

# RF - Akvamiljø

*RF-Akvamiljø is a Centre for environmental research in aquatic environment. The three affiliated companies: RF-Rogaland Research, Akvamiljø a/s and Akvamiljø Caspian AS with 45 scientists and engineers provide advanced research and services within ecotoxicology, environmental risk assessment, monitoring, field- and laboratory experiments and analyses. Akvamiljø Caspian performs environmental consultancy/research in the Caspian region and operates a laboratory - in Baku, Azerbaijan - according to GLP standards.*

## Akvamiljø Caspian

*Akvamiljø Caspian AS (AmC) is a Norwegian company with a subsidiary office in Baku, Azerbaijan - Caspian Environmental Laboratory (CEL). CEL delivers high quality laboratory and consultancy services to the oil and gas industry in the Caspian region. CEL comply with western quality standards and will soon obtain ISO standard accreditation.*

AmC was established in 2002 by Akvamiljø a.s. (part of the Rogaland Research group) of Norway and the international laboratory group Eurofins. AmC took over CEL, which was created in 1998.

CEL is staffed with an experienced team of Azeri scientists, and is equipped with a comprehensive range of modern analytical equipment, together

with first-class biology and ecotoxicology laboratories. CEL maintains unique cultures of marine organisms for toxicity testing, and holds a comprehensive reference collection of Caspian marine invertebrates for taxonomic purposes.

Together with the local staff AmC consultants in Baku can provide services in the Caspian region with extensive support from RF-Akvamiljø and Eurofins. These services cover:



*Oil field in Baku*

- Environmental survey
- Chemical analysis
- Toxicity testing
- Environmental management
- Risk assessment
- Waste management
- Ecological studies
- Seabed mapping
- Atmospheric monitoring

AmC has started a development and expansion of its current capabilities, with the assistance of the expertise and resources of its parent organizations. Some key areas of development and expansion are: contaminated land, ground water, drinking water, ecotoxicology research, biomarker application and Pan-Caspian R&D Activities.

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# Five new NFR projects at RF-Akvamiljø

The Norwegian Research Council (NFR) has launched a new program about long term environmental effects of produced water (Fig 1) and other discharges from the offshore petroleum industry. This program (PROOF) succeeds the NFR-ProFo programme as source of funding for environmental studies offshore. In 2002, RF-Akvamiljø obtained new grants for three short term and two long term projects (see project list).

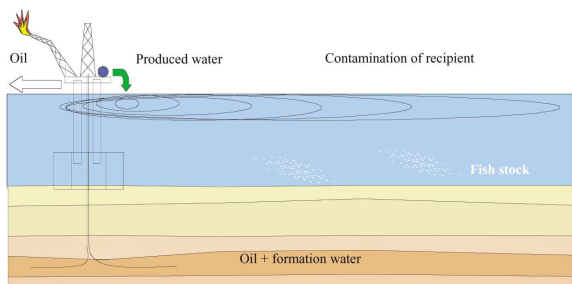


Figure 1: Produced water (PW) is formation water that has been separated from the oil and gas during production. The PW is injected back to the formation or discharged to the sea. In case of the latter solution, PW constituents such as PAHs and APs may contaminate fish stocks in the area.

The first two projects address produced water (PW) effects in fish. The emphasis is put on effects of polyaromatic hydrocarbons (PAHs) and alkylphenols (APs), since both these chemical classes are well represented in PW, and since both are of concern with regard to possible impact on offshore fish stocks (e.g. Figure 2 and 3). The main objectives are to develop better and more sensitive biomarker tools and to provide relevant field data based on analyses of fish collected at the Tampen field; which is a region where large volumes of PW are discharged.

The third project is a pre-study of the mechanisms behind the release of PAHs from oil microdroplets in seawater; an insight that is needed for predicting the potency of PAH uptake in organisms that are exposed to PW in the water column.

The fourth project is a pre-study addressing problems related to the many piles of contaminated drilling discharge in the North Sea; an issue

becoming pertinent as more oilfields enter a decommissioning phase. This issue is particularly relevant for "new" areas of exploration like the Arctic and the deep-sea where the environmental sensitivity is uncertain. More details of the drill cuttings project are given on page 4 in this newsletter

The fifth project addresses the systems for risk prediction and impact assessment of offshore discharges. The overall scope is to achieve better predictions and monitoring of ecosystem health parameters offshore. Further details of this three-year project will be presented in the next newsletter.

The importance of collaboration has been strongly emphasized by NFR, and several partners are therefore taking part in the current RF-Akvamiljø's projects – among them are SINTEF and NIVA. Also foreign scientific expertise has been brought into our projects to obtain well qualified results in certain topics. In addition to the five projects described here, RF-Akvamiljø has in 2002 also become involved in several new NFR projects managed by others; one example is a ProFo project on PW issues managed by the Institute of Marine Research (Havforskningsinstituttet).

Overview of new NFR projects assigned in 2002:

- 152449/720: GC/MS determination of produced water related PAH and alkylphenol metabolites in marine fish. (01.07.2002 – 01.09.2003).
- 153898/720: Pollutant exposure and effects in fish related to the discharge of produced water in the North Sea oil industry (2003-2005).
- 152450/720: Hydrocarbon release from oil droplets to seawater: experimental and computational verification of a model (01.07-31.12.2002).
- 152451/720: Impacts of metals from drill cuttings and mud to the marine water column (01.07.-31.12.2002).
- 153882/720: Validation of methods and data for Environmental Risk Assessment offshore (2003-2005).

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# European scientists together against the environmental pollutants....

