



Rijksinstituut
voor Volksgezondheid
en Milieu

Trend analysis of harmful gases in shipping containers (summary)

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CC	
Author(s)	G.M. de Groot
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Approval

Ir. E. Schols

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Summary

Background

Every year hundreds of thousands of containers containing high levels of fumigants and other harmful components (e.g. the solvent benzene) at the time of arrival are imported through the Dutch ports. The presence of these containers forms a risk for workers at the port (e.g. those unloading containers) and the environment. The Dutch Inspectorate for VROM (Housing, Spatial Planning and the Environment) has inspected imported containers on a regular basis for a number of years by taking samples of the container air and analysing them for concentrations of fumigants and other harmful gases. This report documents the trend analysis of the RIVM, as ordered by the VROM Inspectorate, to determine trends of fumigants and other harmful gases in almost 300 air samples of containers for the 2003-2006 period. This trend analysis was based on the analysis data collected from 2003 to 2006. The main objective was to look for trends in the frequency, type and the concentrations of fumigants and other harmful gases in the inspected containers. This trend analysis only relates to the inspected containers analyzed by the RIVM. According to the VROM Inspectorate the selection method to inspect containers has not changed over the years.

Fumigants

The percentage of inspected containers with fumigants shows a rising trend (see Figure 1). (Please note that in 2003 phosphine and chloropicrin were not analysed, which may cause an underestimation of the total score.)

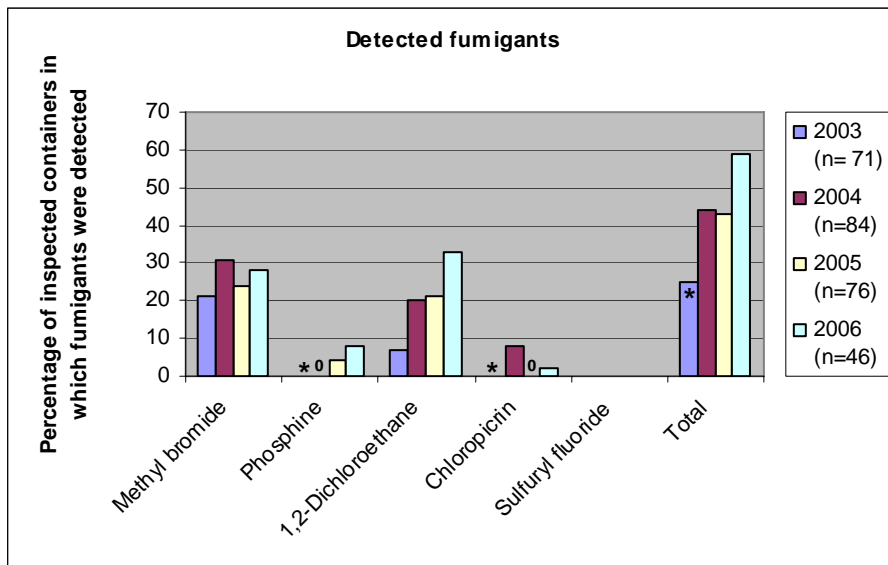


Figure 1: Percentage of inspected containers in which fumigants were detected.

*NB: in 2003 phosphine and chloropicrin were not analysed.

Especially 1,2-dichloroethane is found more frequently in containers: the percentage of containers in which 1,2-dichloroethane was found, rose from 7 to 33% in the 2003-2006

period. Methyl bromide was found most frequently in the last four years (in about 25% of the analysed containers), but there is no clear trend noticeable. Sulfuryl fluoride was not found in any of the containers.

The percentage of containers in which fumigants were found in concentrations above the MAC -value¹ shows a variable outcome (see Figure 2). (Please note that in 2003, phosphine and chloropicrin were not analysed, which may cause an underestimation of the total score.)

