

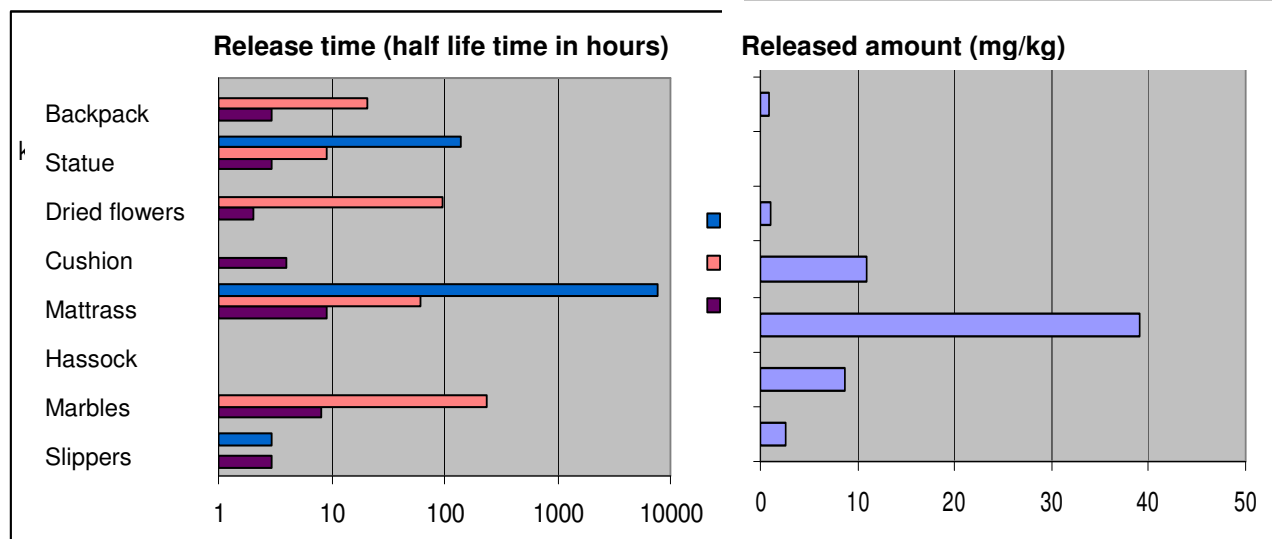
## The release of dangerous volatile substances from container goods and associated health risks

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From the beginning of this century the Dutch National Institute for Public Health and the Environment has investigated import containers containing toxic gases. Around 2000 the awareness grew that there were import containers that contained high concentrations of toxic gases. These gases were fumigants / detergents for pest control. In 2002 a first report was published with results about the amount of containers that had toxic fumigants. Results indicated that in about 20% of the containers fumigants like methyl bromide and phosphine were detected while in 5% the concentrations exceeded the MAC-value (occupational health standards) [RIVM report 609021025]. Monitoring was established and that indicated an increasing amount of containers with fumigants, the use of other fumigants and high concentrations of other dangerous gases like benzene and toluene [RIVM report 609321001].

Given these results the question was if those dangerous substances would be absorbed by goods in the container and would be released later, outside. In 2005 the results were published of an research project on this matter [RIVM report 609021033 (English); 609021034 (German report)]. About 20 samples from fumigated containers were taken. These samples were for example shoes, a cushion, ornaments, mattresses, a stone statue, toys and a paper box. For these objects there was no clear reason for fumigation. It appeared that 75% of these goods absorbed fumigants and released them afterwards.



The desorption was explained by three processes: a quick (dark red bars), a moderate (pink bars) and a slow release (blue bars). In most samples half of the absorbed amount was released within 100 hours. There were goods with a longer release (half life) time. A mattress showed a half life time of almost a year for 50% of the amount that desorbed (10 mg/kg total).

In this research project it was also demonstrated that methyl bromide was also absorbed or even reacted with food and medicines. In medicines an increase of bromide concentration was measured. Bromide itself is not a dangerous substance but risks might arise when reactions take place in the medicine. Reactions may involve essential substances (resulting in lower concentrations) or may result in harmful substances. This path is not fully

investigated further because first results indicate that this only occurs in small and not relevant amounts.

This project showed that all kind of goods may be fumigated and may absorb and release toxic gases. The problem is that the number of scenario's (or the possible exposure routes) is very large. Gases may evaporate in smaller or larger or in well ventilated or poorly ventilated rooms. There might be only a small amount or a larger amount from several goods (a new furnished baby room?). Exposure may occur by air, but also by direct contact and dermal exposure (shoes, cloths) or by indigestion (food, medicines). Cloths may yield in high exposure because contact is over large parts of the body and for some time, but most of the cloths are washed regularly or will be worn outside and thus ventilate well.

We declared a mattress as a worse case situation (maybe not the worst case situation) because of the ability to absorb a large amount, the demonstrated long release time and the closeness of source and nose.

To determine the exposure of methyl bromide from a mattress an experiment was done in ISPRA. A baby room was simulated, mattresses were fumigated with methyl bromide and the release was measured on several heights above the mattress. Unfortunately the experiments had a lot of setbacks (measuring methyl bromide is not easy) and a tight timeslot. At the end we had a few results and we had to support these experiments with simpler experiments at our own institute.

The experiments indicated that the methyl bromide concentrations above an evaporating mattress were below acute, semi chronic and chronic standards.

Overall conclusions of this research projects are:

- import containers in Dutch harbors have (up until 2007) an increasing amount of dangerous volatile substances. These substances are fumigants (for pest control) or dangerous production substances.
- when civilians in the vicinity of these containers are exposed at the opening of containers then they might suffer severe health effects. These risks are rated small - by policy makers - because not many civilians are present when containers with goods are opened.
- the research did not quantify the risk for employers (occupational health). This kind of research was not commissioned by the Ministry of Occupational Health.
- goods in fumigated containers may absorb the fumigants. If so, it is likely that desorption takes place and that might happen in the homely environment.
- there are many exposure routes and scenario's and it is not easy to mark the worst case exposure scenario. Absorption and release from a mattress is a scenario that might happen and is considered as a bad situation.
- experiments with a mattress showed no exceeding of acute, semi chronic or chronic exposure standards for methyl bromide.
- the performed experiments and thus the results should be interpreted as indicative since only a few experiments have been performed. In none of these experiments however an exceeding of Dutch standards was demonstrated.
- for this reason the Dutch National Institute for Public Health and the Environment concludes that 1) civilians are at acute risk when exposed to the fumigation gases in just opened containers and 2) the risks due to evaporation of fumigants from goods are low. There is a big uncertainty in this last statement due to the number of experiments in relation to the possible cases.
- the situation is not stable. There tends to be an increase in number of fumigants used and the concentration in the containers. A risk profile, which means a fact or an aspect discriminating containers with a higher risk, has not been established yet: containers from all continents, no matter what goods they contain, may contain high concentrations of fumigants.