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To get a better understanding of the adverse biological effects of chemicals released to the environment, scientists from 31 different institutes (located in 12 countries) are collaborating in an EU sponsored project called BEEP (Biological Effects of Environmental Pollution). The project is divided into 5 work packages. RF-Akvamiljø is coordinating and managing one of the work packages and has during the past 6 months organised 3 controlled laboratory exposure studies where all BEEP participants were invited to take part in the sampling of fish, mussels and crabs. In the last sampling (in April) 40 scientists from 10 countries were "fighting" over pieces of fish-liver or drops of mussel blood.... Read more about this in the next Newsletter.

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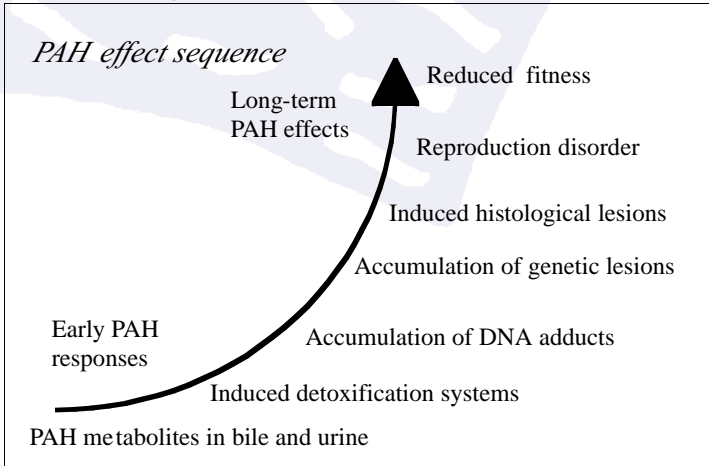
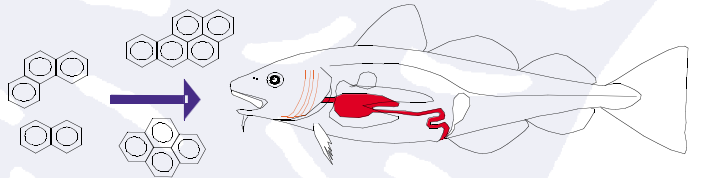


Figure 2: In fish exposed to polyaromatic hydrocarbons (PAHs) various genotoxic effects can be detected in the liver and in other organs. In case of prolonged exposure late effects such as neoplasms may be induced.

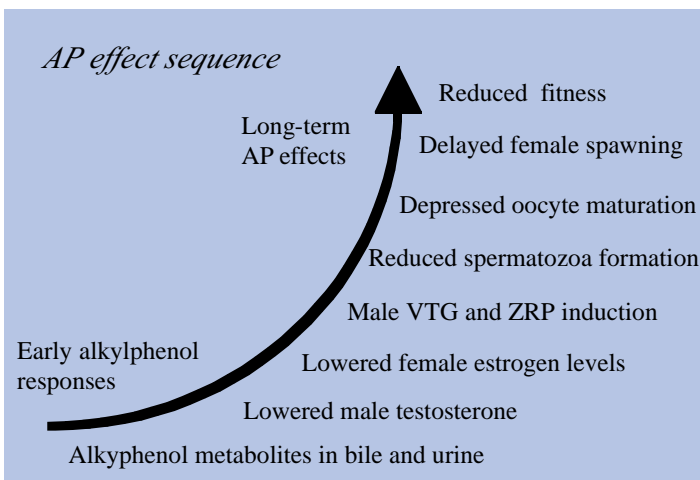
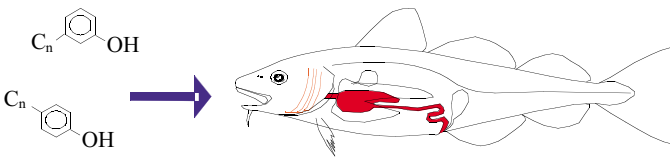


Figure 3: In fish exposed to alkylphenols (APs) the endocrine control of vital functions such as egg development and spawning may be affected.

# Metals from drill cuttings and their impacts on the water column

Impacts from drilling discharges may arise from metal contamination of drilled cuttings and muds. Barite and ilmenite are of particular concern, as they are mainly used as weight substances in drilling mud. Large quantities of these metals are discharged during and after drilling operations. It is assumed that metal contamination in barite is strongly bound to the particles and consequently not very available for biota. However this is not well documented. Barite and ilmenite particles are small and have low



sinking rates and will thus be transported far away from the discharge point. Leakage of metals from the particles might have considerable implications for the environment because of the large quantities discharged and the spreading conditions. With this background, the leaching, and subsequent bioavailability, of metals were studied using a sequential extraction technique.

The intentions of the examination were:

1. to identify the metals having the largest potential for being harmful,
2. to examine whether the metal leaching was affected by biotic and abiotic influences such as reducing, aerobic and anaerobic conditions,
3. to compare the potential toxicity of new and used formulations of varying composition

Some metals were considerably more mobile than others, and it was found that the "new" weight material ilmenite had considerably less mobile and total metal levels than barite. Further, the mobility of metals was found to be lower in oil based drilling formulations (OBM) than in water based formulations (WBM). It is suggested that this is a result of the oil phase forming a film around the particles and by that reducing the extractability of the metals. It is not known whether this is rele-

vant for natural leaching or not. The toxicity tests concluded that ilmenite formulations are less toxic than barite formulations. Furthermore, formulations exposed to anoxic conditions were more toxic than their aerobic counterparts. Microbial activity seems to influence the toxicity of formulations.

This pre-study, together with previous work performed by RF-Akvamiljø and others, has formed the basis for a project proposal to the PROOF program. The objective is to clarify the environmental hazards of drilling formulations, including further studies of metals, with special focus on potential effects in the water column.

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