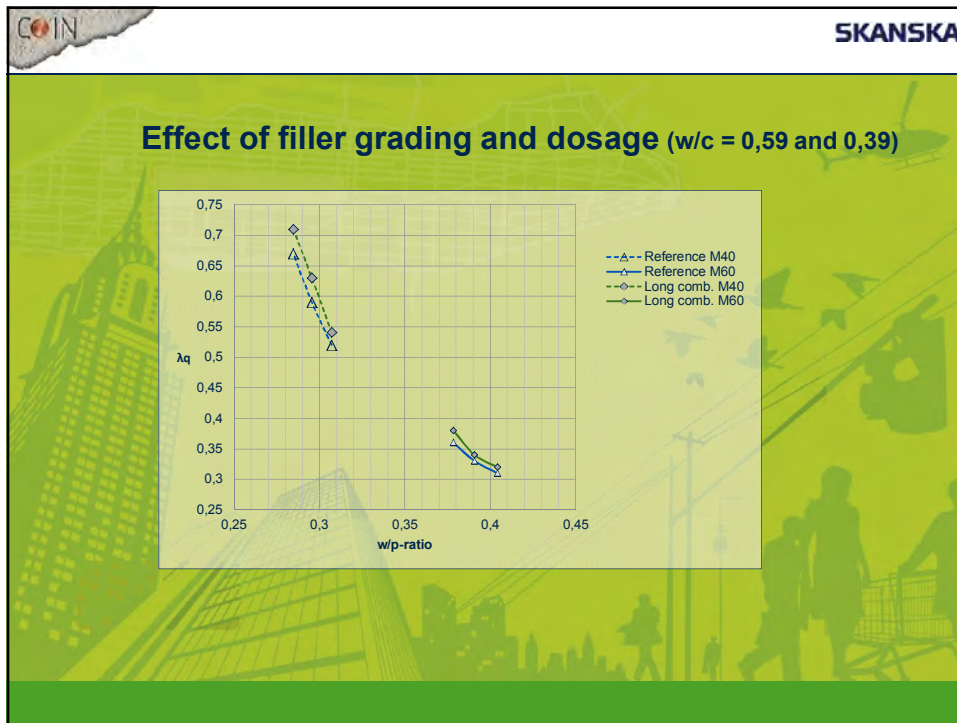
- 
- COIN / Velde test parameters**
- ❑ **Primary**
    - filler grading
    - filler dosage
  - ❑ **Secondary**
    - w/c – ratio
    - cement type
    - dosage of superplasticizer
    - type of superplasticizer

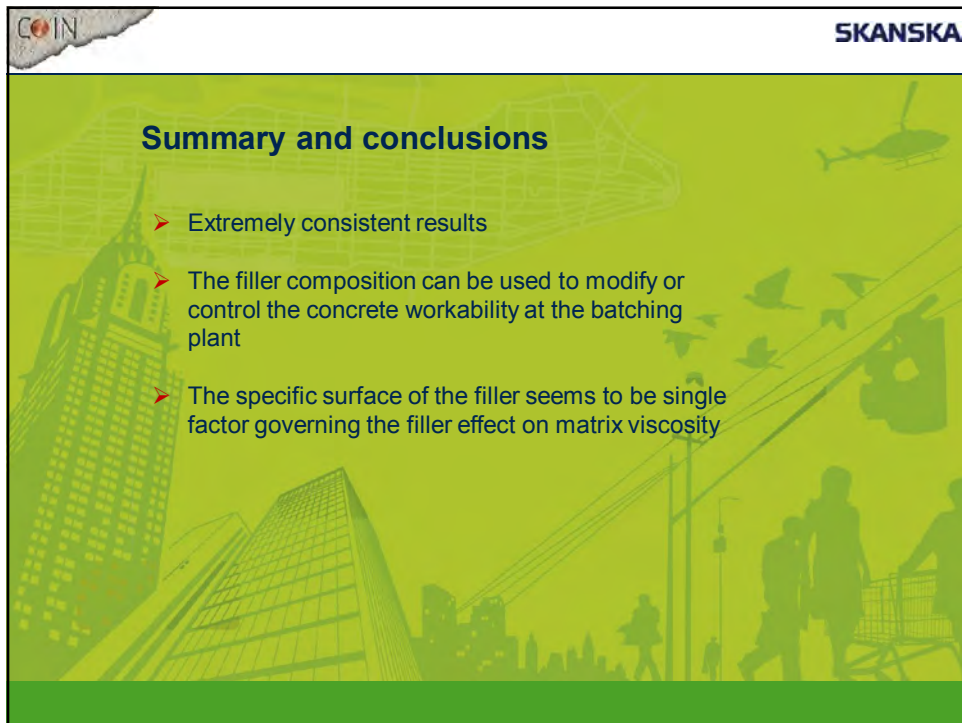


**A total of 52 matrix mixes, all performed at the Velde concrete lab**

| Parameter                 | Combination no.         | Cement        | w/c         | SP type | SP%   | Filler/ filler sources |           |        | f <sub>ic</sub> | Grading        |            |
|---------------------------|-------------------------|---------------|-------------|---------|-------|------------------------|-----------|--------|-----------------|----------------|------------|
|                           |                         |               |             |         |       | Fine                   | Intermed. | Coarse |                 |                |            |
| Model test                | 1                       | Cemex Mija    | 0.59        | SXN     | 0.50% | 100%                   | 0%        | 0%     | 0.51            | Model test M10 |            |
|                           | 2                       | Cemex Mija    | 0.59        | SXN     | 0.50% | 0%                     | 100%      | 0%     | 0.51            | Model test M10 |            |
| Ref. filler grading       | 3                       | Cemex Mija    | 0.59        | SXN     | 0.50% | 0%                     | 0%        | 100%   | 0.51            | Model test M10 |            |
|                           | 4                       | Cemex Mija    | 0.59        | SXN     | 0.50% | 10%                    | 50%       | 40%    | 0.51            | Reference      |            |
|                           | 5                       | Cemex Mija    | 0.59        | SXN     | 0.50% | 85%                    | 40%       | 0%     | 0.51            | Fine comb.     |            |
|                           | 6                       | Cemex Mija    | 0.59        | SXN     | 0.50% | 40%                    | 30%       | 30%    | 0.51            | Long comb.     |            |
|                           | 7                       | Cemex Mija    | 0.59        | SXN     | 0.50% | 0%                     | 40%       | 60%    | 0.51            | Coarse comb.   |            |
|                           | 8                       | Cemex Mija    | 0.39        | SXN     | 1.00% | 10%                    | 50%       | 40%    | 0.32            | Reference      |            |
|                           | 9                       | Cemex Mija    | 0.39        | SXN     | 1.00% | 40%                    | 30%       | 30%    | 0.32            | Long comb.     |            |
|                           | 10                      | Cemex Mija    | 0.39        | SXN     | 1.00% | 0%                     | 40%       | 60%    | 0.32            | Coarse comb.   |            |
|                           | f <sub>ic</sub> reduced | 11            | Cemex Mija  | 0.59    | SXN   | 0.50%                  | 10%       | 50%    | 40%             | 0.48           | Reference  |
|                           |                         | 12            | Cemex Mija  | 0.59    | SXN   | 0.50%                  | 80%       | 40%    | 0%              | 0.48           | Fine comb. |
| 13                        |                         | Cemex Mija    | 0.59        | SXN     | 0.50% | 40%                    | 30%       | 30%    | 0.48            | Long comb.     |            |
| 14                        |                         | Cemex Mija    | 0.59        | SXN     | 0.50% | 0%                     | 40%       | 60%    | 0.48            | Coarse comb.   |            |
| 15                        |                         | Cemex Mija    | 0.39        | SXN     | 1.00% | 10%                    | 50%       | 40%    | 0.27            | Reference      |            |
| 16                        |                         | Cemex Mija    | 0.39        | SXN     | 1.00% | 40%                    | 30%       | 30%    | 0.27            | Long comb.     |            |
| 17                        |                         | Cemex Mija    | 0.39        | SXN     | 1.00% | 0%                     | 40%       | 60%    | 0.27            | Coarse comb.   |            |
| f <sub>ic</sub> increased |                         | 18            | Cemex Mija  | 0.59    | SXN   | 0.50%                  | 10%       | 50%    | 40%             | 0.68           | Reference  |
|                           | 19                      | Cemex Mija    | 0.59        | SXN     | 0.50% | 80%                    | 40%       | 0%     | 0.68            | Fine comb.     |            |
|                           | 20                      | Cemex Mija    | 0.59        | SXN     | 0.50% | 40%                    | 30%       | 30%    | 0.68            | Long comb.     |            |
|                           | 21                      | Cemex Mija    | 0.59        | SXN     | 0.50% | 0%                     | 40%       | 60%    | 0.68            | Coarse comb.   |            |
|                           | 22                      | Cemex Mija    | 0.39        | SXN     | 1.00% | 10%                    | 50%       | 40%    | 0.37            | Reference      |            |
|                           | 23                      | Cemex Mija    | 0.39        | SXN     | 1.00% | 40%                    | 30%       | 30%    | 0.37            | Long comb.     |            |
|                           | 24                      | Cemex Mija    | 0.39        | SXN     | 1.00% | 0%                     | 40%       | 60%    | 0.37            | Coarse comb.   |            |
|                           | Cement                  | 25            | Cemex Rapid | 0.59    | SXN   | 0.50%                  | 10%       | 50%    | 40%             | 0.51           | Reference  |
| 26                        |                         | Cemex Rapid   | 0.39        | SXN     | 1.00% | 10%                    | 50%       | 40%    | 0.32            | Reference      |            |
| 27                        |                         | Cemex Rapid   | 0.59        | SXN     | 0.50% | 80%                    | 40%       | 0%     | 0.51            | Fine comb.     |            |
| 28                        |                         | Cemex Rapid   | 0.39        | SXN     | 1.00% | 0%                     | 40%       | 60%    | 0.32            | Coarse comb.   |            |
| 29                        |                         | Norcem Sic FA | 0.59        | SXN     | 0.50% | 10%                    | 50%       | 40%    | 0.51            | Reference      |            |
| 30                        |                         | Norcem Sic FA | 0.39        | SXN     | 1.00% | 10%                    | 50%       | 40%    | 0.32            | Reference      |            |
| 31                        |                         | Norcem Sic FA | 0.59        | SXN     | 0.50% | 80%                    | 40%       | 0%     | 0.51            | Fine comb.     |            |
| 32                        |                         | Norcem Ant FA | 0.39        | SXN     | 1.00% | 0%                     | 40%       | 60%    | 0.32            | Coarse comb.   |            |
| 33                        |                         | Norcem Ant FA | 0.59        | SXN     | 0.50% | 10%                    | 50%       | 40%    | 0.51            | Reference      |            |
| 34                        |                         | Norcem Ant FA | 0.39        | SXN     | 1.00% | 10%                    | 50%       | 40%    | 0.32            | Reference      |            |
| SP                        | 35                      | Norcem Ant FA | 0.59        | SXN     | 0.50% | 80%                    | 40%       | 0%     | 0.51            | Fine comb.     |            |
|                           | 36                      | Norcem Ant FA | 0.39        | SXN     | 1.00% | 0%                     | 40%       | 60%    | 0.32            | Coarse comb.   |            |
|                           | 37                      | Cemex Mija    | 0.59        | SRN     | 0.50% | 10%                    | 50%       | 40%    | 0.51            | Reference      |            |
|                           | 38                      | Cemex Mija    | 0.59        | SRN     | 0.50% | 10%                    | 50%       | 40%    | 0.51            | Reference      |            |
|                           | 39                      | Cemex Mija    | 0.59        | SRN     | 0.50% | 80%                    | 40%       | 0%     | 0.51            | Fine comb.     |            |
|                           | 40                      | Cemex Mija    | 0.39        | SRN     | 1.00% | 0%                     | 40%       | 60%    | 0.32            | Coarse comb.   |            |
| SP dosage                 | 41                      | Cemex Mija    | 0.59        | SXN     | 0.30% | 10%                    | 50%       | 40%    | 0.51            | Reference      |            |
|                           | 42                      | Cemex Mija    | 0.59        | SXN     | 0.70% | 10%                    | 50%       | 40%    | 0.51            | Reference      |            |
|                           | 43                      | Cemex Mija    | 0.59        | SXN     | 0.30% | 80%                    | 40%       | 0%     | 0.51            | Fine comb.     |            |
|                           | 44                      | Cemex Mija    | 0.39        | SXN     | 0.70% | 0%                     | 40%       | 60%    | 0.32            | Coarse comb.   |            |
|                           | 45                      | Cemex Mija    | 0.59        | SXN     | 0.70% | 10%                    | 50%       | 40%    | 0.51            | Reference      |            |
|                           | 46                      | Cemex Mija    | 0.39        | SXN     | 1.30% | 10%                    | 50%       | 40%    | 0.32            | Reference      |            |
|                           | 47                      | Cemex Mija    | 0.59        | SXN     | 1.30% | 10%                    | 50%       | 40%    | 0.51            | Fine comb.     |            |
|                           | 48                      | Cemex Mija    | 0.39        | SXN     | 1.30% | 0%                     | 40%       | 60%    | 0.32            | Coarse comb.   |            |





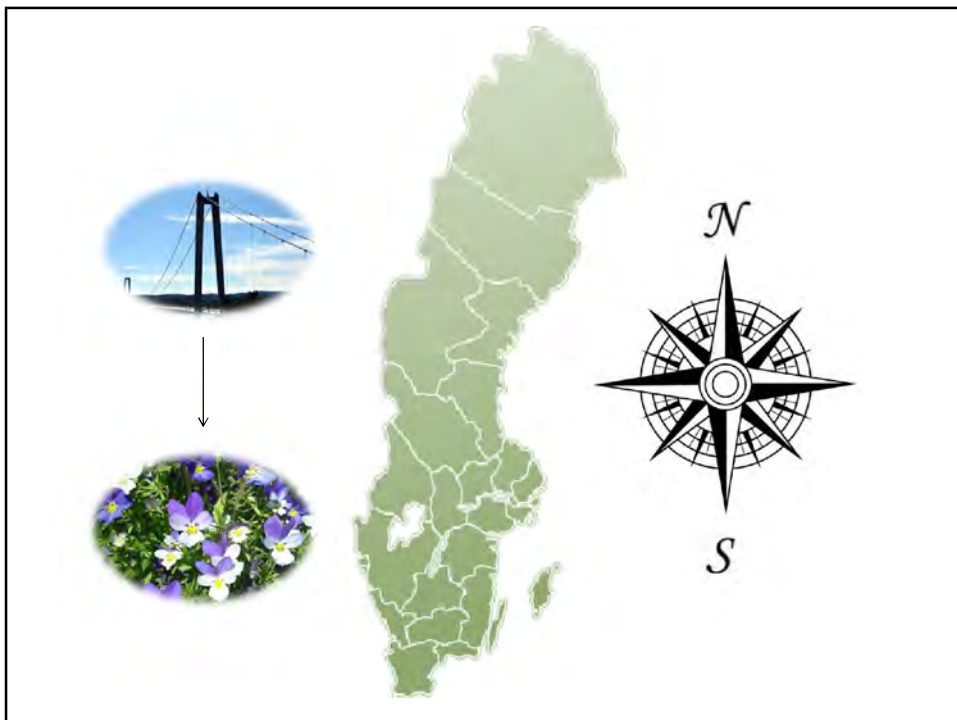


**COIN** **SKANSKA**

## Summary and conclusions

- Extremely consistent results
- The filler composition can be used to modify or control the concrete workability at the batching plant
- The specific surface of the filler seems to be single factor governing the filler effect on matrix viscosity





