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Author(s) Kajolinna, Tuula; Pellikka, Tuula; Pitkänen, Marja
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TECHNOLOGY FOR BUSINESS

Gas risk in freight container handling

Tuula Kajolinna • Tuula Pellikka • Marja Pitkänen
VTT Technical Research Centre of Finland Ltd

Introduction

Transport container traffic carries millions of containers worldwide. To protect transported freight and inhibit the spread of foreign species, the containers are fumigated with chemicals, some of which having effect to central nervous system. Gas components and concentrations should be known to define safe handling procedures for each container. The Finnish Work Environment Fund and VTT funded and performed project to collect the needed information, including ventilation times, to support future work to prepare instructions for the safe handling of containers.

Research methods

The literature part of the project studied the gases found in containers and their properties, as well as suitable measuring methods for measuring the concentrations of such gases. Experimental part focused on examining the ventilation times of containers with tracer gases.

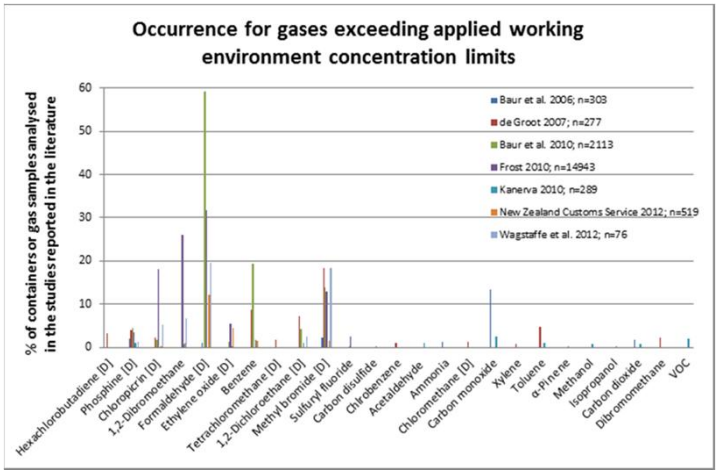

Figure 1. Occurrence for gases exceeding applied working environment concentration limits in freight containers. Data was collected from seven reports, covering measurement results from 18520 containers.

Compounds

About 80 different volatile compounds were found from published reports, including about 60 chemical substances classified due to their occupational health risk (Fig. 1). About 15 of those were known fumigants, others were supposed to be evaporated from the freight.

Generally used measurement devices

Methods typically used for the measurement of gas concentrations are indication tubes, small hand held detectors and gas analyzers. Their usability, detection limits and reliability vary a lot, as well as investment costs which can be from thousands of euros up to few hundred thousand euros.

Ventilation time measurements

Ventilation times of containers loaded with unfilled corrugated board boxes were tested using tracer gases of butane and nitrous oxide in field conditions. Butane tracer gas was selected to simulate low boiling gases like methylbromide and nitrous oxide was selected to simulate high vaporizing gases like carbon monoxide, oxygen etc. In this study three FTIR analyzers were used simultaneously. Test arrangement included two loading ratios, different temperatures (-18° and room temperature) and three different ventilation systems (natural, forced and suction).

As a result of ventilation time measurements, fully loaded containers had even 60 times longer ventilation time than partially loaded containers. Thus, the ventilation of containers can take even several days, depending on the load rate, temperature and ventilation procedures applied. Ventilation of room temperature containers were relatively quicker than in temperatures below zero degree.

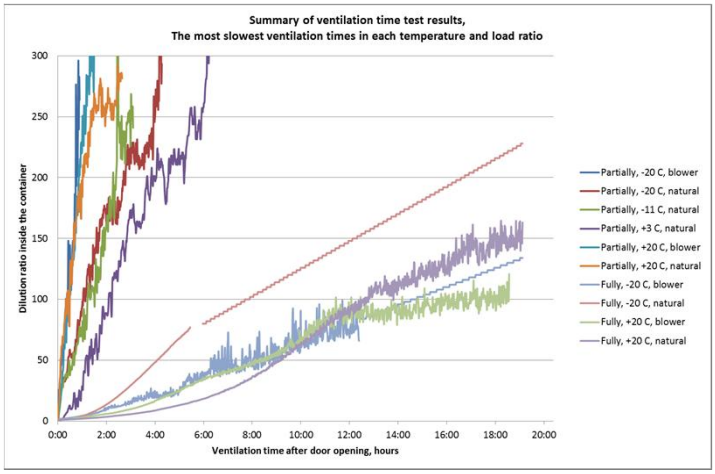

Figure 2. Longest ventilation time results of partially and fully loaded containers

Conclusions

Containers may contain many gases depending on cargo and fumigations, and measurement of those gases requires accurate gas analyzers, instead of indicative devices. Ventilation of the containers are important, but sufficient ventilation time depends on cargo, container type, load rate, temperature and existing gases.

At the moment, VTT carries out with Finnish Institute of Occupational Health (TTL) research in which the occupational exposures during the logistic chain are studied. Also development of the automated sampling system for container gas monitoring has been started.

Contacts
Tuula Kajolinna
Tel. +358 4056 24379
tuula.kajolinna@vtt.fi, www.vtt.fi

Työsuojelurahasto
Arbetarskyddsfonden
The Finnish Work Environment Fund