

Subsea releases of oil and gas

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SINTEFs laboratory for studying subsea releases of oil and gas

Oil droplet sizes are important for the fate of subsea releases of oil and gas. The oil droplet sizes strongly influence;

- Position & size of the surface oil slick
- Thickness & persistence of surface slick
- Possible environmental impact both in the water column, at the surface and in the coastal zone

Subsea releases has been one of SINTEFs Environmental Technology's main research areas since the mid-nineties and culminated with an experimental deepwater oil and gas release at 940 meter (DeepSpill).

SINTEF and Statoil established the TowerBasin in 2005 and the activity were increased by the DWH deepwater release 2010. The SINTEF TowerBasin is 6 meters high, 3 meters wide and holds 42 m³ of natural sea water. The tank is equipped with an advanced system for releasing oil and gas, and monitoring oil droplet size distributions and oil concentrations in the released plume.

Main monitoring systems in TowerBasin:

1. LIST 100X Particle size analyser (2 - 500 µm)
2. LISST HOLO (10 - 2 000 µm)
3. SINTEF Silhouette Camera (30 – 12 000 µm)
4. Sampling of water and oil for analysis (e.g. IFT)
5. Video - HD cameras at 2-10 positions along the rising plume

The TowerBasin is operated together with the smaller MiniTower and the Inverted Cone system. The MiniTower (1 meter high, 100 Liter) is used for standard effectiveness testing for subsea injection of dispersants.

The Inverted Cone system simulate individual rising oil droplets and was established in close cooperation with University of Hawaii.



All three instrument platforms lowered and ready to initiate an experiment. The squared release platform can be seen in the middle on the bottom of the tank.



TowerBasin experiment with the 32 mm nozzle and 120 L/min of Oseberg blend (left)



TowerBasin experiment with SIT injection of 1% C9500 (right).

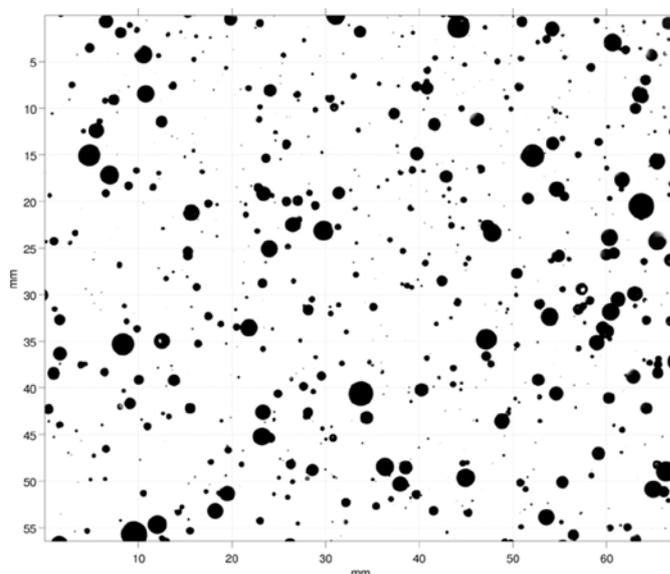
Examples of type of project performed in SINTEF's laboratory for subsea releases of oil and gas.

- Initial oil droplet formation as a function of (TowerBasin & MiniTower;
 - a. Release diameter (0.5 – 50 mm)
 - b. Oil release temperature
 - c. Oil properties
 - d. Injection of different dispersant products
 - e. Using different injection techniques
 - f. Hydrostatic pressure (in cooperation with SwRI, Texas)
 - g. Mechanical subsea dispersion
- Droplet coalescence and splitting of droplets after initial formation (TowerBasin).
- Maximum stable droplet size for rising oil droplets versus oil properties and dispersant injection (Inverted Cone).
- Tip streaming as a possible process for secondary droplets splitting (Inverted Cone).
- Standardized bench-scale dispersant effectiveness testing for subsea injection (MiniTower).

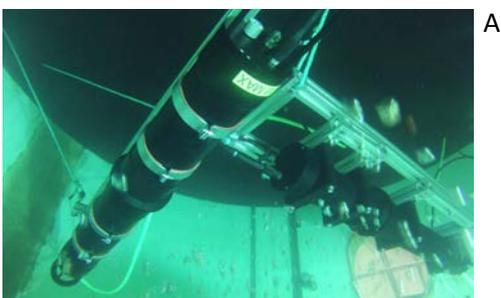
These projects have been funded by industry groups (e.g. API, OGP, IPIECA), individual oil companies or authorities.



SINTEF MiniTower can be used as a bench-scale test for subsea dispersant effectiveness



Images from Silhouette cameras showing individual droplets (25 mm nozzle, 50 L/min in the multiple mm range)

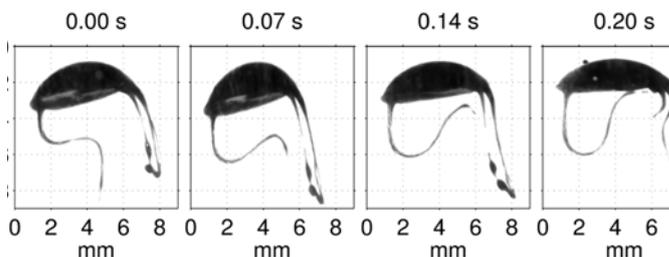


A



B

TowerBasin experiments showing two silhouette cameras in the top section of the tank (1 meter depth), before (A) and under release of oil (B).



Sequence of 4 images from the Inverted Cone system showing a large tip-streaming droplet (4-5 mm) after treatment with 2% premixed dispersant (DOR 1:50).



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