# AIM

**Sustainable supply of Rock Products**

**Improved Quality by man-made materials**

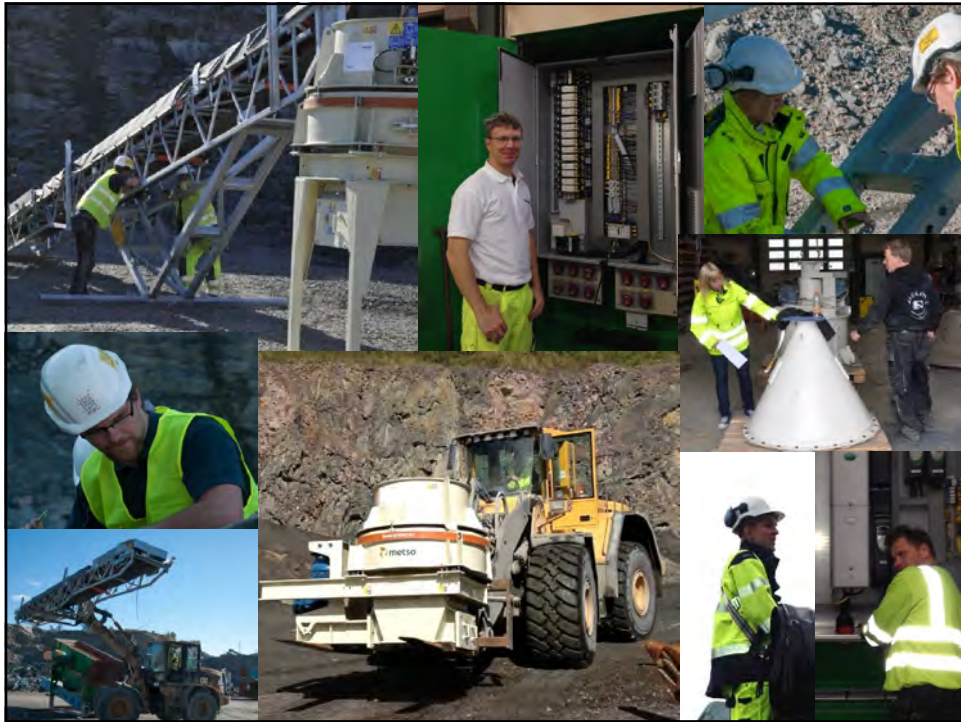
**Replace natural resources and secure the Environmental goals No 9 and 15**

**Demonstrate the Possibilities  
In the whole contry.  
Test Equipment on a road show**



## 24 Project Partners





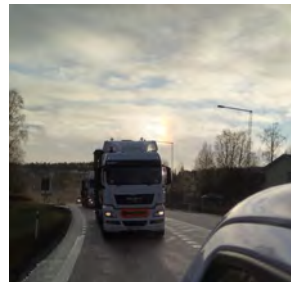
Transported on two jumbotrailers





## Road show through Sweden

- The Equipment has been on tour for 49 weeks
- It has been demonstrated in 12 different Quarries
- In total the Equipmnet was transported over 4000 km



## Many people involved

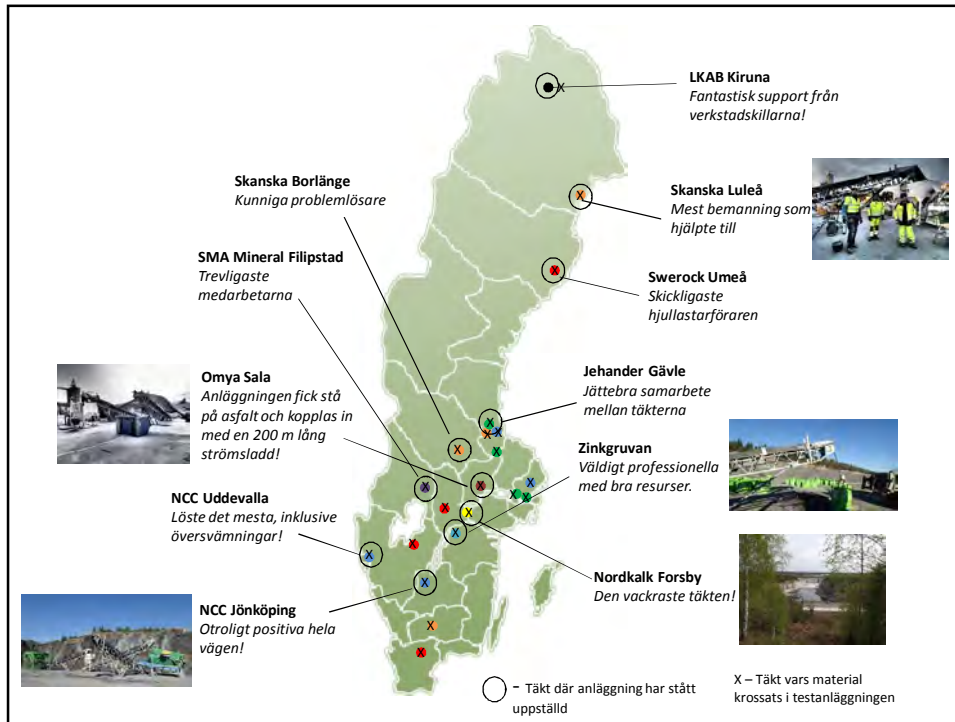
- The Equipment has been operated by two persons from Chalmers Technical University every week for 42 weeks.
- In total 41 different persons worked with the Equipment.
  - 17 from Chalmers
  - 24 from participating companies.



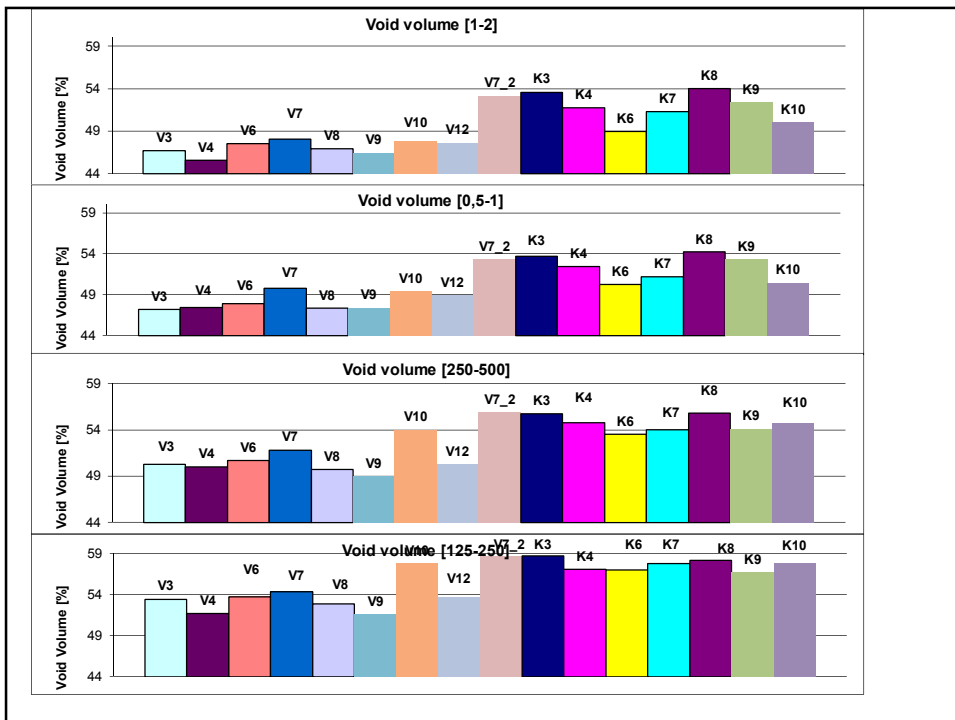
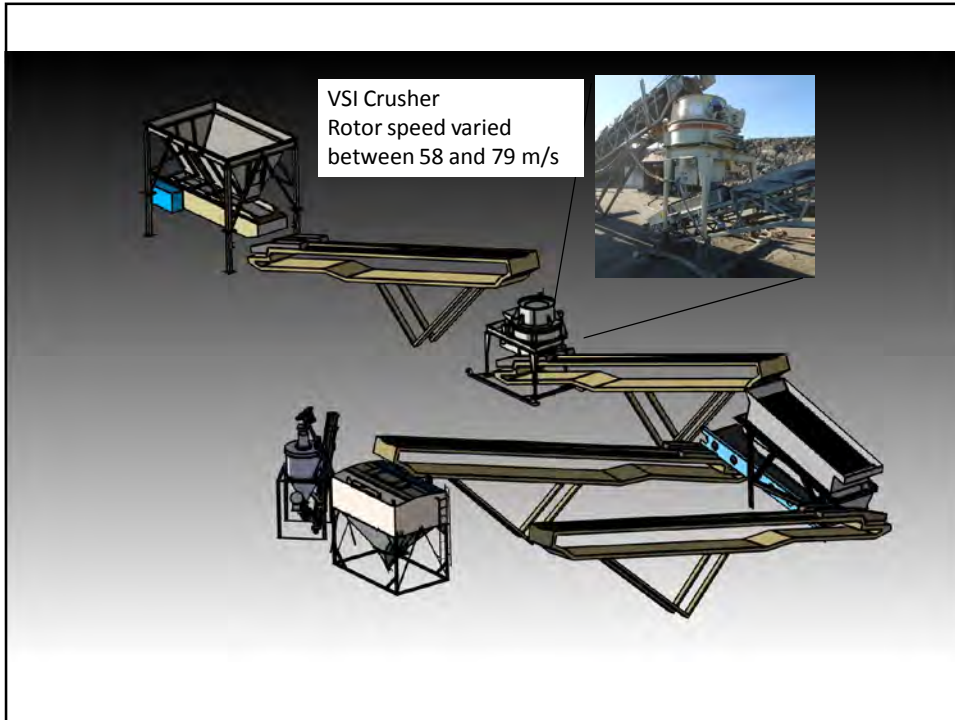
## Unique Test

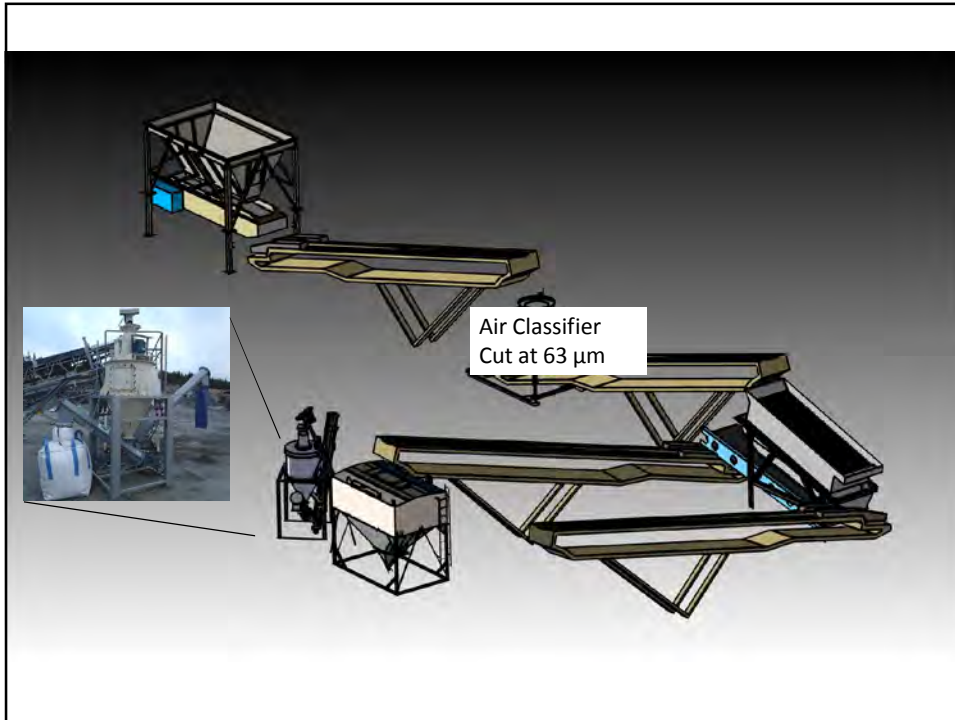
- 27 different rock materials have been treated.
  - 21 of them within the project.
- In each Quarry at least 10 different test setups were made and at least 60 specimens were sent for analysis.



