Mineral dust emissions generated in Norwegian surface mineral production – sources, requirements and monitoring programmes

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Outline of the presentation

This presentation deals mainly with
• dust emissions from mineral production to the ambient air (ext. environment)
• monitoring of dustfall at the neighbourhood of 6 mineral production plants
  – Chosen from monitoring programmes implemented at approx. 30 plants
• An empiric model for estimating suspended dust from dustfall
Summary

- Mineral production plants* emit dust to the ambient air
- Monitoring of dustfall indicates that the dust emission rates at the six mineral production plants are lower than the “limit value”
- Paradoxically, health risk evaluation from dust exposures are made different for
  - Work environment air quality: Concentration, time of exposure, individual sensitivity and composition
  - Ambient air quality: As work environment but minus composition
  - *Quarries, gravel extraction, crushing plants, concentrators etc.
Summary

• The sources of dust are always present
• New or changing processes may cause new sources and new dust emissions
• Spreading of dust depends strongly on meteorological effects
• Mineral dust may cause health, amenity and environmental impacts
• The mineral industry meet increased focus and tougher requirements to both ambient and work environment air quality?
• Conflicts are registered
What is dust or particulate matter (PM)?

Particles matter (PM)/dust in air
- Mineralogical part
- Organic (Insect & plant fragments, pollen, combustion products, soot and oil)
- Other (sea salt spray, textile fibers and droplets)

Total suspended PM in air (max. size 300-400 µm)
- > 75 µm (dustfall)
- < 75 µm (suspended dust)
- PM$_{10}$ (inhalable fraction)

Particle travelling distances - examples (Péwé, 1981):
- 5-50 µm → 100 km
- 1-10 µm → n·1000 km
- < 2 µm → enters troposphere, very long distances

*Particles with sizes < 10 µm (PM$_{10}$), are hardly visible in air!*
Dust emission examples

Dust emission from a quarry

Dust deposited on tree leaves (near sand blasting facility)
Sources of particulate matter

Mineral production:
- Blasting
- Loading and rock handling
- Crushing & sieving
- Transport (conveyors, vehicles etc)
- Ground areas
- Stockpiles
- Land fills
- Roads

Other:
- Public traffic/sand on icy roads
- Other industry
- Wood burning stoves
How do neighbours experience dust problems?

• Visible dust in the air (at the quarry)
• Dust depositions on
  – Buildings, cars, garden furniture etc.
• Fear of dust causing health impacts
• An additional drawback to
  – Vibrations, noise and traffic (trucks)
• Ambient environment pollution
• Less attractive real estate – value losses
# Particulate matter (PM)- legislation

Requirements to concentration of particulate matter

<table>
<thead>
<tr>
<th>Particulate matter (PM)</th>
<th>Average</th>
<th>Limit value</th>
<th>Max. excesses/ nonconformances</th>
<th>Evaluation limit (U/L/max.)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Air quality (AQ):</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Suspended dust PM$_{10}$</td>
<td>24 hour 365 days</td>
<td>50 µg/m³</td>
<td>&lt; 35 times/year</td>
<td>U: 30 µg/m³ -7x L: 30 µg/m³ -7x</td>
</tr>
<tr>
<td></td>
<td>40 µg/m³</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dust deposition</td>
<td>30 days ±2days</td>
<td>5 g/m²/30days</td>
<td>0 times / one year monitoring</td>
<td>d &lt; 500 meters</td>
</tr>
<tr>
<td><strong>Working environment – administrative norms (AdN):</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mineral dust (inert dust)</td>
<td>8 hour / 40 hour week</td>
<td>Tot: 10 mg/m³ Res: 5 mg/m³</td>
<td>EU-proposal for respirable silica: 0,05 mg/m³</td>
<td>Exp&lt;¼ AdN → OK!</td>
</tr>
<tr>
<td>Quartz</td>
<td>8 hour / 40 hour week</td>
<td>Tot: 0,3 mg/m³ Resp:0,1 mg/m³</td>
<td></td>
<td>AdN&gt;Exp&gt;¼AdN → monitoring &amp; contr. action evaluation</td>
</tr>
<tr>
<td>Asbestos</td>
<td>8 hour / 40 hour week</td>
<td>0, 1 fibre/m³</td>
<td></td>
<td>Exp&gt;AdN → Cause? Immediate control actions!</td>
</tr>
</tbody>
</table>
Monitoring dustfall

