


MITIGATING EXPOSURE TO VOLATILE COMPOUNDS

PROOFING CONTAINERS

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To protect transported freight and inhibit the spread of foreign species, containers are always fumigated with chemicals and many of these are also dangerous to humans. Often, warning labels and proper documents regarding fumigant treatment are missing from containers, and based on recent inside air studies, freight containers may also contain concentrations of volatile compounds evaporated from cargo such as benzene, toluene and formaldehyde. These may originate from adhesives, paints or raw materials.

This article presents the study conducted by the VTT Technical Research Centre of Finland on the potential exposure of workers to harmful volatile compounds existing inside of freight containers and imported goods packages. The first part of the study focused on examining the ventilation of freight containers and its duration in different kinds of circumstances. These included type of loading, with or without mechanical exhaust ventilation, and testing at various different temperatures.

The objective of this study was to produce reliable research data and provide foundations for drawing up national occupational health and safety guidelines for container handling. The results were also utilized at work places in defining the appropriate and safe occupational health practices. The literature part of the study clarified the gaseous chemical compounds found in freight containers and their properties, as well as suitable measuring methods for measuring the concentrations of such gases. The second part of the research focused on the potential occupational exposures during unloading the containers and handling the imported goods along the logistic chain up to retail shop.

COMPOUNDS DETECTED IN CONTAINERS

In several published reports and scientific papers, the existence of over 80 volatile chemical compounds have been reported in freight containers, including about 60 chemical substances classified due to their occupational health risk. About 15 of those chemical substances turned to be fumigants, others were expected to have emanated from the freight. In some containers, the concentration of harmful volatile compounds exceeded its occupational exposure limit (OEL) meaning that it would be dangerous to enter without protective equipment or before performing other effective risk managing measures, such as sufficient ventilation.

During the study, we collected measurement results from seven reports and scientific publications covering over 18 500 containers in total. The data showed that formaldehyde and methyl

bromide were the most common toxic compounds existing in freight containers in concentrations above the applied OELs. Formaldehyde and methyl bromide are used as fumigants, but formaldehyde is commonly used in many industrial applications like in adhesives and in finishing agents intended, for example, for textiles. Also other fumigants, such as 1.2-dibromoethane, benzene, chloropicrin, ethylene oxide and 1.2-dichloroethane, were regularly detected in inside air of freight containers. Presence of phosphine was also reported in almost all reports.

VARIATION IN GAS MEASUREMENT DEVICES

Typically, indication tubes are employed as gas concentration measurement tools. 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. Measurement of the gases known to exist in freight containers requires accurate gas analyzers instead of indicative devices. The range of components to be measured is wide and the concentration ranges low. Today, there is no single commercial device which could reliably measure all the potential gaseous compounds at concentration ranges low enough.

EFFICIENT EXPOSURE RISK MANAGEMENT

During these studies, we learned that freight containers contain many gases depending on cargo and performed fumigations. As no single commercial device is capable of performing the measurement at concentrations low enough, several simultaneous measuring methods are needed, and the measurement of those gases requires accurate gas analysers, instead of indicative devices. Ventilation of the containers is important, and the sufficient ventilation time depends on cargo, container type, load rate, temperature and existing gases. During the studies, plenty of useful competence have been generated. Ports, transport companies and actors in the retail trade chains can utilise the competence created at VTT when defining the sufficient ventilation practices for the imported freight containers arriving to their distribution centres. In determining the adequate ventilation time and appropriated handling practices, for example, the local characteristics and ventilation equipment applied can be taken into account. Based on the on-line measurement results, the company will get a clear picture about the circumstances that affect the ventilation and get hands-on experience on behaviour of the harmful gases in their own processes. It would also be useful to include the respiratory zone measurements in the working plan in order to determine the real exposure of the workers during unloading and handling the imported goods.

In our study, the main part of the containers was free of toxic compounds at harmful concentrations. However, the results, as well as the reports published globally, showed that in the logistic value chain, containers and imported goods exist with concentrations exceeding the corresponding OEL. Based on our study, unloading the container and opening the transport boxes of imported goods seemed to be the most risky stages related to the chemical exposure of workers. Most of the stages where exposure can be happen were linked in the practices performed in the distribution centre; however, the exposure may happen in retail shops too. Although the high concentrations observed inside the containers and the packages, all the concentrations measured in the workers respiratory zone were below the corresponding OEL values, indicating that the exposure of the employees was unlikely.

CONCLUSION

We observed also that the existence of hazardous substances vary from one container to another. Therefore, clear guidelines for safe handling of the containers and imported goods should be defined in all workplaces. Instructions should include, at least, ventilation procedures for the freight containers including practices to ensure the absence of toxic substances before starting the unloading. This calls accurate and sufficiently sensitive measuring methods. Roomy working spaces and good ventilation may also reduce the potentially existing harmful substances in working environment. Information of the occurrence of the toxic substances must be delivered along the value chain to the next stage where worker exposure can be happen, so that the additional safety actions can be applied. Improved information flow of the harmful substances, existing in containers and imported goods, through the global retail trade value chain will help to decrease the workers' exposure.

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