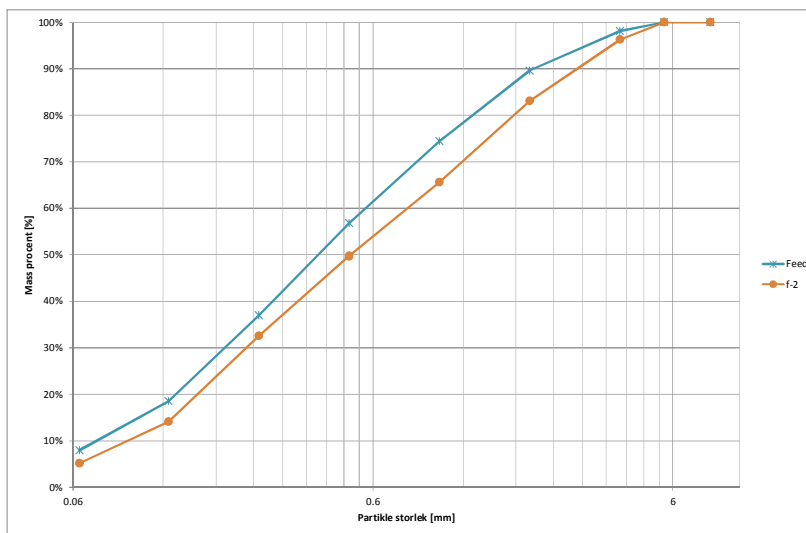


## The set up of the Equipment





### Effect on the particle size distribution curve



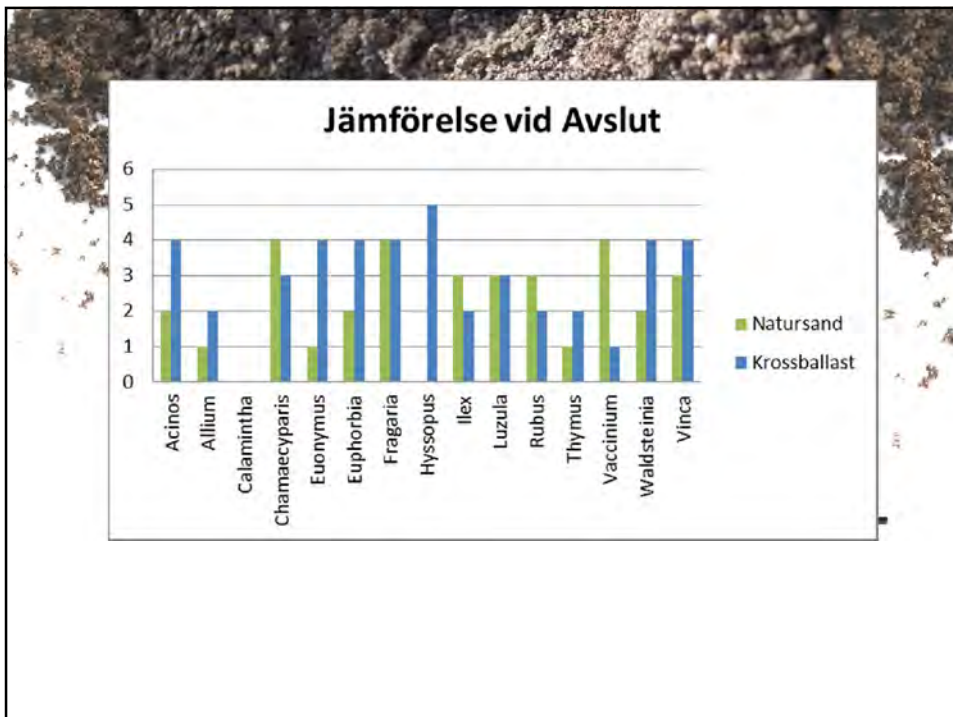
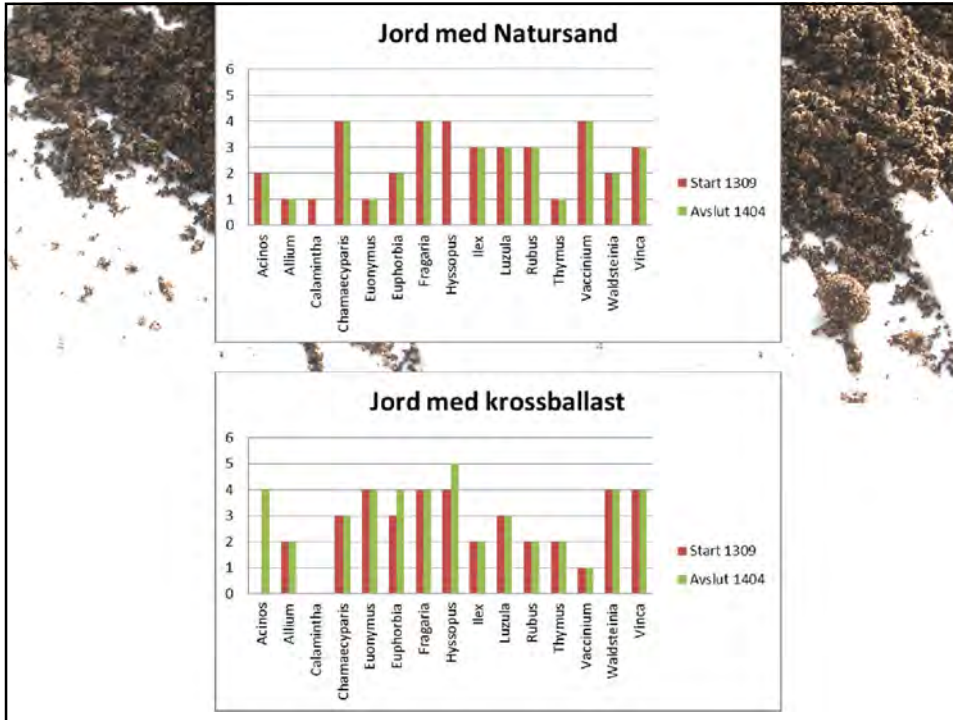


## Soil production

## Soil production

- Pot tests
- Full scale tests in Malmö





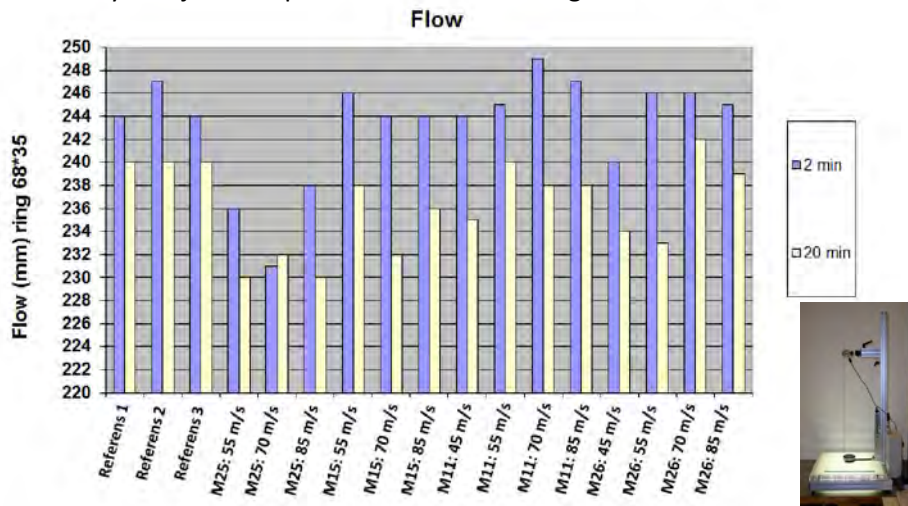
## Mortar screed

### Study of Mortar screed

- Tests in the Lab have been made with mortar screeds containing
  - Three references with natural sand
  - Four different crushed fine aggregates treated with different rotor speeds in the VSI.

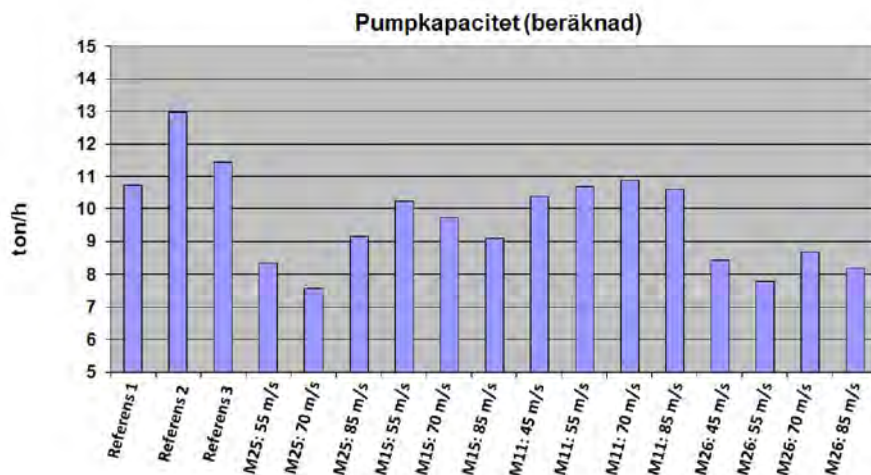
## Test of spread

- Målvärde 240-250 mm. Efter 20 min får det inte minska mer än 10 mm
- Utflyt okej för alla prover med ett undantag



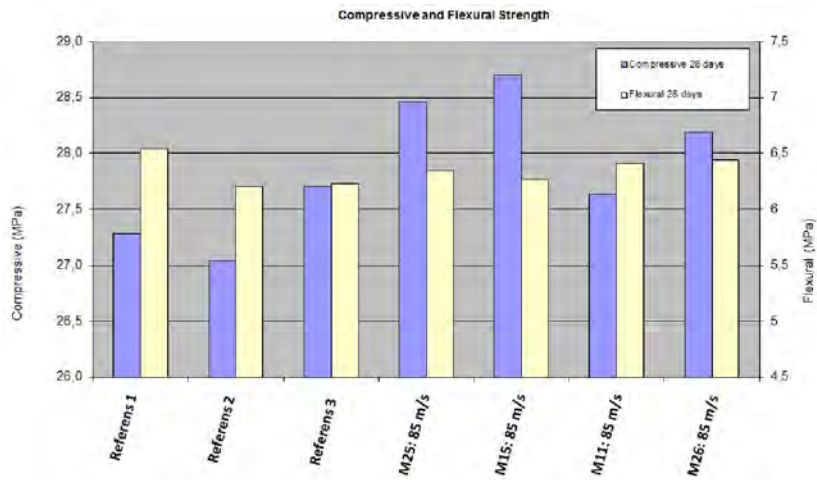
## Calculated pump velocity

- Target 10 ton/h
- Two of the crushed fine aggregates reached the target.



## Strength

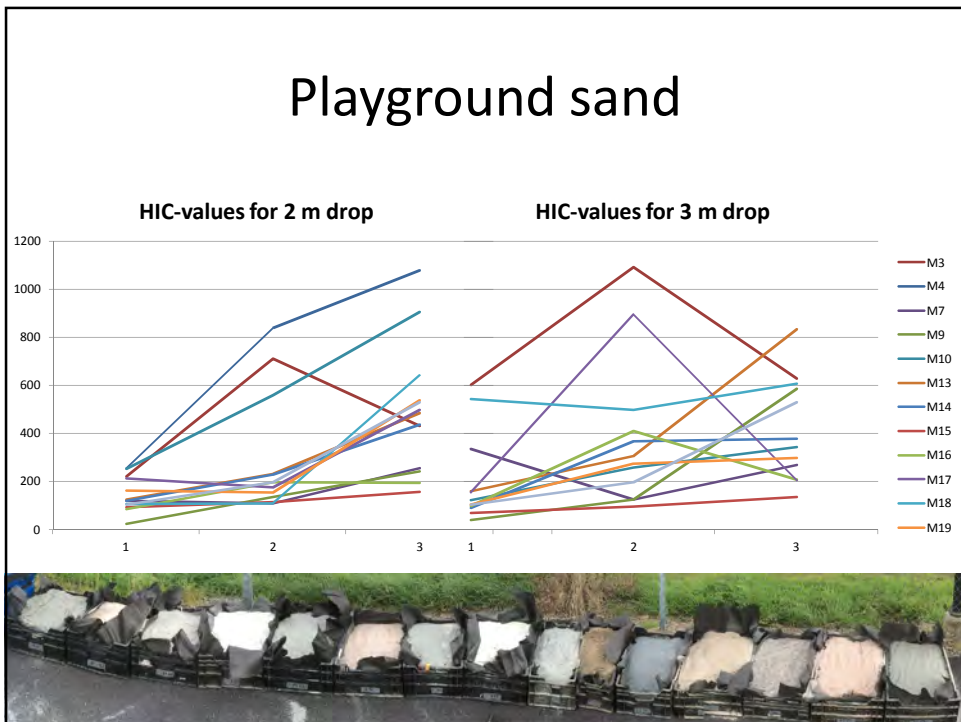
- Target in compressive Strength 25 MPa
- Small differences in compressive and flexural strength between manufactured and natural fine sand.

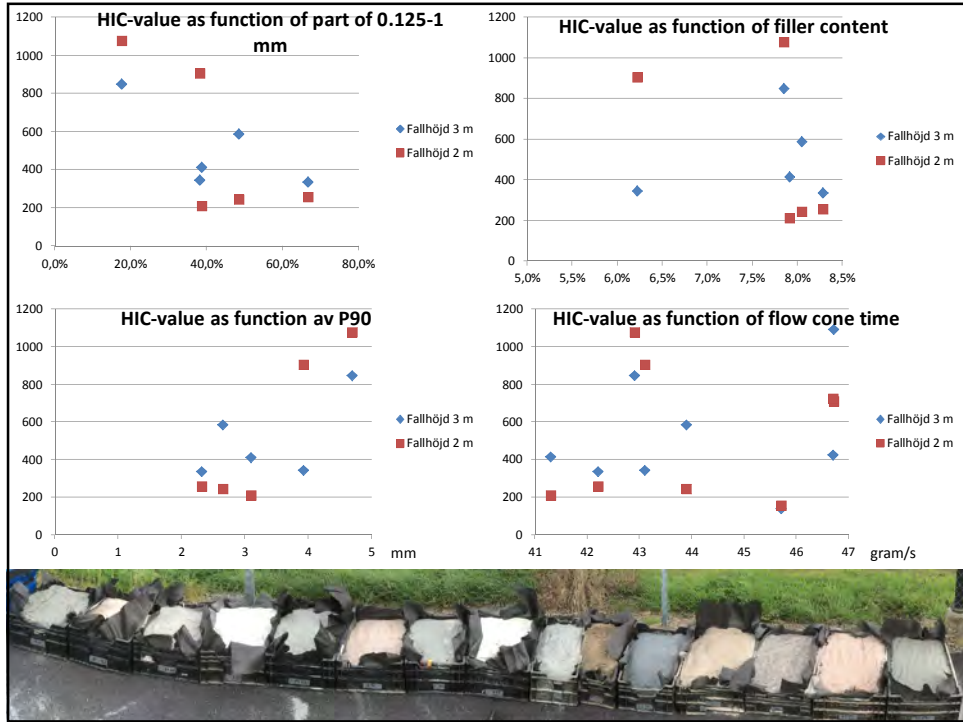


## Playground sand

## Playground sand

- Device released from 3 resp. 2 m
- The Retardation is measured
- Maximum value after after 3 drops gives the HIC-value.

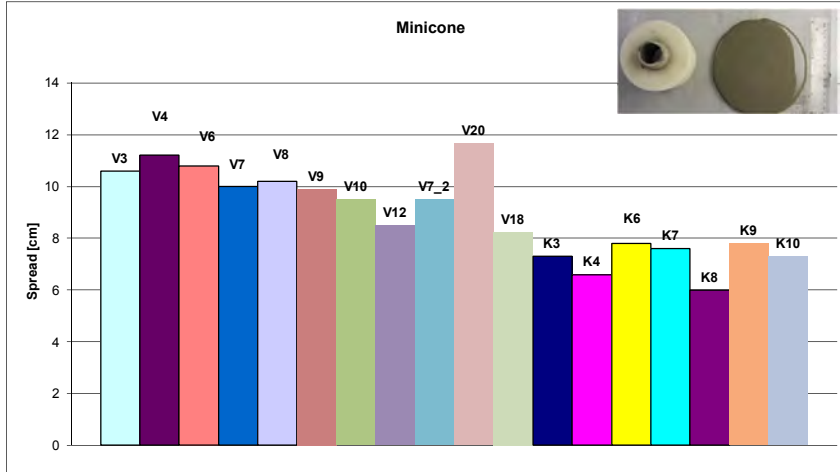




Concrete

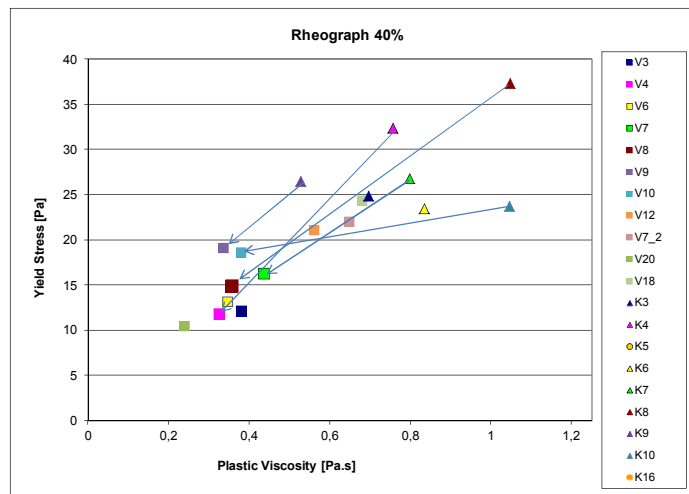
## Spread with minislump cone

The bigger spread the better. Same recipe as for rheological tests(0-0,125 mm)  
 V= Air classified, K= VSI crushed