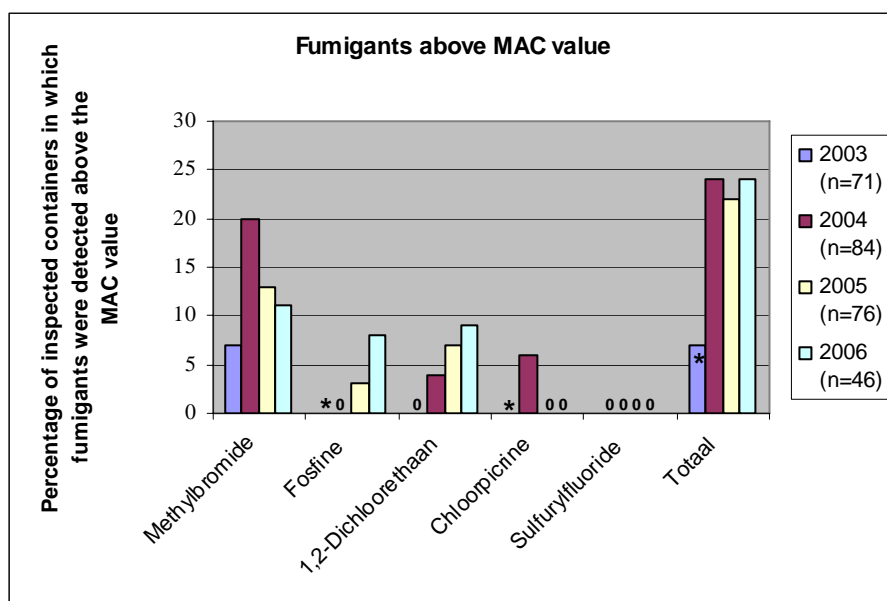


Figure 2: Percentage of inspected containers in which fumigants were detected in concentrations above the MAC value. *NB: in 2003 phosphine and chloropicrin were not analysed.

The percentage of inspected containers that contain concentrations of methyl bromide above the MAC value, has, after an initial increase, decreased in the last two years. Especially 1,2-dichloroethane is found more frequently in concentrations above the MAC value. In 2006 almost one-quarter of the inspected containers contained fumigants in concentrations above the MAC value.

When we look at Table 1, we see that there is no clear increase or decrease in the mean or median methyl bromide concentration. For 1,2-dichloroethane we see an increase in the mean concentration. This fumigant is not only found more frequently, but also in higher concentrations. For phosphine and chloropicrin there is not enough data to be able to comment on a possible trend in the mean or median concentration.

¹ MAC value: maximum allowable concentration; the maximum concentration of a gas, vapour or haze or a substance at the workplace, which in general don't has a negative effect on the health of employees en their progeny.

Table 1: Mean or median concentration (in $\mu\text{g}/\text{m}^3$) of fumigants in positive samples.

Fumigant	MAC value ($\mu\text{g}/\text{m}^3$)	2003		2004		2005		2006	
		Mean	Median	Mean	Median	Mean.	Median	Mean	Median
Methyl bromide	1000	1342	359	61364	2259	5237	1516	10882	442
Phosphine	140	-	-	n.d.	n.d.)*)*)*)*
1,2-Dichloroethane	7000	1199	733	7011	1212	11649	631	22256	1836
Chloropicrin	700	-	-	1920	1398	n.d.	n.d.)*)*
Sulfuryl fluoride	10000	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.

: not available; n.d.: not detected; *: too less positive samples (≤ 3)

Other compounds

Except for fumigants, other harmful gases too are often detected in high levels in shipping containers. Aromates such as benzene, toluene, ethyl benzene and xylenes are found in most of the containers, with chloromethane being found frequently. These compounds are used mainly as solvents in glues, paints, varnishes, plastics, cleaning products and cosmetics. There is a rising trend in the percentage of containers which contain harmful gases at a level above the MAC value (see Figure 3).

