

Fate and effects of dispersed oil

Examples from research projects 2001-2008

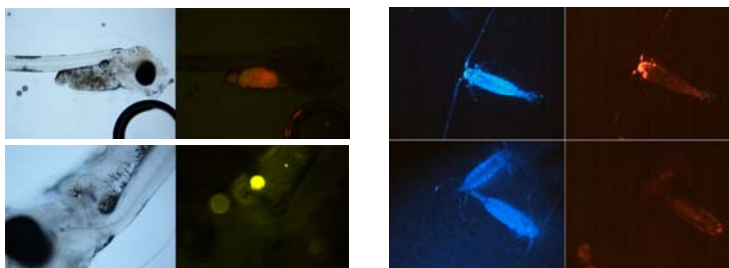
Effects of Dispersed Oil Workshop
Anchorage, March 2008

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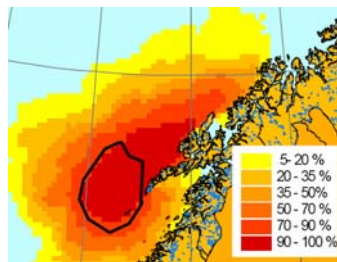
Outline of presentation

- Identification of knowledge gaps
- Overview of recent research on fate and effects of dispersed oil on cod larvae and *Calanus finmarchicus* at SINTEF
- Recommendation for further research



Identification of knowledge gaps

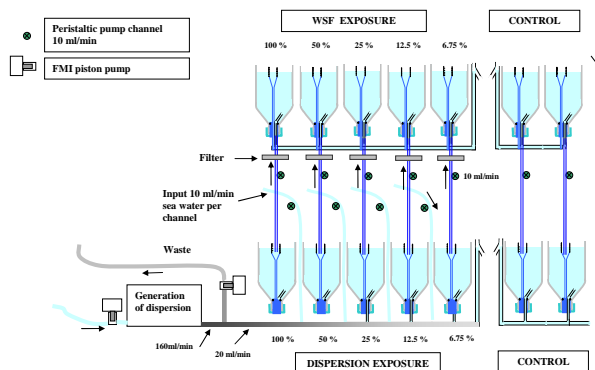
- Earlier experimental work adopted methodology from Concawe for preparation of dispersed oil in ecotox-studies
 - For acute oil spill situations, the size distribution in earlier experiments was not realistic or controlled
 - The assignment of water soluble and particle-bound oil compounds was not clear
- An regional risk assessment of oil and gas production in northern Norway (“ULB 2003”) identified dispersed oil as a significant environmental risk in the water column



Overview of recent research on fate and effects of dispersed oil

Controlled generation of oil dispersions

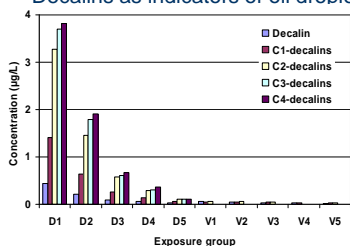
- Realistic, reproducible and documented size distributions



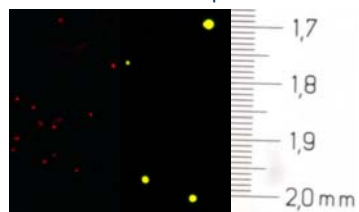
Overview of recent research on fate and effects of dispersed oil

Controlled generation of oil dispersions cont.

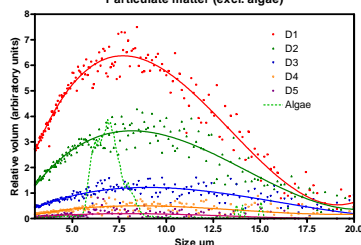
Decalins as indicators of oil droplets



Visualisation of oil droplets

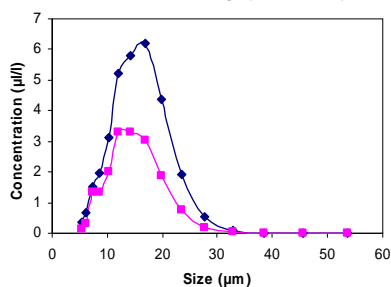


Particulate matter (excl. algae)

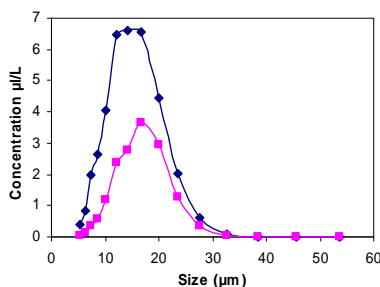


Controlled generation of oil dispersions

Size distribution of droplets Troll 200+ residue at different loadings (50 and 100%)