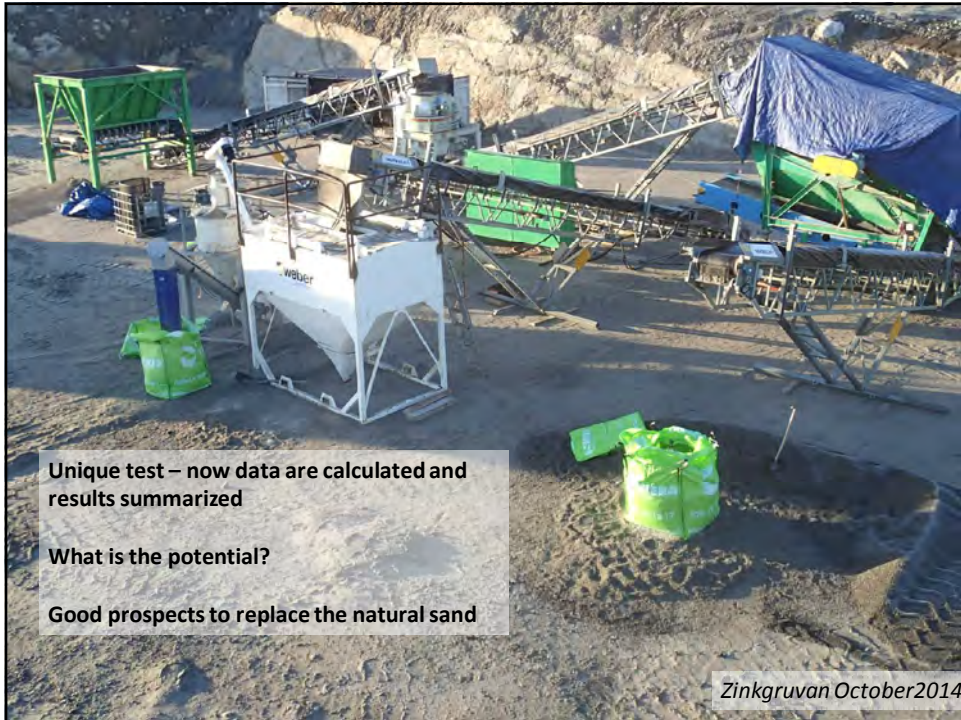


## Rheology for micro mortar

Recepy: Cement 1000g, water 450 g.  
 Filler addition is 40% by volume of the Cement.  
 V= Air classified, K= VSI crushed







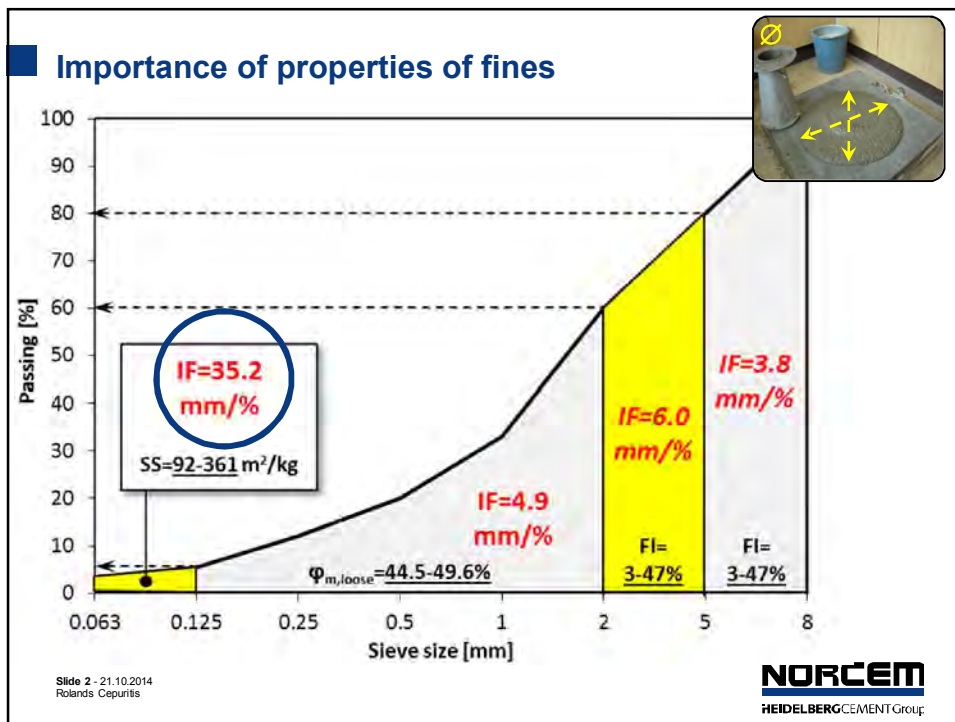
COIN [www.coinweb.no](http://www.coinweb.no)

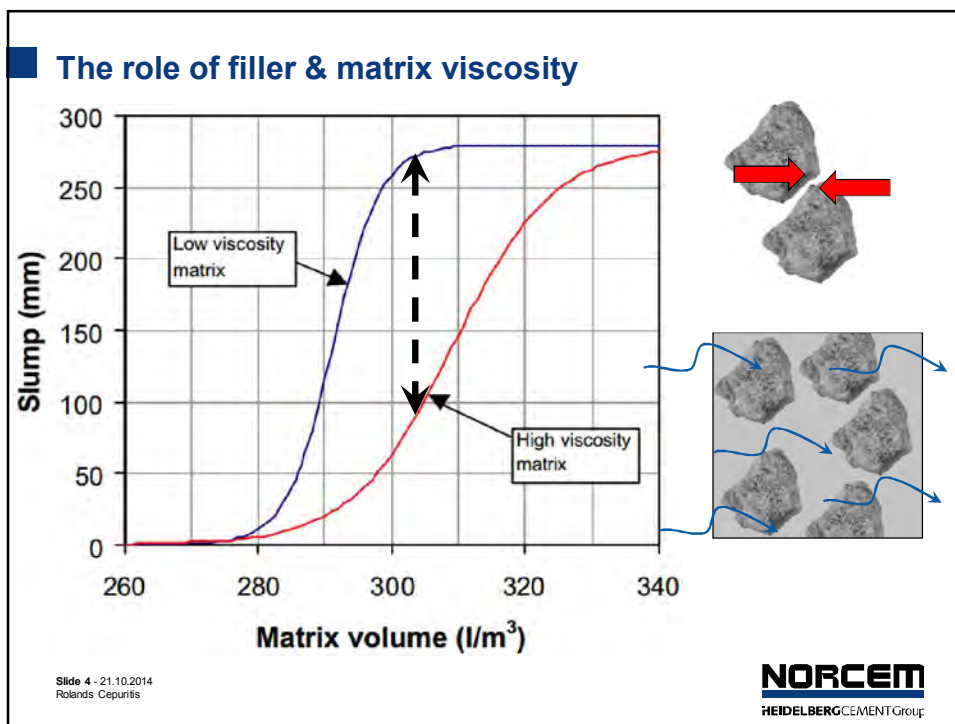
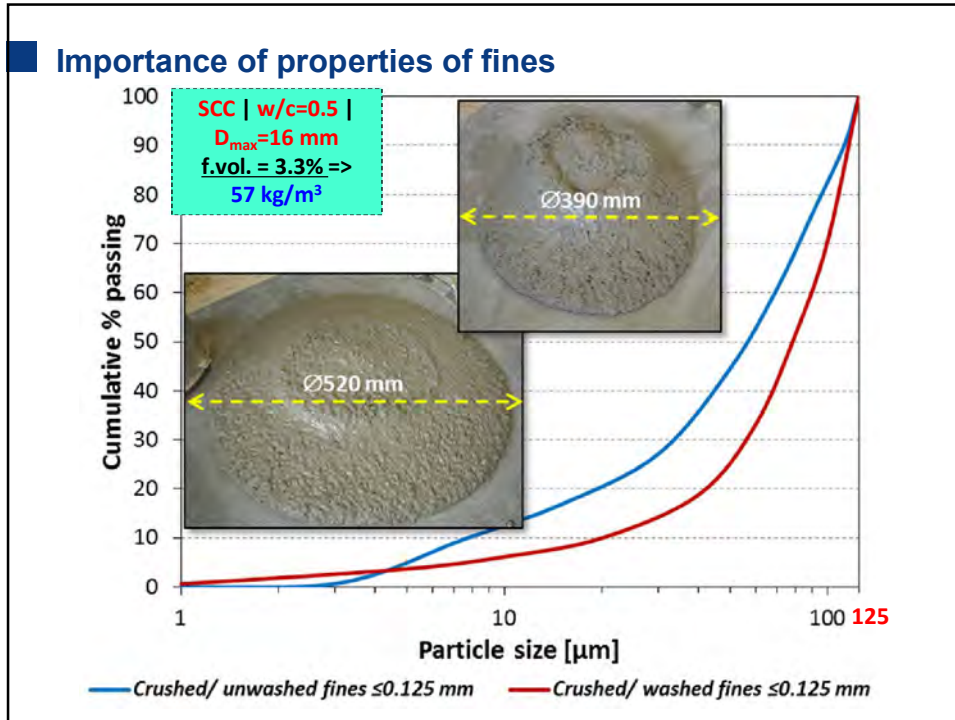
NTNU Norwegian University of Science and Technology [www.ntnu.no](http://www.ntnu.no)

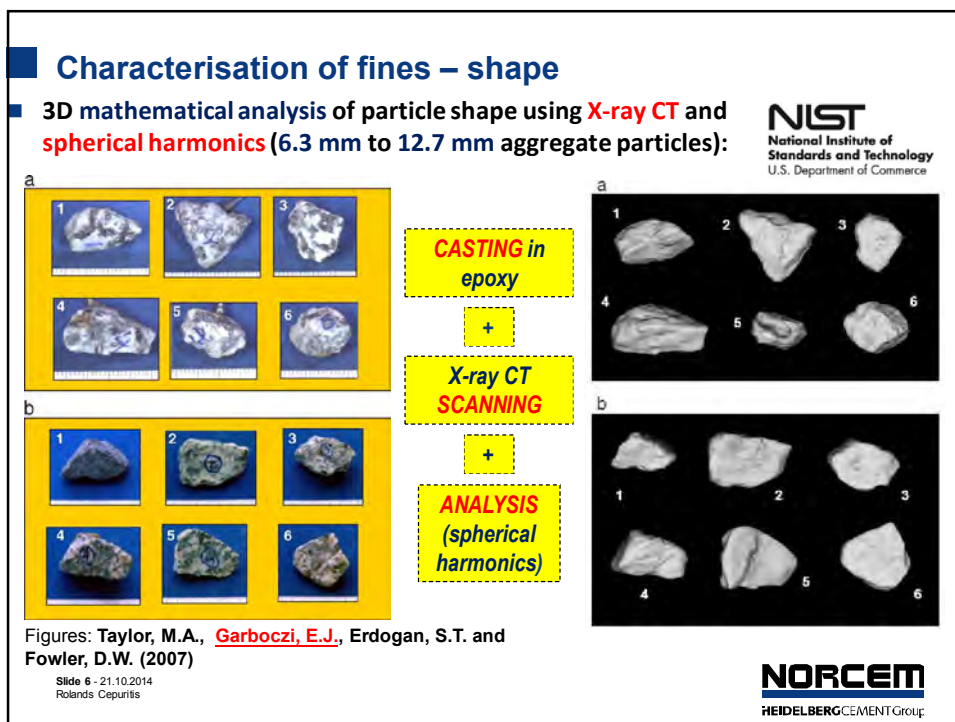
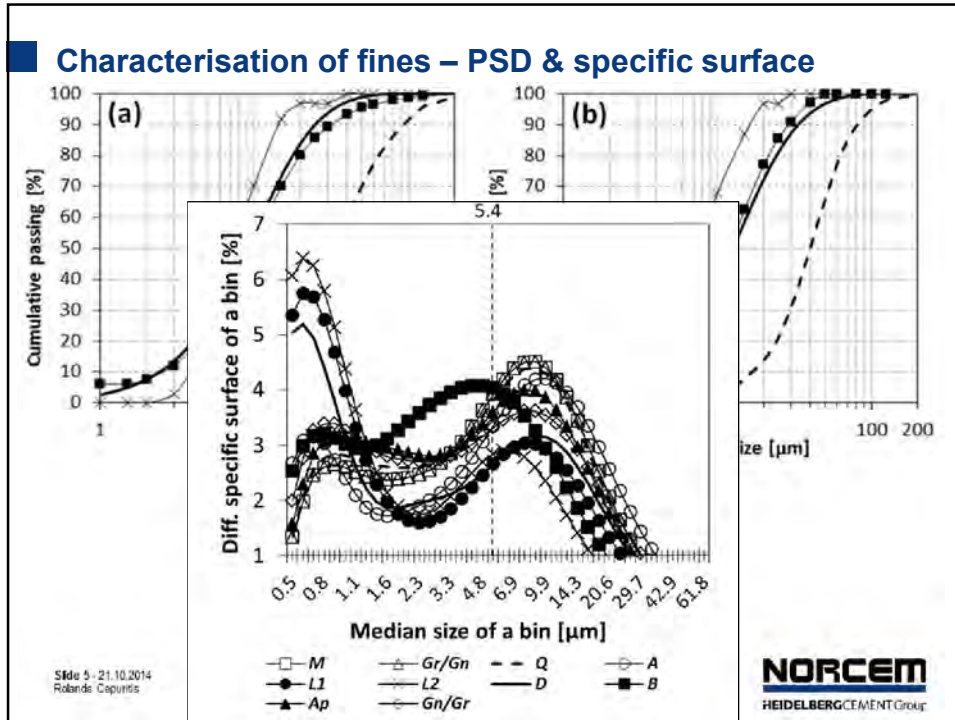
**Methods for characterization of crushed filler properties and principles of proportioning concrete**

[www.norcem.no](http://www.norcem.no)  
**NORCEM**  
HEIDELBERGCEMENT Group

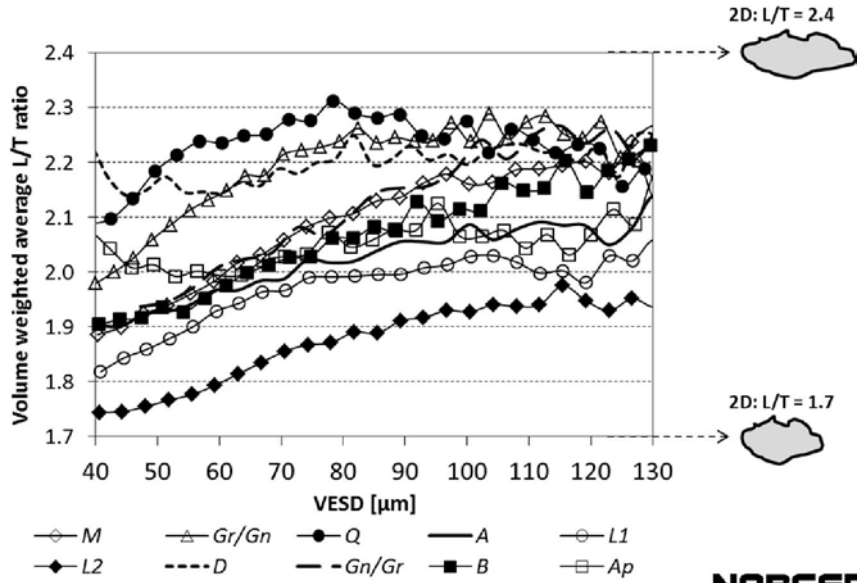
Manufactured sand seminar, Stavanger, Norway, October 20<sup>th</sup> and 21<sup>st</sup>, Rolands Cepuritis



