Ship engine emissions adversely affect macrophages

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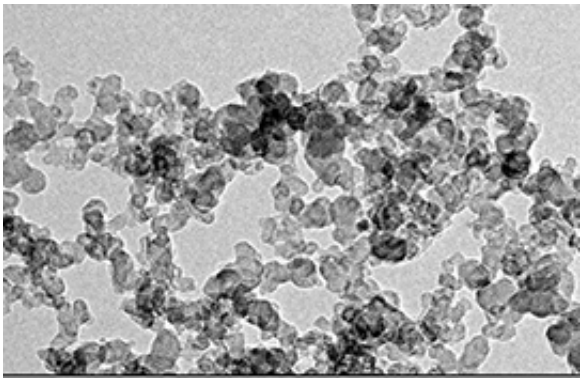

Soot agglomeratio created by of ship engine emissions. Source: University of Rostock

Ship emissions adversely affect the health of inhabitants of coastal regions. This was the main finding of a study on the influence of ship engine emissions on macrophages in the lungs conducted by scientists of Helmholtz Zentrum München and the University of Rostock in cooperation with colleagues of the University of Luxembourg, the Max Delbrück Center for Molecular Medicine, the Karlsruhe Institute of Technology and the University of Eastern Finland, which has now been published in the journal *PLOS ONE*. Since macrophages also play a key role in lung diseases such as COPD, the study is important for understanding the health risks of ship exhausts.

In 2015 the scientists already showed that exposure to particle emissions

from heavy fuel oil (HFO) and diesel fuel (DF) adversely affects human lung cells and is responsible for strong biological responses of the cells ("How Ship Emissions Adversely Affect Lung Cells" www.helmholtz-muenchen.de/en/p … cle/26995/index.html). For example, inflammatory processes are triggered that may influence the development of interstitial lung diseases. Now the team led by Professor Ralf Zimmermann has found in further studies that macrophages are also influenced by the exhaust gases. These are much more sensitive than lung epithelial cells and therefore react more strongly to exposure. Zimmermann is speaker of the international consortium Helmholtz Virtual Institute of Complex Molecular Systems in Environmental Health (HICE), head of the cooperation group Comprehensive Molecular Analytics (CMA) at Helmholtz Zentrum München and head of the Department of Analytical Chemistry at the University of Rostock.

"Macrophages are known as scavenger cells of the immune system and respond more sensitively to particulate matter in the lungs than lung epithelial cells, since they are the 'first line of response' against foreign invaders in the lungs such as germs or even fine dust particles," said Sean Sapcariu, first author of the study and doctoral student at the University of Luxembourg, a cooperation partner in HICE. "We found that the ship emissions of heavy fuel oil and diesel fuel had different effects on triggering pro-inflammatory reactions," said Sapcariu. Fine particles from heavy fuel oil emissions have a stronger effect on the development of pro-inflammatory reactions than particles emitted from diesel ship engines, but the latter more strongly influence other fundamental biological processes such as DNA-, RNA- and protein-synthesis.

"We then found that the emitted particles both from the heavy fuel oil and from the diesel exhaust had similarly high toxic effects on the macrophages. Surprisingly, the toxic effects leading to cell death are even slightly lower in the heavy fuel oil emissions, although the concentrations of known toxic pollutants in the heavy oil emissions are

much higher," Zimmermann added. "Foregoing the ban of the heavy fuel oil use in coastal shipping, as is currently propagated and partially already implemented via the current fuel-sulfur content regulations, is therefore probably less beneficial than expected for protecting the health of people in coastal areas. The simplest and safest way to mitigate these adverse health effects from ship engine emissions would be to introduce efficient particle reducing measures such as exhaust gas scrubbers and particle filters. These would precipitate the harmful fine particles from the emissions and thus reduce the adverse health effects, irrespective of the fuel used. Since such measures are generally not implemented on a voluntary basis, in our view there is an urgent need for action by policy makers in government and by national and European regulatory authorities."

More information: Sean C. Sapcariu et al. Metabolic Profiling as Well as Stable Isotope Assisted Metabolic and Proteomic Analysis of RAW 264.7 Macrophages Exposed to Ship Engine Aerosol Emissions: Different Effects of Heavy Fuel Oil and Refined Diesel Fuel, *PLOS ONE* (2016). DOI: 10.1371/journal.pone.0157964

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