

Occupational exposure during treatment of offshore drilling waste

Aim: To assess the occupational exposure for workers recycling offshore drilling waste

Pål Graff¹, Anne Mette Madsen², Hanne Line Daae¹, Nils Petter Skaugset¹ and Kari K. Haldal¹

¹National Institute of Occupational Health, Pb 5330 Majorstuen, N-0304 Oslo, Norway

²The National Research Centre for the Working Environment, Lersø Parkallé 105, DK-2100 Copenhagen Ø, Denmark

Email: hanne.l.daae@stami.no pal.graff@stami.no

Introduction:

Concern has been raised about health effects from potential exposures for workers that are recycling offshore drilling mud. Nausea, headache and throat problems have been reported. Also knowledge about the occupational exposure at the land-based treatment of offshore drilling waste is insufficient.

The drilling waste from the offshore industry consists mainly of three fractions; mud, drill cuttings and slop water. Mud is mainly drilling fluids (water or oil-based), oil-water emulsions and chemical additives to lubricate and stabilize the drill bit. Drill cuttings are small pieces of oil-contaminated rocks originating from the drilling operation. Slop water is oil-contaminated water from drilling operations and different cleaning procedures offshore.

This study aims to describe the occupational exposures for workers employed in the recycling of offshore drilling mud.

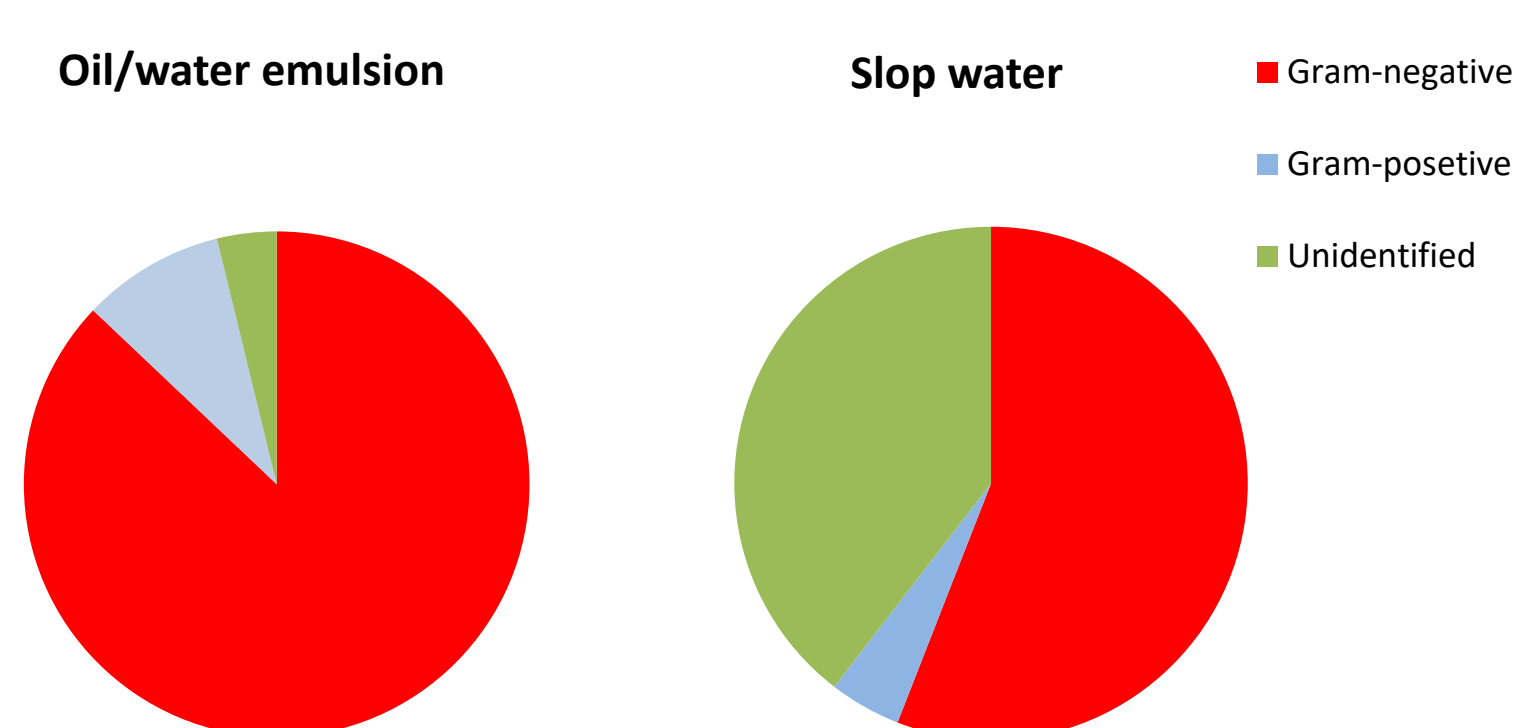
Methods:

- Five plants working with recycling of offshore drilling mud were included in this study.
- From two to seven employees at each plant participated in the sampling. In total 90 work shifts (8 h) were included and the measurements were carried out during winter and summer, to cover seasonal variations.
- The occupational exposure to oil mist, oil vapor, solvents, volatile organic compounds (VOC), endotoxins and hydrogen sulphide (H₂S) in air were performed by personal sampling.
- Bacteria in bulk samples were identified using both MALDI-TOF MS Biotyper System and shotgun sequencing. Airborne bacteria in stationary samples were identified using MALDI-TOF-MS.