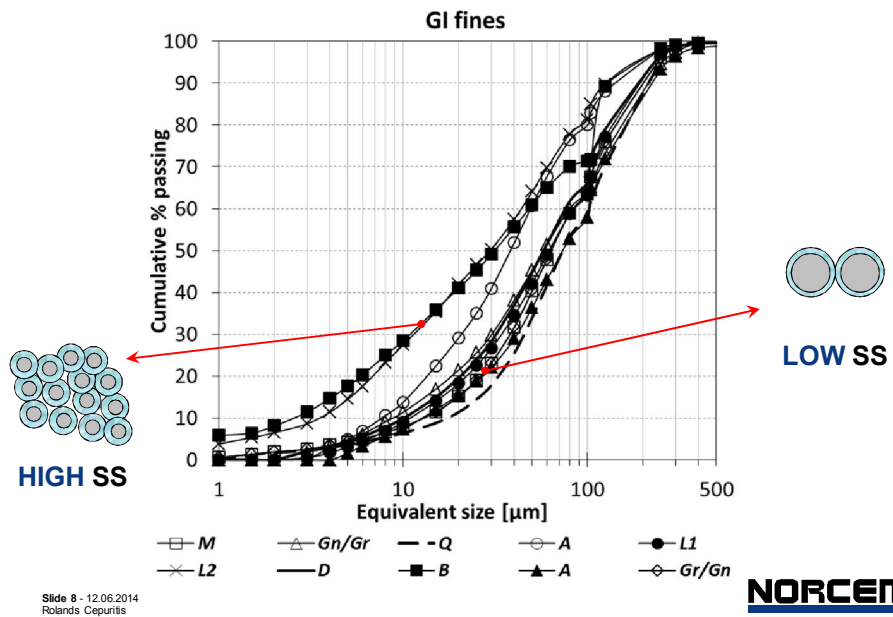




### Characterisation of fines – shape



### Static air-classification – opportunities





## How to determine the influence of aggregate fillers on the yield stress and plastic viscosity of micro mortar

Hans-Erik Gram

Stavanger 21 October 2014

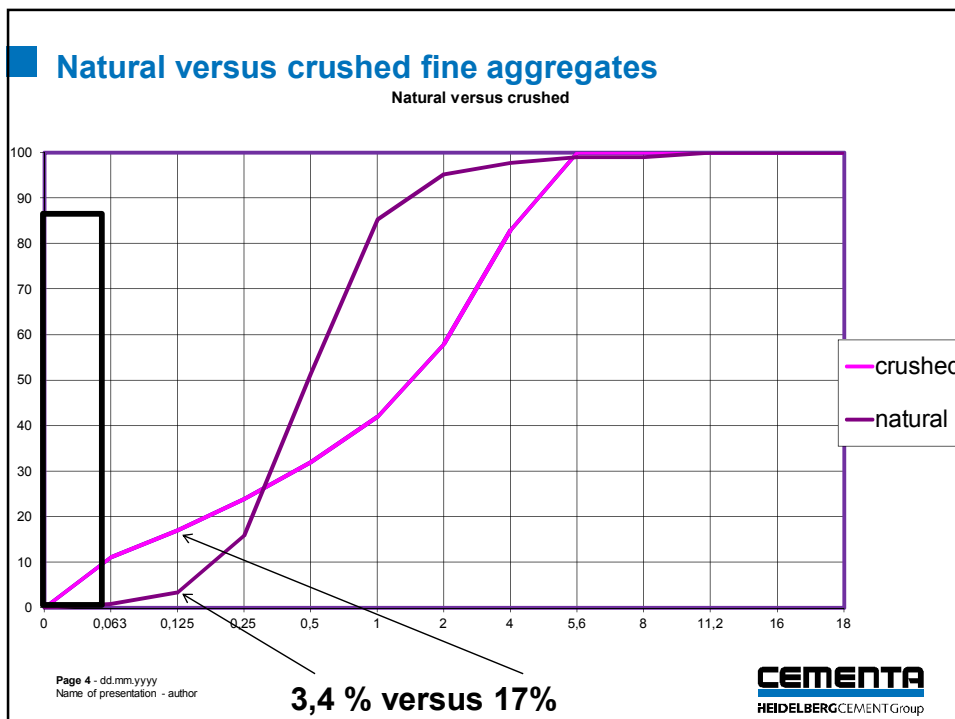
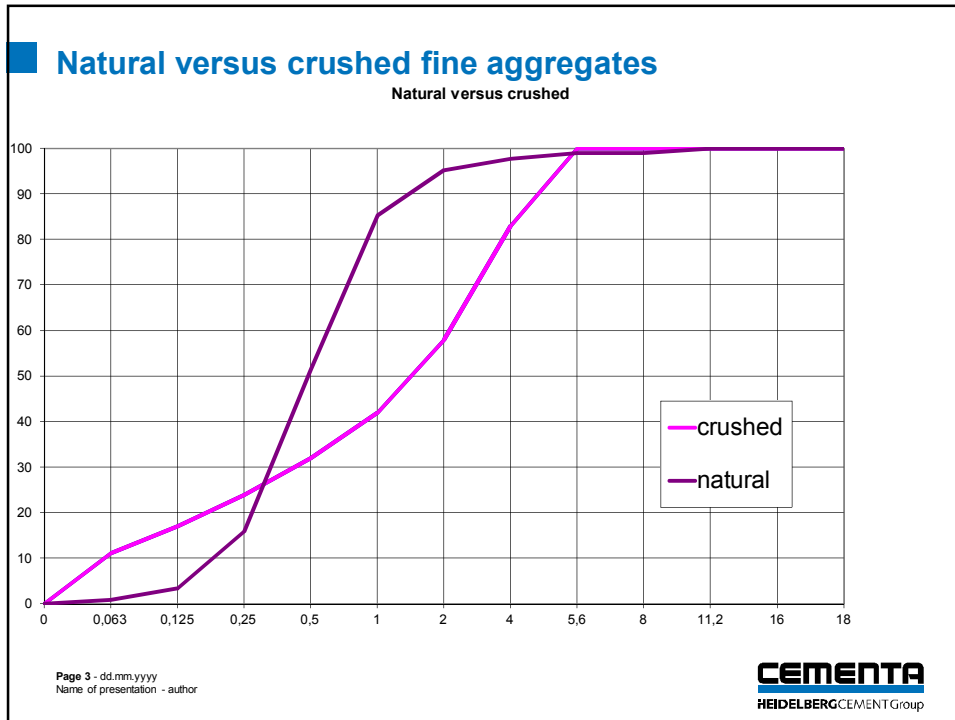
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### Content

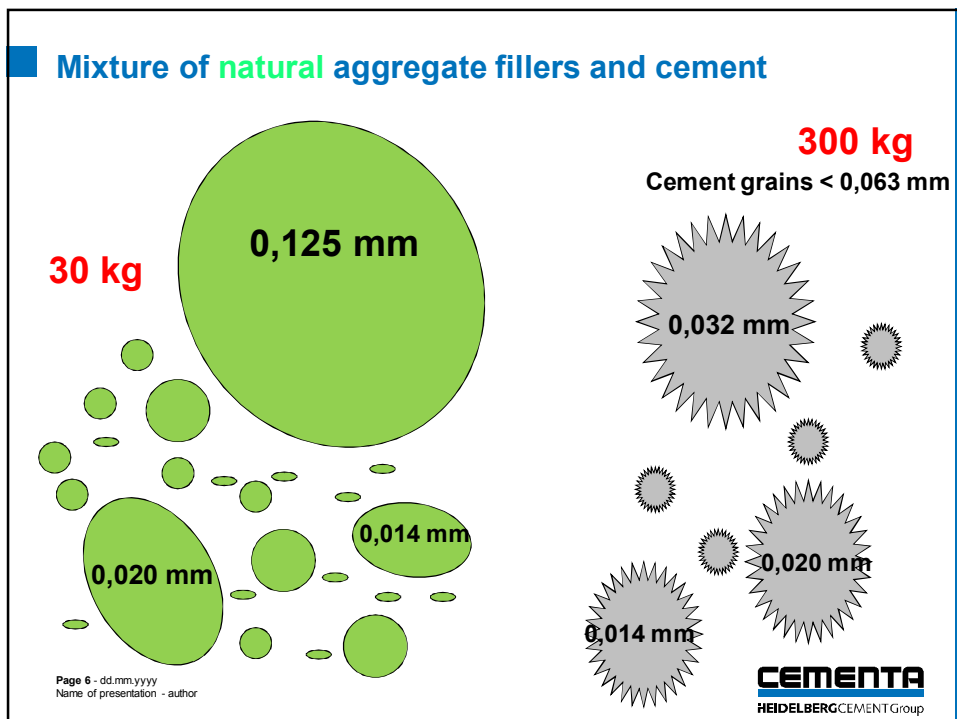
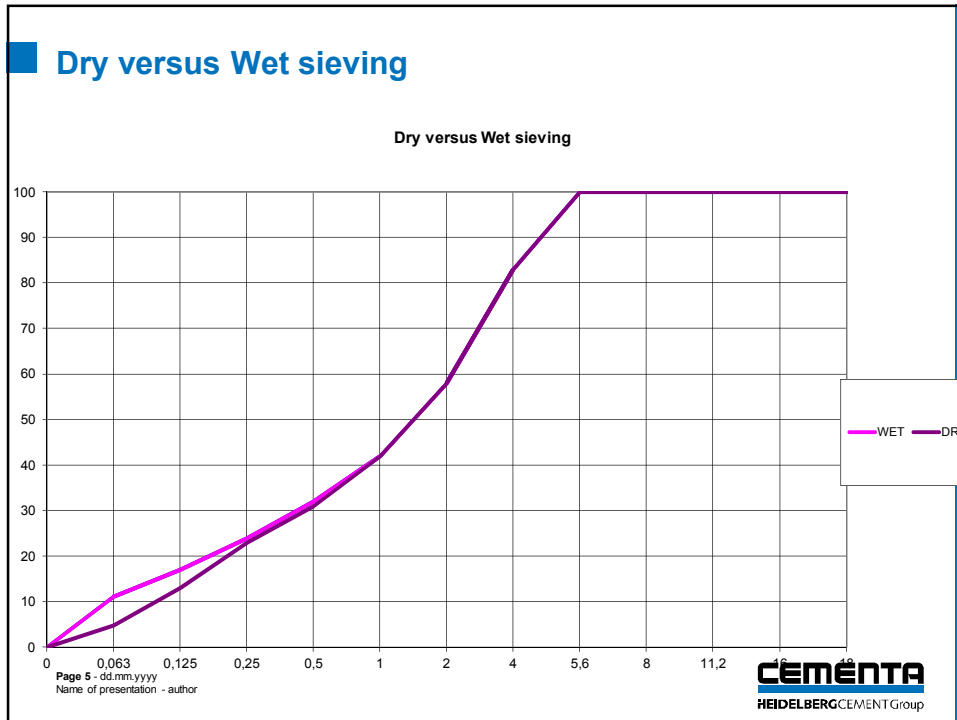
- Definition of filler < 0,063 mm (<0,125 mm)
- Differences between natural and crushed fillers
- Test methods
- Effect of superplasticizers
- Water absorption of fillers?

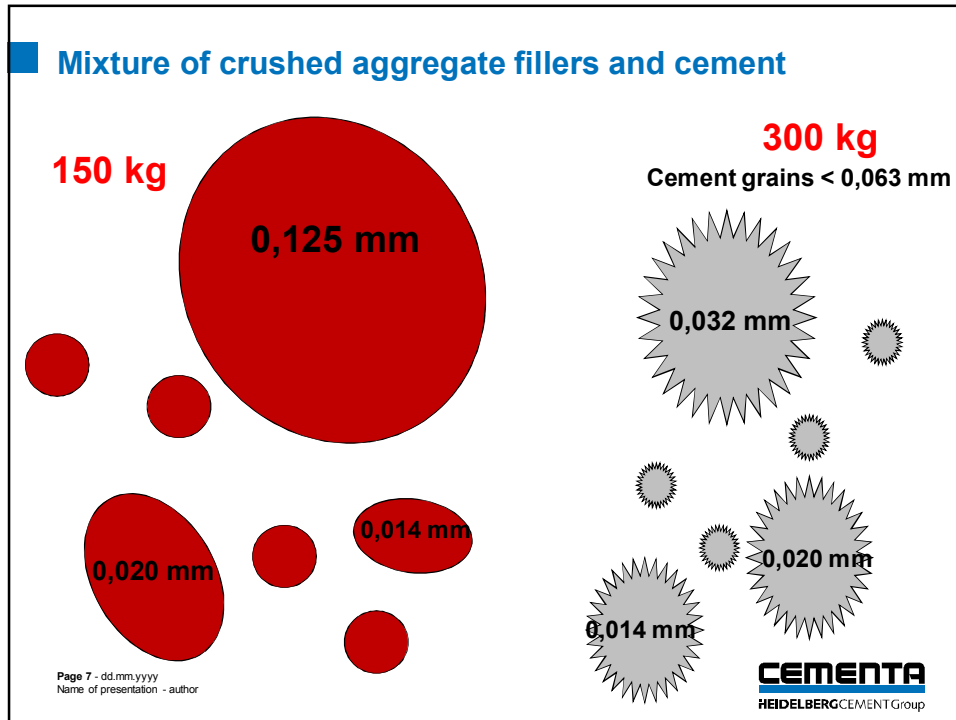
Page 2 - 141022  
Hans-Erik Gram

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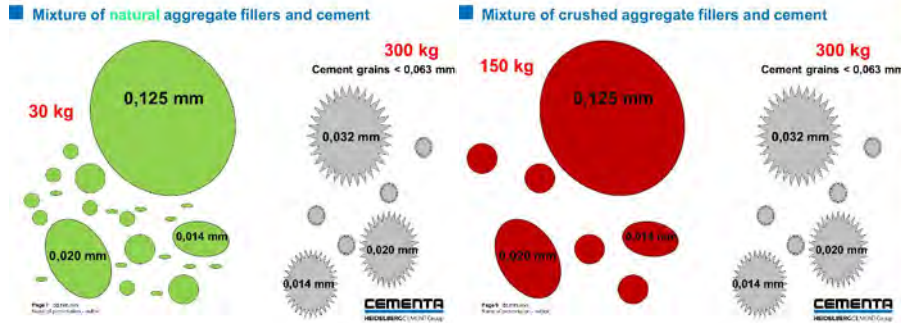






- ### Test methods for particles < 0,125 mm Wet methods
- Laser Sieving
  - BET surface
  - Sand Equivalent SS-EN 933-8:2012
  - Methylene Blue Test
  - Viskometer/Rheometer tests
  - Flow time in Cone tests like FlowCyl, other cones etc
  - Minislump cones and Hägermann cone
  - L-box for micromortar
  - Puntke –test
  - Sausage-test
- CEMENTA**  
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## How is the filler to be studied?



## With or without Cement???

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## The sausage method – needs 500 g of powder



Water added until sausages are formed. The saturation point is then calculated.



