Version 2 Diesel exhaust particles 11072019

Short report from Danish Working Environment Authority´s (AT) Occupational exposure limit quality committee. Evaluation of the report: Diesel exhaust particles: Scientific basis for setting a health-based occupational exposure limit

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This report is based on a meeting 8th April 2019 at AT where the results from the report were discussed after the authors presented the content of the report. The members of the quality committee had the chance to ask questions to the authors.

The Report: Anne Thoustrup Saber, Niels Hadrup, Sarah Søs Poulsen, Nicklas Raun Jacobsen and Ulla Vogel. Diesel exhaust particles: Scientific basis for setting a health-based occupational exposure limit. The National Research Centre for the Working Environment (NFA) December 2018. Report available from www.nfa.dk

Overall evaluation of the report

The report reviews data relevant to assessing the hazard of diesel exhaust particles (DEPs) in humans and animals. Furthermore, toxicokinetics and mechanisms of toxicity are reviewed, and core previous risk assessments of DEPs s are summarized. The scientific basis for setting an occupational exposure limit (OEL) are presented and based on this, the authors suggest a health based OEL for DEPs.

In general, the report is well written with a clear structure and easy to follow. A table describing key characteristic for the three studies included in the meta-analysis used for risk assessment could have been helpful.

The committee judge the included literature in general to be sufficient and covering. The literature search was performed by a research librarian, and we recommend including details of searched databases and the search strings including dates for covering of the search as an appendix in the report.

DEE consists of gases (VOC, COx, NOx) and particles with a large surface area and can be regarded as a process-generated nanomaterial. Often elemental carbon are used as measure of DEP, and the authors regard this as the best marker of DEP. There is sufficient evidence of carcinogenicity of DEE, DEP, and DEP extracts in experimental animals, as well as sufficient evidence that DEE is carcinogenic to humans and causes lung cancer, and DEE is classified as a group 1 carcinogen by IARC (IARC 2014). There is very limited evidence from DEE emitted from "new technology" diesel engines and the DEP concentrations in the performed chronic inhalations studies with new technology engines in rats and mice were likely too low to induce detectable levels of cancer.

The authors chose to focus on studies dealing with occupational exposure by inhalation, and the committee supports that decision, as inhalation probably is the major route of exposure for DEP´s.

The authors were able to base the suggested health-based OEL on human data from epidemiological studies, but they also assessed DEP hazard based on experimental animal studies in order to support the human data. The committee supports the use of epidemiological data as the best suited data for setting a health based OEL for DEP, and we will not further evaluate the hazard assessed from animal studies. Of note, data from animal studies provided considerable higher DEP levels for excess lung cancer risk level compared to the estimations based on the epidemiological data.

The authors regard inflammation and carcinogenicity as the critical adverse effects, but because both DEP and NOx induces inflammation the authors abstain from using inflammation and assessed carcinogenicity as the critical adverse effects which is supported by the committee.

The authors states that both inhalation of DEE and instillation of DEP and DEP extracts is able to induce mutations in lungs of mice and conclude both primary and secondary genotoxicity of DEP is present, and the committee supports to consider carcinogenicity as a non-threshold effect.

The authors used estimates from a meta-analysis including 3 original studies in their risk assessment (Vermeulen et al. 2014b). All three studies had information on dose-response relationship between exposure to diesel exhaust quantified as elemental carbon and risk of lung cancer (Vermeulen et al. 2014b). All but one study had information about smoking, and the authors of the meta-analysis justify that smoking does not confound the result presented in the meta-analysis. All together the three included studies are regarded as high quality studies with low risk of bias.

Setting an occupational exposure limit for DEP

The present working group supports the decision to use the epidemiological data to derive OELs

Exposure was measured as elemental carbon in µg/m3-years. The intercept was set at 0, and the slope was determined to be 0.000982 with a standard error of 0.000219 based on Vermeulen et al 2014b.

The authors use Danish life time risk of developing lung cancer (0-74 years): 4.9% for men and 4.5% for women.

The quality committee support the author's recommendation: The expected excess lung cancer risk in relation to occupational exposure to DEPs is 1:1 000 at 0.45 µg/m3, 1:10 000 at 0.05 µg/m3 and 1:100 000 at 0.005 µg/m3.

Of note the risk estimates allowing 1: 10 000 excess lung cancer cases or less are all close to the current ambient air concentrations of elemental carbon (0.4 µg/m3 for rural measurements in Denmark (Massling et al. 2011) and 2.7 µg/m3 on a major street in Copenhagen, Denmark (Palmgren et al. 2003)

References

IARC. Diesel and gasoline engine exhaust and some nitroarenes. IARC Working Group on the Evaluation of Carcinogenic Risks to Humans. Vol. 105. IARC Monographs on the Evaluation of Carcinogenic Risks to Humans. Lyon, France: WHO; International Agency for Research to Cancer, 2014.

Massling A, Nøjgaard JK, Ellermann T, Ketzel M, Nordstøm C. Particle project report 2008 - 2010. Particulate contribution from traffic in Copenhagen. NERI Technical Report, No. 837. Aarhus, DK: National Environmental Research Institute, Aarhus University, 2011.

Palmgren F, Wåhlin P, Loft S. Luftforurening med partikler i København. En oversigt. Faglig rapport fra DMU nr. 433. København: Danmarks Miljøundersøgelser, Miljøministeriet, 2003.

Vermeulen R, Silverman DT, Garshick E, Vlaanderen J, Portengen L, Steenland K. Exposure-response estimates for diesel engine exhaust and lung cancer mortality based on data from three occupational cohorts. Environ Health Perspect 2014b;122:172-177.