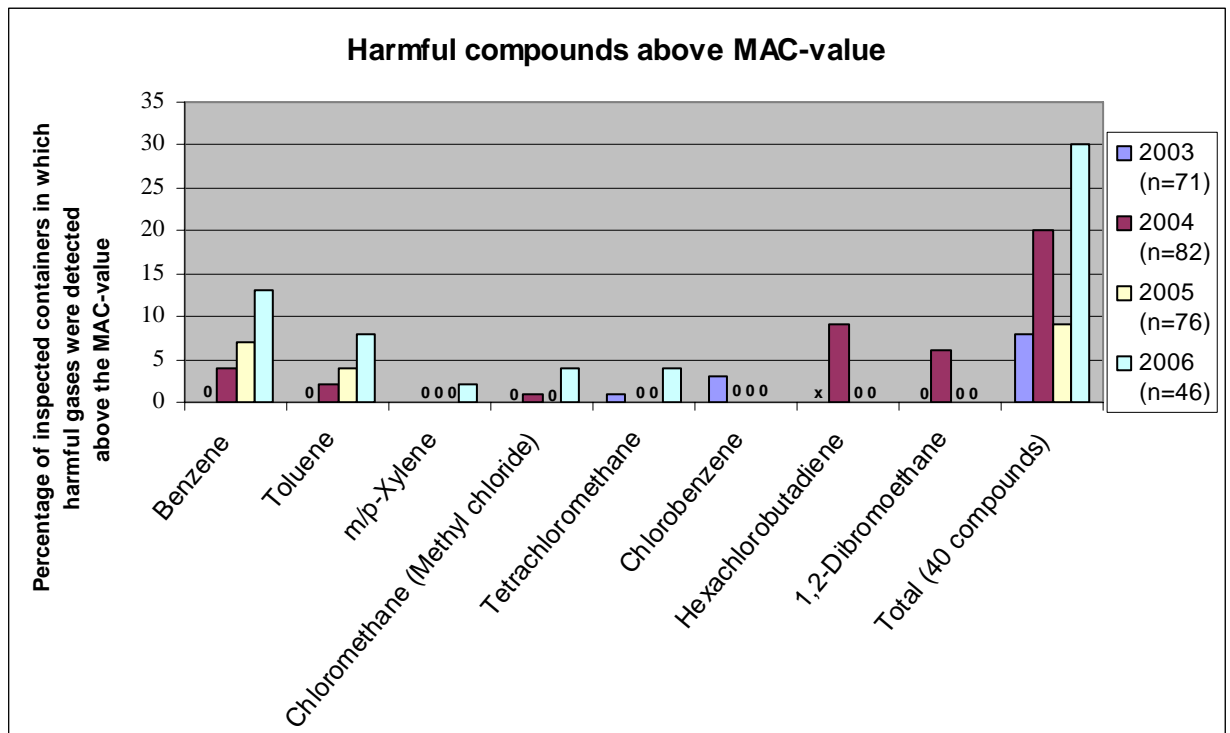


Figure 1: Percentage of inspected containers showing harmful compounds above the MAC value.

In 2006, 30% of the inspected containers showed an exceedance of the MAC value for one of the 40 examined compounds. This represented an increase in comparison with earlier years. Especially benzene and toluene were found more frequently in concentrations above the MAC value.

When we look at Table 2, we can see that, in general, the mean and median concentrations of benzene and toluene show a rising trend, while the levels of chlorobenzene show a falling trend. For the other compounds, there is no clear trend noticeable.

Table 2: Mean and median concentration ($\mu\text{g}/\text{m}^3$) of harmful compounds in positive samples.

Compound	MAC value	2003		2004		2005		2006	
		Mean	Median	Mean	Median	Mean.	Median	Mean	Median
Benzene	3250	295	141	801	93	5787	135	3172	349
Toluene	150000	5237	575	20826	483	19133	467	126957	1433
m/p-Xylene	210000	11875	2205	2627	442	3422	254	9680	310
Chloromethane (Methyl chloride)	52000	5868	360	8422	140	1336	257	73078	261
Tetrachloromethane	3200)*)*	66	62)*)*)*)*
Chlorobenzene	23000	14529	3600	358	107	43	43	70	39
Hexachlorobutadiene	240	n.d.	n.d.	1193	970	32	42)*)*
1,2-Dibromoethane (Ethylene dibromide)	2	n.d.	n.d.	157	106	n.d.	n.d.	n.d.	n.d.

N.d.: not detected; *****: too few positive samples (≤ 3)

Conclusions

- The percentage of inspected shipping containers in which fumigants were detected, shows a rising trend, which is caused mainly by the increasing number of containers containing 1,2-dichloorethane and, to a lesser extent, the increase in phosphine. The percentage of containers with methyl bromide and chloropicrin does not show a clear trend. As in the 2002 study, sulfuryl fluoride was not detected in a single container.
- The percentage of inspected containers with concentrations of fumigants above the MAC value shows a variable trend. The percentage of containers with methyl bromide concentrations above the MAC value decreased after an initial increase. The percentage of containers in which the MAC value for 1,2-dichloroethane was exceeded, shows a rising trend. In 2006, almost one-quarter of the inspected containers exceeded the MAC value for a fumigant.
- The percentage of inspected containers with other harmful substances (like solvents) above the MAC value has increased. In 2006, 30% of the inspected containers showed an exceedance of the MAC value for one of the 40 examined compounds. Especially the number of containers with exceeding benzene and toluene MAC values has increased.
- These results relate to containers inspected by the VROM Inspectorate for whom the selection method has not changed over the last few years.