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Source: Stephane Broccas

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## The Puntke - method

### Vibrating table



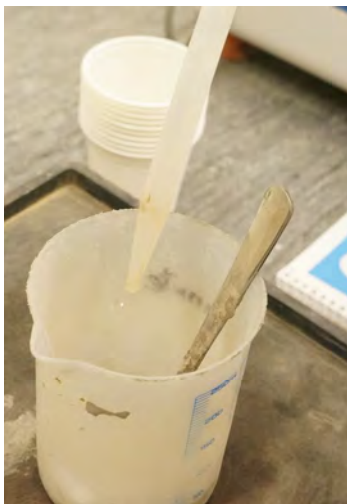
### Container and scale



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## The Puntke test – adding water and mixing



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The Puntke test – The surface shall be blank when sample is vibrated – then the sample is placed on the scale

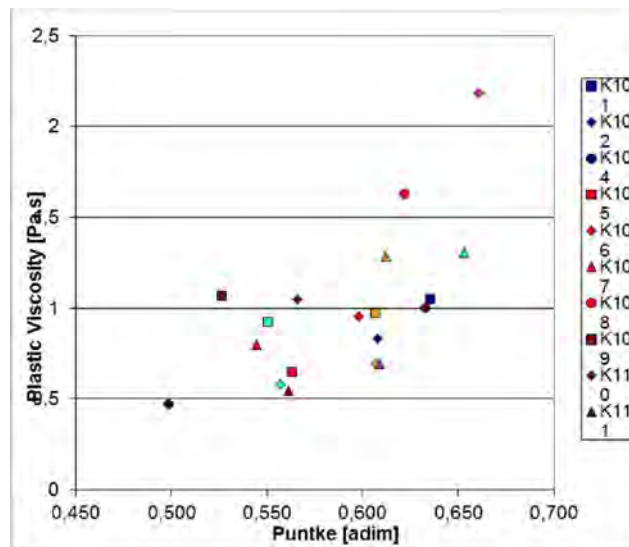


The saturation point is then calculated

Page 13 - dd.mm.yyyy  
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Plastic viscosity versus Puntke absorption value

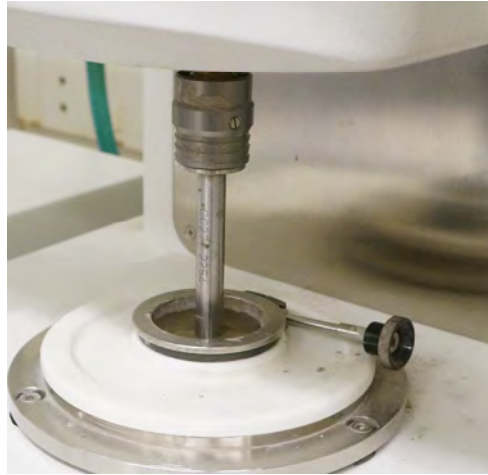
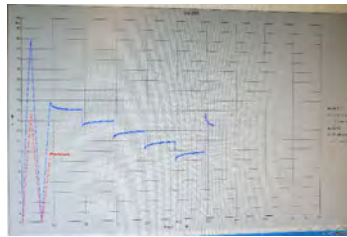


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Björn Lagerblad, CBI

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## The Rheometer



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## Alternatives to the Rheometer – The L-box for micro mortar



The camera registers the flow and  
The time to reach a specified distance  
is determined.



Developed by Annika Gram

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## Operation of the L-box

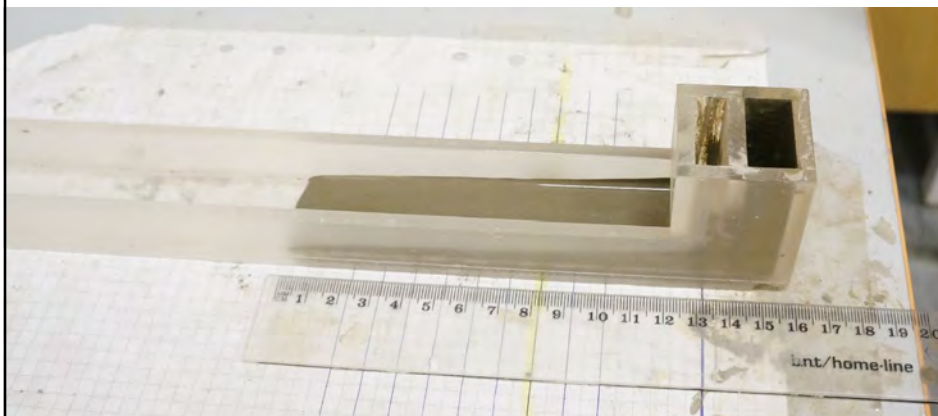


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The flow distance is measured – correlates with the **yield stress**

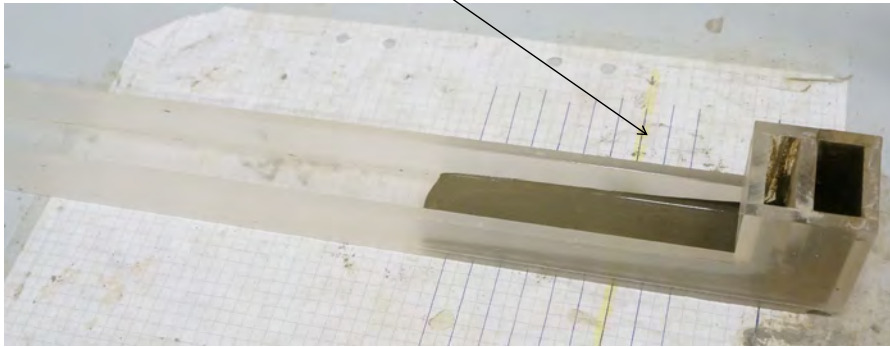
The micro mortar is also tested in the Rheometer to control the result



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The time it takes for the mortar to reach a specified distance is used to calculate the **plastic viscosity**



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Another alternative to the Rheometer is the flow cone and micro mortar cone

The sample is prepared  
And the place on a scale



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The flow time is measured – correlates to the **plastic viscosity**



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The spread is determined and it correlates with the **yield stress**



Page 24 - dd.mm.yyyy  
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## ■ Water absorption of fine aggregates

**According to the standard fines shall be removed when determining the water absorption.**

**In manufactured sand a substantial part is filler**

**The filler does increase the water demand of the concrete.  
Is some part of this water absorbed????**



-Stavanger 21. oktober 2014

**Bård Dagestad**  
**Kjell Apeland**  
NorStone AS



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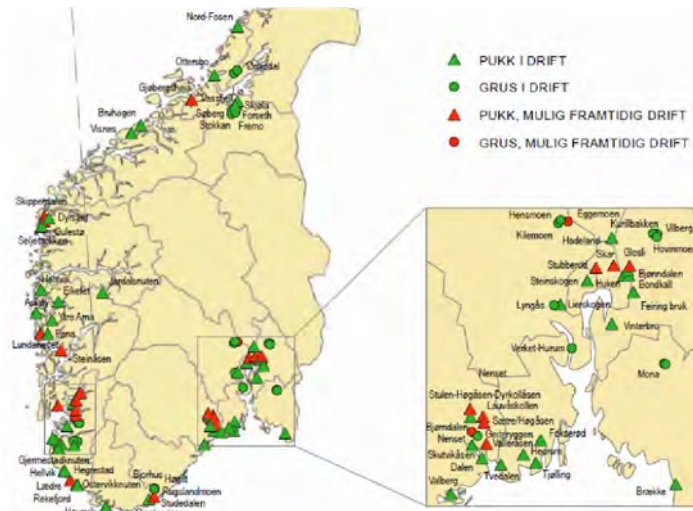
**The future for sand and gravel?**

“Sand & gravel“



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Find the red circles (sand and gravel future resources)



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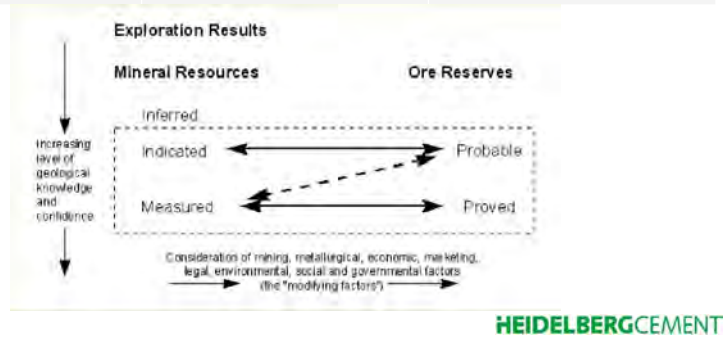
Production of sand and gravel 2013  
Source NGU

|                |                     |                  | UTTAK      |            |            |
|----------------|---------------------|------------------|------------|------------|------------|
| Produkt        | Antall Uttakssteder | Antall bedrifter | Produsert  | Skrotstein | Sum        |
| ↓              |                     |                  |            |            |            |
| BYGGERÅSTOFFER |                     |                  |            |            |            |
| Grus/Sand      | 461                 | 409              | 14 079 715 | 68 749     | 14 148 463 |

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**NGU report 2012 062 reserves and resources, sand and gravel table five million tons according to (FRB ) jorc code**

| Reserves  | probable  | Proved   |
|-----------|-----------|----------|
|           | 289       | 24       |
| Resources | Indicated | measured |
|           | 452       | 68       |
| Sum       | 741       | 92       |



**Use of sand and gravel in the future**

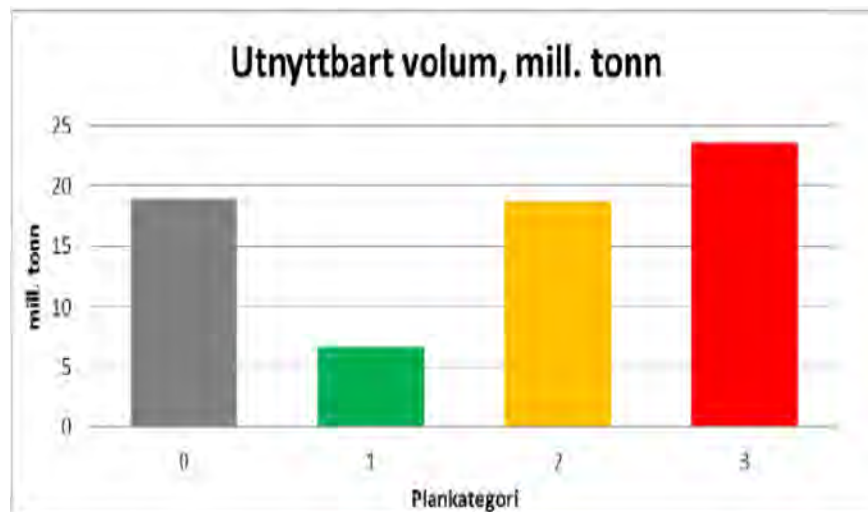
- **Easy mathematics if present depletion continues. 140 million tons lost in next ten years and 280 million in the next twenty years.**
- **But we might have reserves and resources in the range of 850-900 million tons**
  - Maybe enough for 60 yrs.
- **Or do we?**
- **I suggest, that within the present regime of planning, cultural heritage and landscape protection the remaining accessible reserves and resources lies between 1/3 to 1/2 of the the maximum of 900 million tons.**
  - Maybe enough for another 20-30 yrs. Without taking in to account proximity to marked etc.

## ■ Limiting factors sand and gravel Resources

- **Our ancestors liked living on and burying their dead in sand and gravel.**
  - Large part of the remaining resources sterilized by cultural heritage
- **Cheap and good ground for buildings and structures**
  - Norway's main airport and the airport at Geiteryggen.
- **Quaternary geology**
  - Resources sterilized for landscape purposes
- **We love to stroll in quaternary landscapes**
  - Important leisure areas in several municipalities
- **Gravel and sand = water**
  - Important groundwater resources may sterilize resources
- **A large part of our remaining resources sterilized by these factors**

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## ■ Sand and gravel in Ryfylke (from regional plan) grade of sterilizing from left to right



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## Regional plans for sand and gravel

### Why make a regional plan for sand and gravel?

- ❑ Gives us better picture of the future situation for sand and gravel
- ❑ Will help us plan for future sand and gravel pits
  - ❑ Better understanding of future supply and demand
  - ❑ Common guidelines for municipalities
- ❑ Securing access to building materials in a sustainable perspective
  - ❑ Prioritize between different land use issues
  - ❑ Secure important resources against alternative use

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## Regional plan Jæren



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### Regional plan Jæren main features

- ❑ **A plan for Jæren future needs for building materials?**
  - ❑ Gives an opening for future expansion of existing quarries
  - ❑ Planning for new sites
  - ❑ Explore the need for importing materials. Especially from Ryfylke
  - ❑ Extract remaining resources in a sustainable manner.
- ❑ **The conclusion is that the region are facing a future shortage of sand and gravel.**

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### Regional plan Jæren

- ❑ **Completed 2006**
- ❑ **Consumption ( 2013 ) sand and gravel      about 1,5 Mill tons**
- ❑ **Estimated remaining resources sand and gravel( 2006 )**
  - ❑ about 20 Million tons
  - ❑ Challenges are environmental issues, transport and alternative use of land

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## Regional plan Ryfylke



Vilje gir vekst

**Regionalplan for byggeråstoff i Ryfylke**


Vedtatt i fylkestinget 10. desember 2013

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### Important issues

- Local communities
- Outdoor activities
- Cultural heritage
- Sites of importance
- Landscape




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**Important issues**

- Agriculture
- Biodiversity
- Protected waterways
- groundwater




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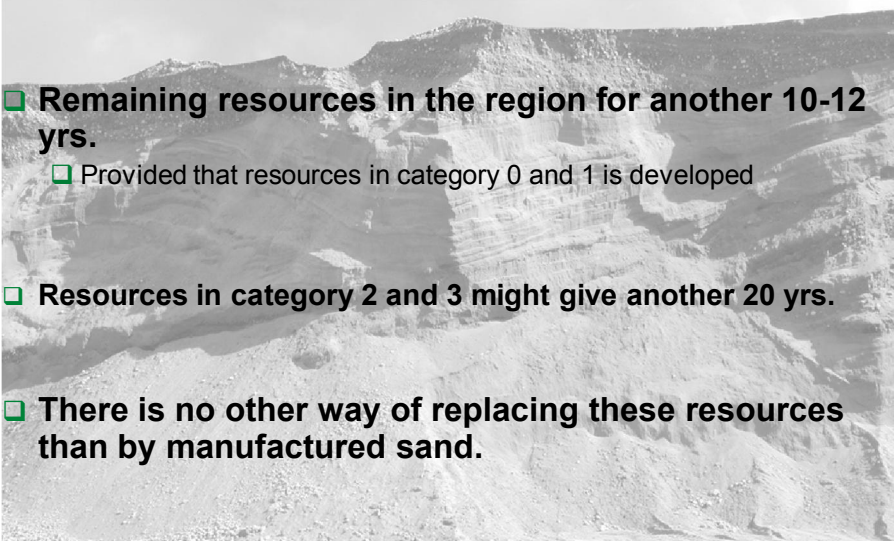
**Issues regarding the resources**

- Inherent quality
- Relative importance of the resource (size)
- Location
- Marked