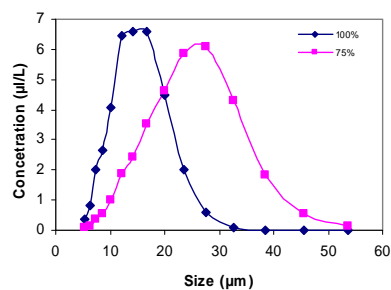


Size distribution of droplets Skarv 200+ residue at different loadings (50 and 100%)



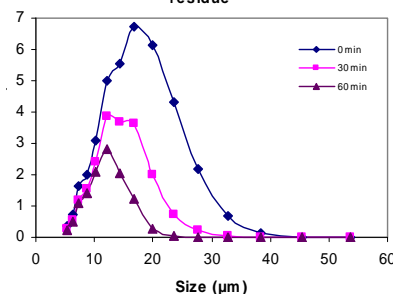
Changing energy input – changed size distribution:

Size distribution of Troll 200+ residue at
different energy inputs



The effect of settling – changed size distribution and concentration:

Size distribution during settling in stagnant
water (20 mm water column); Troll 200+
residue



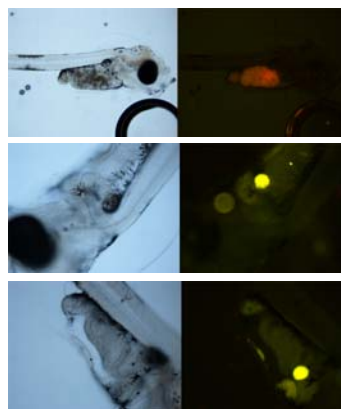
Overview of recent research on fate and effects of dispersed oil

Exposure of cod larvae – uptake and distribution

Control
No bile

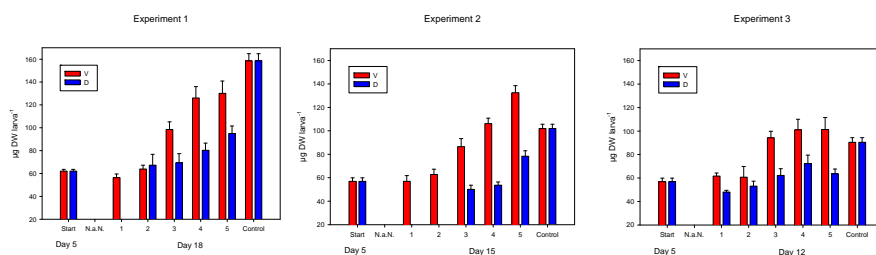
WSF
Metabolites in bile
Dependant on
concentration

Dispersion
Metabolites in bile
Dependant on
concentration



Overview of recent research on fate and effects of dispersed oil

Exposure of cod larvae – effects on growth



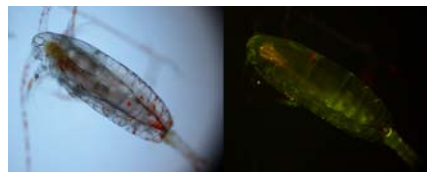
Exposure to dispersed oil affects growth of cod larvae

Overview of recent research on fate and effects of dispersed oil

Exposure of *Calanus finmarchicus* – uptake and distribution

Low concentration:

→ The copepod is able to feed; uptake via food



High concentration:

→ Oil droplets are attached to the body and mouth; the copepod is unable to feed



The toxicity of oil dispersions

- Main objective: Determine the relative contribution of particulate and dissolved oil to toxicity

- Results are to be used in estimating the toxic impact of oil in water dispersions based on
 - on oil concentration,
 - oil composition
 - oil droplet size distribution

The toxicity of oil dispersions cont.

- Methodology
 - Generate dispersions of known concentration (composition) and droplet size distribution
 - Determine the toxicity of the dispersions
 - Calculate the concentration of dissolved components (from dissolution theory)
 - Calculate the toxicity of the dissolved phase by the unit toxicity model
 - Determine the contribution of dispersed oil from the difference between the total mixture toxicity and the toxicity of the dissolved phase

Suggestion for further research

- Continue ecotox-testing on relevant organisms under realistic conditions
- Create and validate data and knowledge on fate of dispersed oil for incorporation in numerical models;
 - Droplet formation
 - Coalescence
 - Adsorption characteristics – particles in the water column and sediment
 - Surface properties as function of time (“skin formation”)
 - Biodegradation – persistent compounds?

This work has been carried out by:

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- Sonnich Meier, Anders Mangor-Jensen and Bjørn Einar Grøsvik – Institute of Marine Research
- Anders Olsen – NTNU
- Dag Altin – Biotrix

- The work has been funded by StatoilHydro, National Research Council of Norway and OLF

THANK YOU FOR YOUR ATTENTION!