- Monitoring according to:

- Result
  - Total dustfall
  - Mineralogical dustfall
  - Organic dustfall

Dustfall [grams/m²/30days]
**Monitoring dustfall**  
**Six cases/companies, 17 sample locations**

<table>
<thead>
<tr>
<th>Case</th>
<th>Sample locations</th>
<th>Source descriptions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1-1; 1-2</td>
<td>Stockpile at pier</td>
</tr>
<tr>
<td>2</td>
<td>2-1; 2-2; 2-6</td>
<td>Tailings disposal, main road</td>
</tr>
<tr>
<td>3</td>
<td>3-1; 3-2; 3-4</td>
<td>Industrial area, factory point sources</td>
</tr>
<tr>
<td>4</td>
<td>4-2; 4-4; 4-6</td>
<td>Industrial area, factory point sources</td>
</tr>
<tr>
<td>5</td>
<td>5-1; 5-2; 5-3</td>
<td>Aggregates plant, open pit, industrial area</td>
</tr>
<tr>
<td>6</td>
<td>6-1; 6-2; 6-3</td>
<td>Aggregates plant, open pit, industrial area</td>
</tr>
</tbody>
</table>
Dustfall monitoring results

Monitoring of dustfall rates

Plotted from data presented in table 2 in the SDIMI2007 conference proceedings!
Case 4 Seasonal variations
Period May 1998 – March 2004

Case 4 - Composition of particulate matter

S = Summer season (1. April – 30. Sept.)
Empiric model for estimating suspended dust from dustfall

Parallel monitoring of traffic situations in Trondheim, Norway (Hedalen, 1997):

- Suspended dust concentration (PM10) and dustfall
- Covariation between PM10 and dustfall
- Development of empiric model

Equations:

PM10,AVERAGE(x) = 2.5·x + 7.8 (1)
PM10,MINIMUM (x) = 0.7·x + 7.8 (2)
PM10,MAXIMUM(x) = 4.7·x + 13.1 (3)

x: Total rate of dustfall [g/m²/30 days]
PM10: Suspended dust concentration [µg/m³]
Parallel monitoring
Estimated & measured dust in suspension


* Estimates of suspended dust concentrations are based on dustfall

** Measured PM10: Sequential Air Sampler, type EK
Monitoring results
The six cases – susp.dust estimates

Plotted from data presented in table 3 in the SDIMI2007 conference proceedings!
To minimise ambient environment dust problems

You need to focus on:

• HSE management
  – Setting goals
  – Daily follow-up at the plant

• Control actions - evaluate and implement

• Inform, educate and train your employees

• Inform your neighbours

• Take your neighbours seriously – dialogue is extremely important to avoid conflicts!
Control actions

• Water sprays, chemicals, foam
• Equipment covers, e.g. conveyor covers combined with dust filters
• Mine area rehabilitation
• Monitoring – incident – activity planning
• Organisational actions
• Maintenance improvements (equipment and vehicles).
Conclusions

- Monitoring of dustfall show rates being lower than 5 grams/m²/30days (acceptable level)
  - At the six cases/companies (17 sample locations)
  - Also low levels compared with city traffic situations
- Seasonal variations can be seen
- Organic contents up to 80%
- Increasing contributions from other dust sources at distances over 500 meter
- Increasing focus on dust emissions to amb.air
  - neighbours, society, mass media, pollution control authorities, environmentalists and other