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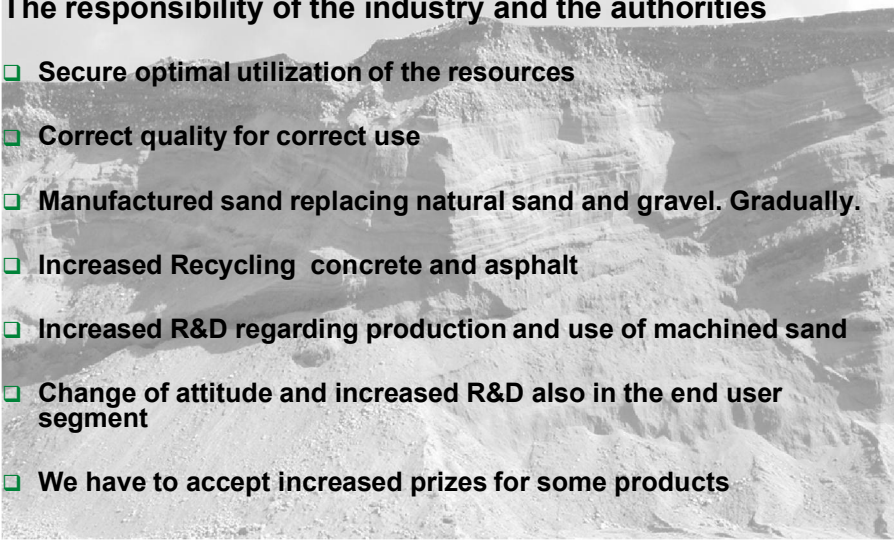
## Conclusion regional plan Ryfylke

- 
- ❑ **Remaining resources in the region for another 10-12 yrs.**
    - ❑ Provided that resources in category 0 and 1 is developed
  - ❑ **Resources in category 2 and 3 might give another 20 yrs.**
  - ❑ **There is no other way of replacing these resources than by manufactured sand.**

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### The responsibility of the industry and the authorities

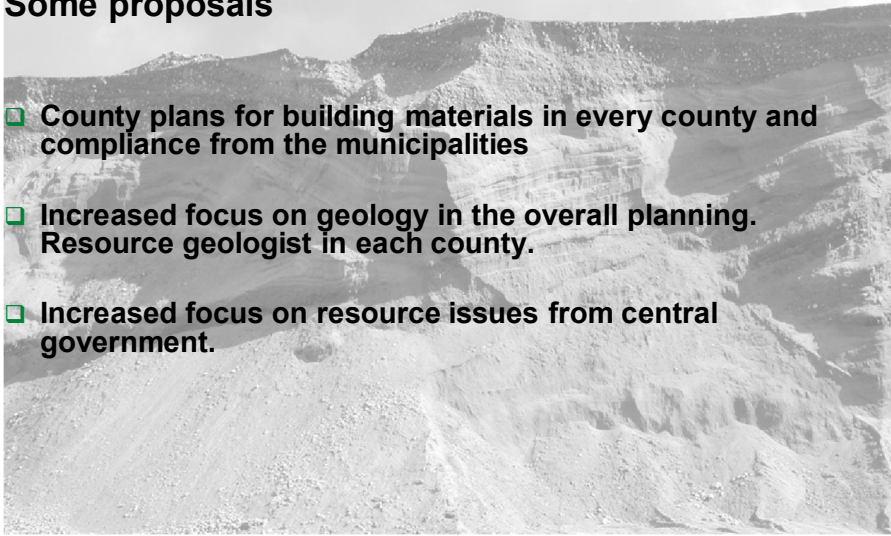
- 
- ❑ **Secure optimal utilization of the resources**
  - ❑ **Correct quality for correct use**
  - ❑ **Manufactured sand replacing natural sand and gravel. Gradually.**
  - ❑ **Increased Recycling concrete and asphalt**
  - ❑ **Increased R&D regarding production and use of machined sand**
  - ❑ **Change of attitude and increased R&D also in the end user segment**
  - ❑ **We have to accept increased prizes for some products**

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### Some proposals

- ❑ County plans for building materials in every county and compliance from the municipalities
- ❑ Increased focus on geology in the overall planning. Resource geologist in each county.
- ❑ Increased focus on resource issues from central government.



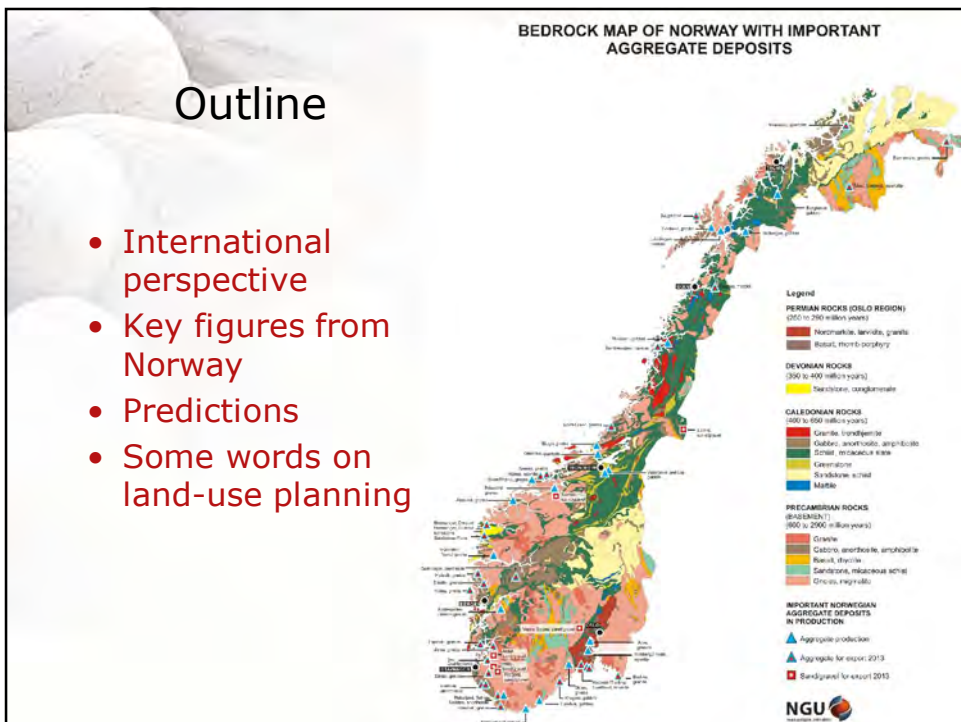
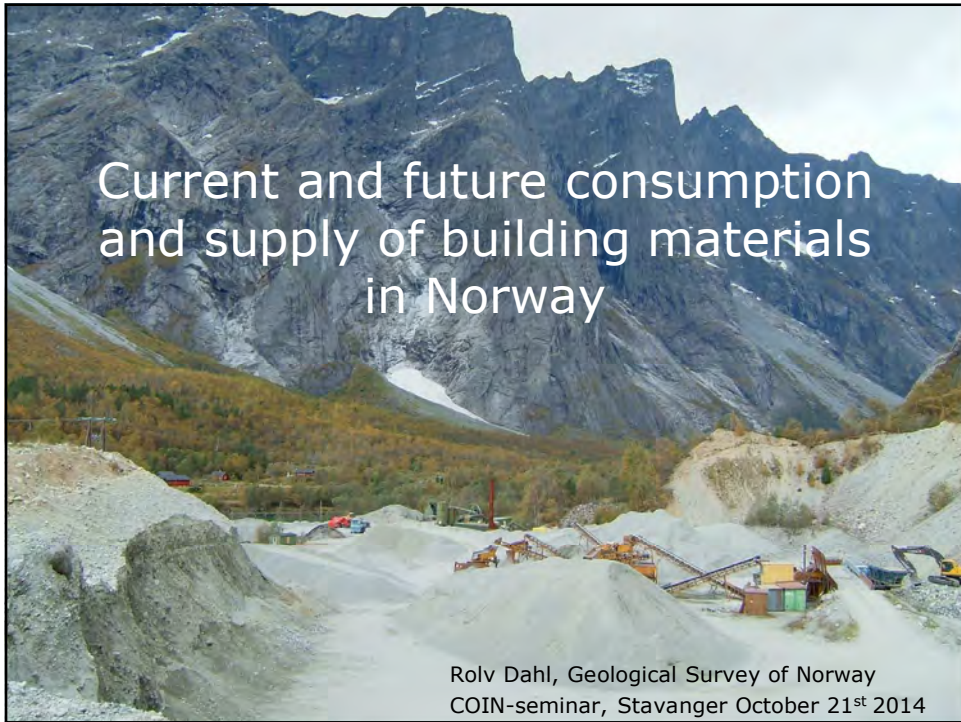
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Thank you



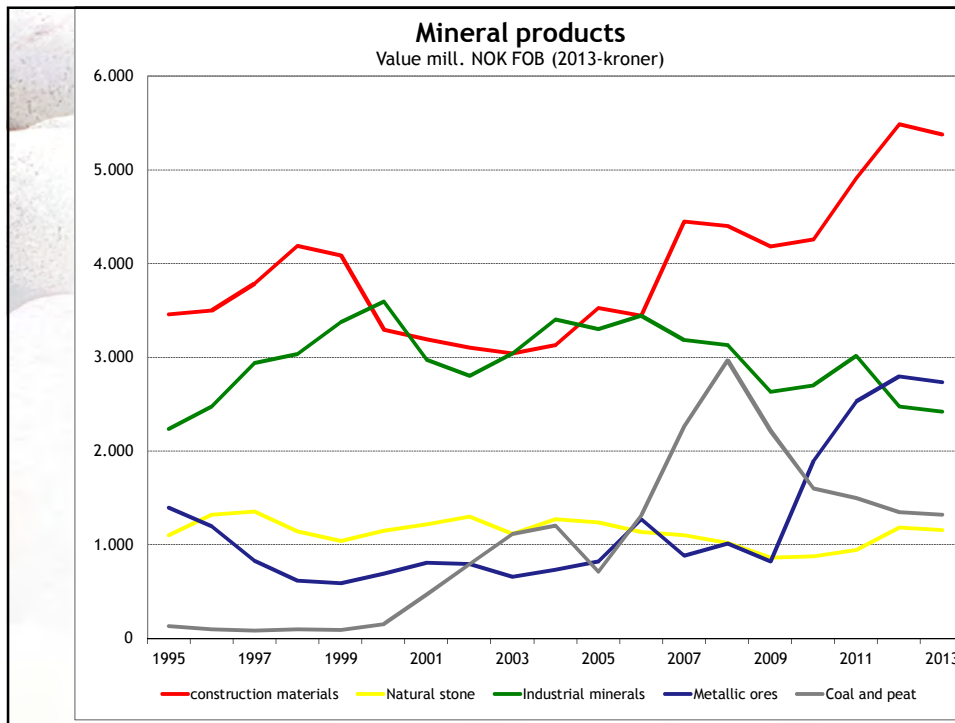
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## Global perspectives

- Consumption of cement in the USA totaled about 4.56 Gt during the entire twentieth century –
- while China emplaced more cement (4.9 Gt) in new construction in just three years between 2008 and 2010 ,
- and in three years between 2009 and 2011 it used even more, 5.5t.

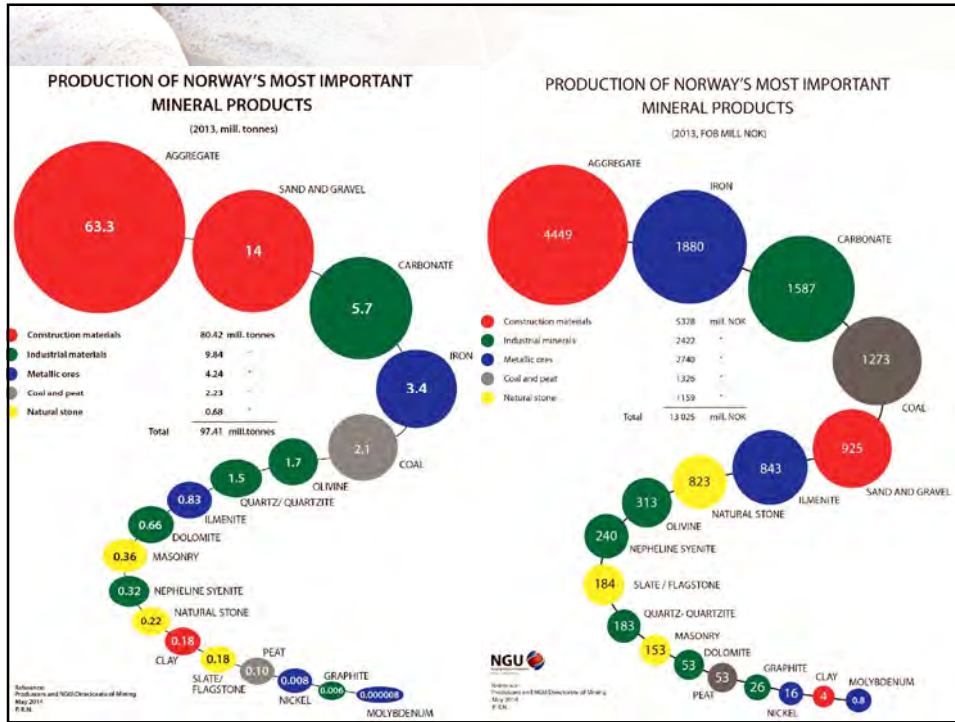




### Norwegian construction materials industry in 2013

- Total turnover: aggregates: 4400 Mill NOK  
sand 925 Mill NOK.
- 66 million tonnes hard rock.
- 14 million tonnes sand and gravel.
- Export sales: NOK 1100 Mill NOK.
- 21 million tonnes exported.
- 531 aggregate quarries, 461 gravel pits in operation, ranging from small enterprises to international companies.