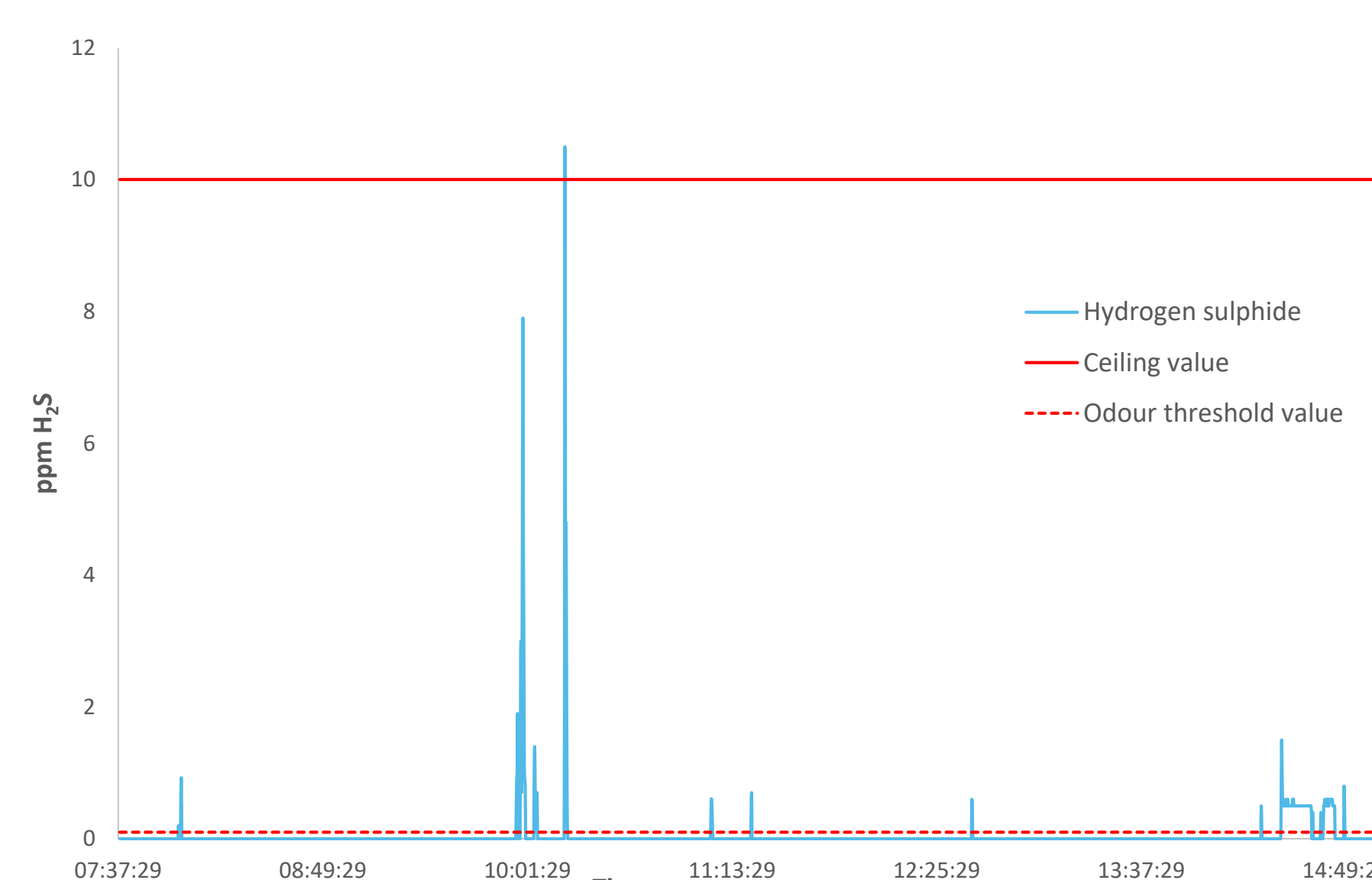
Results:

Bacteria in bulk samples from a Norwegian drilling waste treatment plant



- High concentration of bacteria (2-4 x 10⁴ CFU/mL)
- High diversity (Shannon index of 5.7) with a large fraction of Gram-negative
- Several genera or species belonging to risk group 2 agents were found, examples are *Klebsiella oxytoca* and *Enterococcus* spp. (*aquimarinus*, *avium*)
- Endotoxin measurements performed during winter revealed a median concentration of 5.4 EU/m³ (1-40 EU/m³)

H₂S- measurements



- Most of the higher H₂S values were recorded in connection with the slop water cleaning process
- Levels above the odour threshold of 0.1 ppm was measured at four plants
- H₂S was measured above the Norwegian ceiling value of 10 ppm at one plant

Oil mist exposure

Season	Sample	(n)	GM mg/m ³	Median mg/m ³	SD mg/m ³
Summer	1 (0 - 2 h)	66	0.09	0.10	0.091
	2 (2 - 4 h)	64	0.08	0.07	0.075
	3 (4 - 6 h)	58	0.09	0.09	0.066
	TWA (~6 h)	67	0.09	0.09	0.066
Winter	1 (0 - 2 h)	23	0.13	0.16	0.079

- The median exposure to oil mist are below the Norwegian occupational exposure limit (1 mg/m³)
- The winter measurements were higher than summer measurements for oil mist
- No exposure variance during the day was found

Conclusions:

- Despite moderate exposure levels to endotoxins in the working atmosphere (median level of 5.4 EU/m³) high concentrations of gram-negative bacteria were found in the bulk samples
- Several pathogenic species of bacteria were found in the bulk samples and exposure to these might be a potential health hazard to workers
- Exposure levels for all exposure measurements were below the Norwegian OEL
- The exposure for hydrogen sulphide was above the odour threshold limit and may cause unpleasant working conditions
- The exposure levels for oil mist, oil vapor and endotoxins were higher during winter than summer