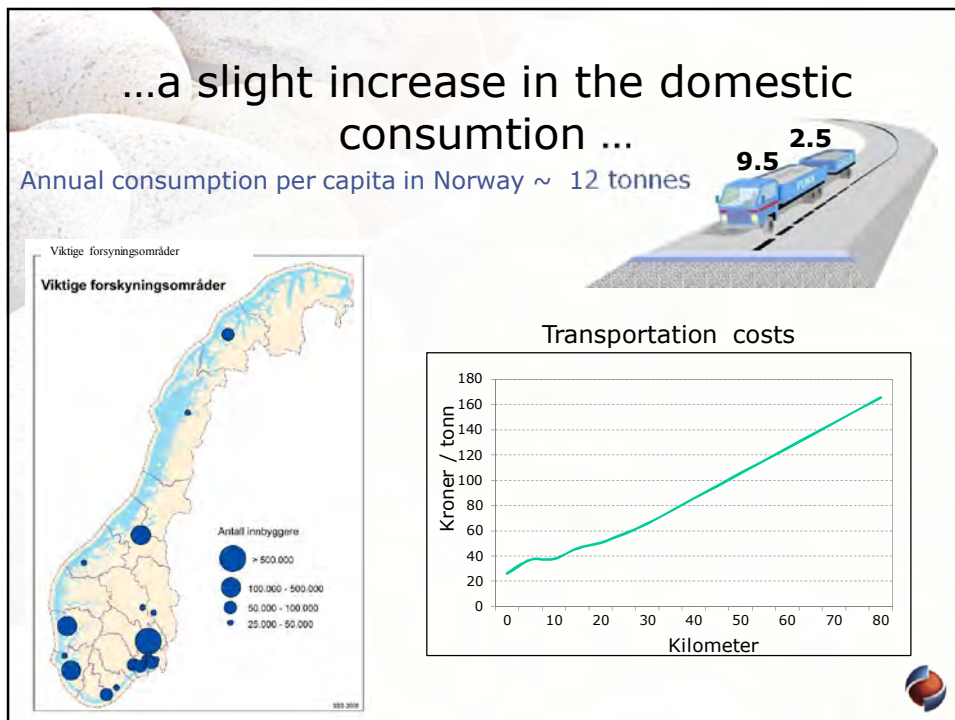
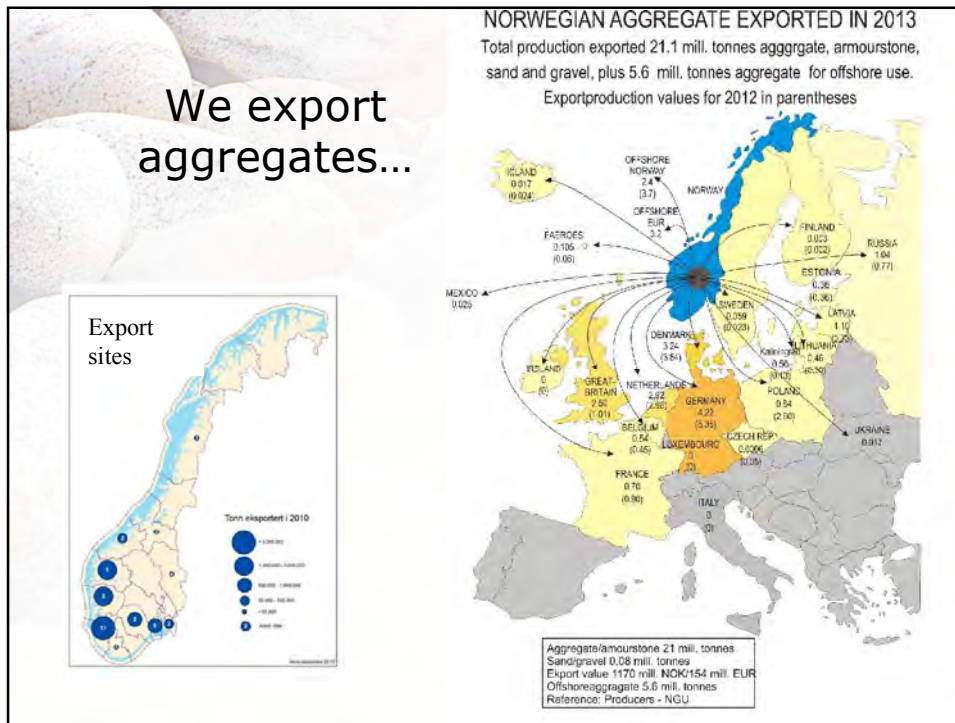




## Use of Norwegian construction materials

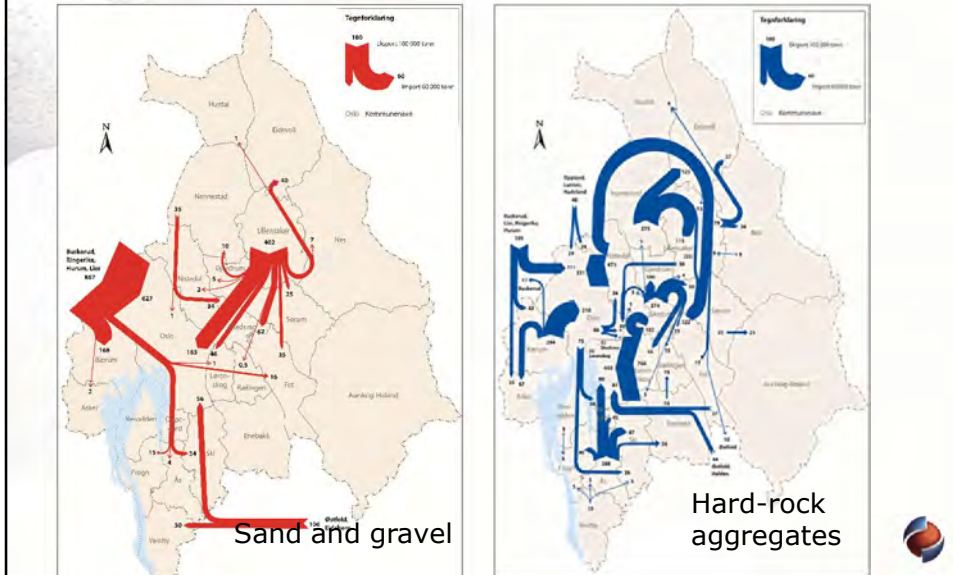
| Type/ use            | Roads         | Asphalt | Concrete      | Other  |
|----------------------|---------------|---------|---------------|--------|
| Sand/gravel          | 18.5 %        | 13.6 %  | <b>48.4 %</b> | 19.1 % |
| Hard-rock aggregates | <b>44.6 %</b> | 11.3 %  | 8.7 %         | 35.1 % |





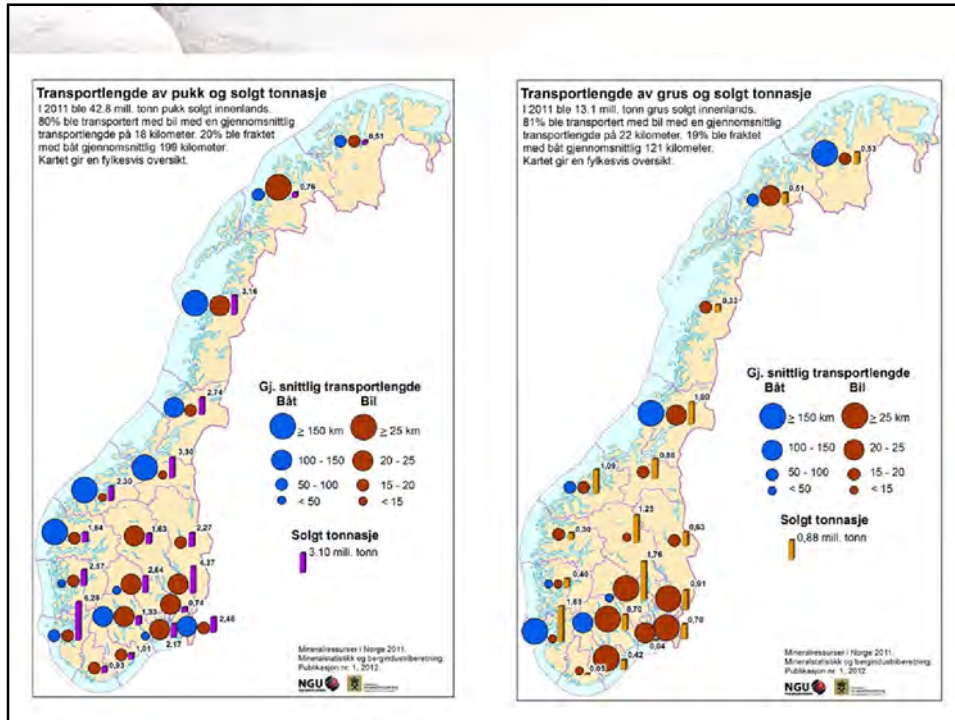
...particularly around cities...

Annual consumption of 7.2 mill tonnes of gravel and hard-rock aggregates in Oslo/Akershus



...and it is transported far.

- Sand was in average transported 21 km by car, 147 km by boat
- Hard-rock aggregates was in average transported 17 km by car, 135 km by boat
- The transportation causes an annual CO<sub>2</sub> emission of 140.000 tonnes.



## Shift towards hard-rock aggregates

| Type/production      | 2002<br>Ktonnes | 2008<br>Ktonnes | 2013<br>Ktonnes |
|----------------------|-----------------|-----------------|-----------------|
| Hard-rock aggregates | 35000           | 54000           | 66000           |
| Sand and gravel      | 15000           | 15000           | 14000           |

The resource/production ratio of natural sands is low in parts of Norway



## Predictions

- No decrease in demand
- Decrease in offer?
- Fewer, bigger quarries
- Shift towards manufactured sand
- Recycling?
- Landfill?
- Harbour terminals for megaquarries?
- Underground quarrying?
- Need for better material characterization



You are all invited!

November 18-19  
at NGU, Trondheim

**NORDIC AGGREGATES  
AND STONES –  
INFORMATION AND  
COLLABORATION**

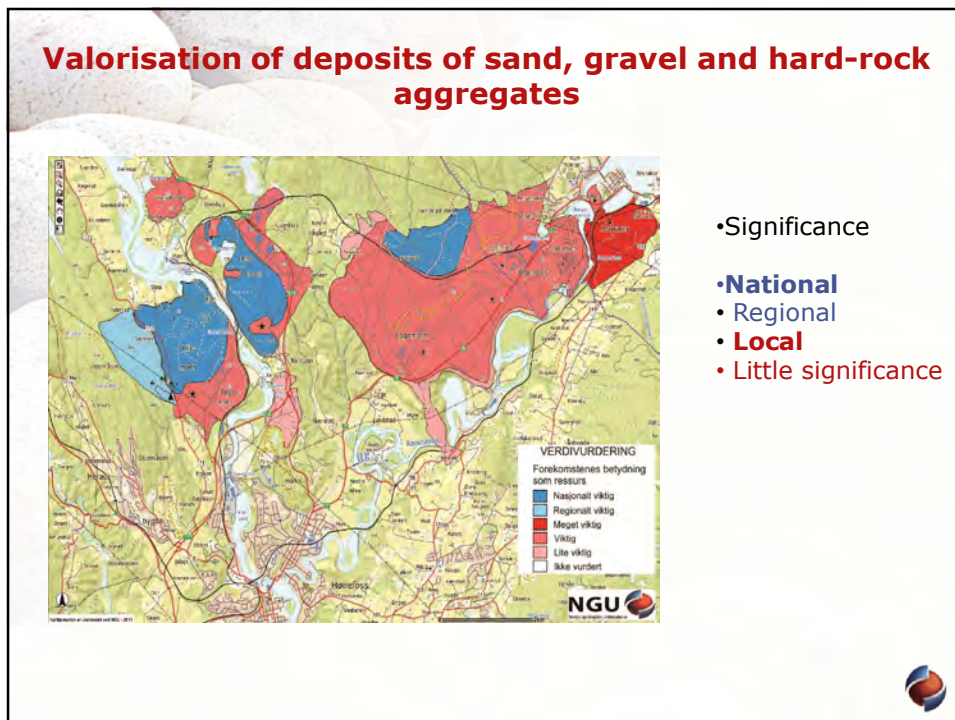
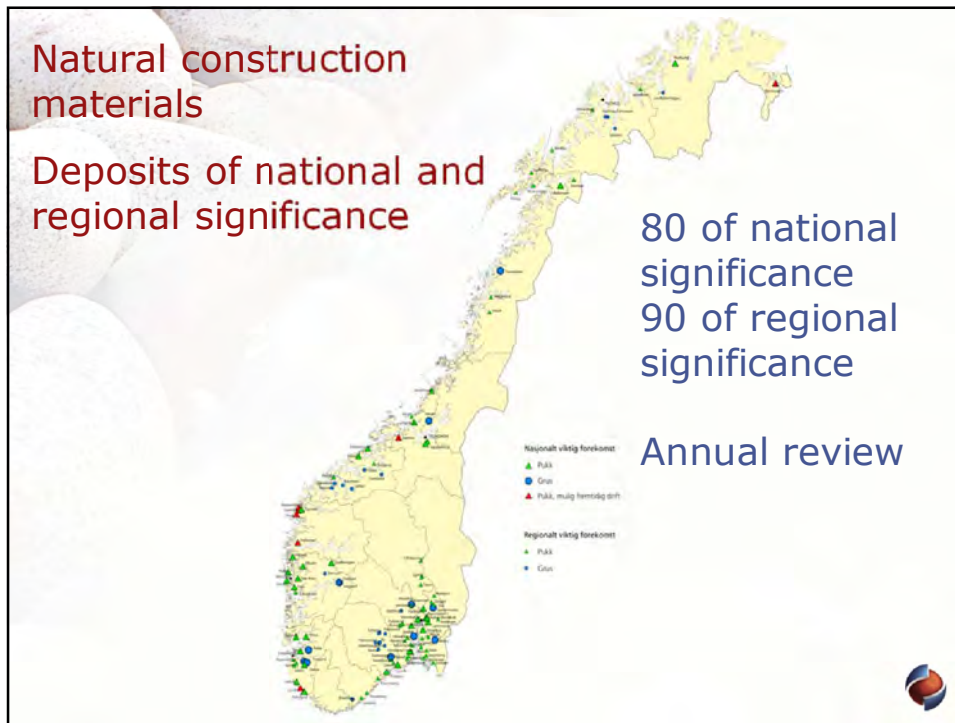


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Geological Survey of Norway









## Public Management of Geological Resources

Olav Hallset, Norwegian Mineral Industries



### How to secure Norway's aggregate supply?

10 tons of aggregates pr. person pr. year



## Mineral Strategy

- Presented by the Ministry of Trade and Industry in March 2013
- Shows great expectations to the Norwegian mineral industry in the years to come
- High hopes for increased sustainability and environmental standards
- The new government continues the work of its predecessors



## The mineral industry is considered a key policy area

- Parliamentary Elections one year ago won by liberal/conservative coalition
- The Government will pursue an active policy for the High North
- Seeks to intensify the exploration of mineral deposits in the Northern counties
- Very positive signals in the new government's political platform was presented on October 7<sup>th</sup> 2013
  - The mineral industry is considered to be a **key policy area**



## Future supplies in the hands of local governments



## Cooperation, communication, knowledge



Simple tool for difficult task: A [movie](#) to open peoples eyes



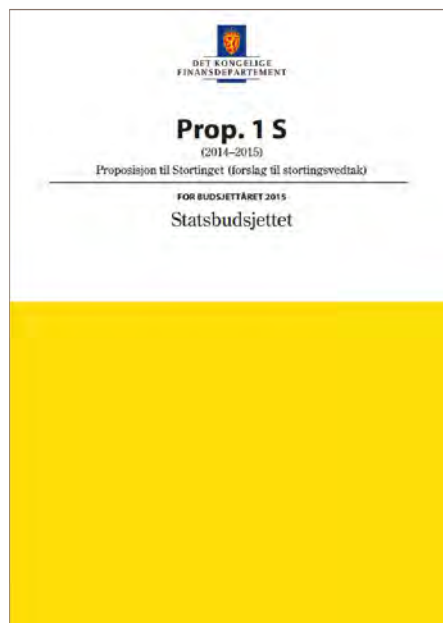
## A man with no colleges

Region Geologist in  
Buskerud, Telemark and  
Vestfold, Sven Dahlgren



## State budget 2015

- Presented on October 8. 2014
- This government's first original budget
- Substantial increase on infrastructure development means increased need of aggregates



## Challenges

- Need to increase knowledge about geological resources within both national, regional and local governments
- Need for more predictable and less time consuming planning processes
- Need for enhanced communication between national and local governments in order to implement means to reach goals set out in the Mineral Strategy



## Possibilities

- The mineral industry is pointed out as a key policy area by the new government
- The state budget includes NOK 55 billion to infrastructure – very positive for the aggregate industry
- The new government are well aware of the challenges with unpredictable planning processes

## Thank you for your time

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