Lookalikes on the outside, unique on the inside.

Danger in Big Boxes

Containers bring goods to Europe from all over the world. Because **DANGEROUS CHEMICALS** often hitch a ride across the ocean with the machines, textiles, furniture or foods, experts are calling for the introduction of uniform criteria for measuring the harmful substances load.

RUBBER VERSUS STEEL—this battle is soon over. The tip of the metal shining probe slips under the door seal, which has been dulled by saltwater and weather, and slides into the dark, mysterious interior of the giant shipping container. The small instrument is inserted as far as possible into the 40-foot container, whose roof is ablaze with the summer sun in the port of Rotterdam, Netherlands. The metal probe with the fine hole at its tip opens into a chamber from which three tubes lead to a gas pump and measuring instruments.

Blinding light outside; deep darkness inside the container. A fitting symbol for the uncertainty over what, besides the actual goods, has made the journey across the ocean inside the container. Twenty per cent of the import containers—more than 400 million tons of cargo were transferred in Rotterdam alone in 2008—is contaminated with levels of harmful substances that are higher than permitted. Methyl bromide (bromomethane, CH_3Br), 1,2-dichloroethane ($C_2H_3CL_2$), phosphine (PH_3), and sulfuryl difluoride (SO_2F_2) are the substances most frequently found in containers, but formaldehyde (HCHO), ethylene oxide (C_2H_4O), hydrocyanic acid (HCN), and carbon dioxide (CO_2) also occur. In most cases these substances have been introduced into the containers intentionally to prevent pest and mold infestation and also to prevent the spread of pathogens. Industrial chemicals may also be released by the goods loaded into the containers. Other risks associated with shipping containers include critical concentrations of spores and dust, a lack of oxygen, and an explosive atmosphere.

PHOTOGRAPHY: CORBIS

Danger, poisonous substances!

Substances with poisonous to very poisonous properties pose the greatest health hazard to people handling freight containers contaminated with these substances. “Logistics industry workers, particularly those involved in the transfer of goods at ports and those working in large warehouses for imported goods, are exposed to the greatest risks,” says Professor Xaver Bauer. The occupational health specialist is the Director of the Central Institute for Occupational and Maritime Medicine (ZfAM) and Chair of the Department of Occupational Medicine at Hamburg-Eppendorf University Hospital, and has been working with the poisons in import containers for many years now.

In fall 2008, the ZfAM held a workshop entitled “Safe Handling of Import Containers,” during which current studies of the contamination levels of import containers and the health consequences thereof, in particular neuropsychological damage and respiratory illnesses, and developments in measurement technology were presented. The next workshop on November 11, 2009 will focus primarily on different portable measurement technologies.

Gas detectives are on the case

Back in Rotterdam, a gas detector pump (Dräger accuro) fitted with Dräger tubes and a gas detector (Dräger X-am 7000) are drawing air samples out of the 40-foot container via a measuring probe and a mixing chamber. The employees of a specialized Dutch company are using this analytical technology to search for a whole series of hazardous substances simultaneously. With this particular container, the experts are focused primarily on methyl bromide, 1,2-dichloroethane, ammonia, phosphine, and chloropicrin. They are also monitoring the oxygen concentration and taking measurements to determine the risk of explosion.

A glance at the methyl bromide 0,2/a Dräger tube confirms the suspicion of the gas detectives. The container, which has been placed in a fenced-off area of the port marked with warning signs, must be ventilated. The concentration of the gas is too high. The limit for methyl bromide is set at 0.25 ppm in the Netherlands. With its standard measurement ranges of 0.2 to 2 ppm and 2 to 8 ppm depending on the number of strokes and the measurement time, the Dräger tube is the established measuring method of the measurement team. Ventilation, in some cases supported by the use of high-performance fans, is the usual method for lowering the gas load in containers. The gas concentration is remeasured one or more times depending on the duration of the process.

Measurements provide certainty

“Our Dräger Fumigation Kit is a tailor-made solution for the detection of fumigants in containers and other enclosed spaces,” says Bettina Runge of the Industry Focus Group at Dräger. The classic configuration for use in >

A journey of discovery with the probe: No one can say with certainty what gases are in the sealed container and will be released when the container is opened. Measurements provide certainty.

Hamburg: 18 per cent of the containers have higher concentrations of harmful substances

> container applications comprises the accuro gas detector pump, a container probe, the Simultaneous Test-Set, and the corresponding Dräger tubes. Dräger has developed an expanded fumigation case in response to customer demand at Europe's largest deep-sea port. "In addition to the tubes and the probe, the case also includes the instruments X-am 2000 or X-am 7000 and the electronic gas detector pump accuro 2000," says Denis Donkers, a Dutch sales consultant at Dräger.

When asked during a site visit to describe the scenario facing the measurement team, Donkers, standing between towering cranes and stacks of containers, answered, "Nobody knows what gases are present in what concentrations." The atmosphere in a transport container arriving from overseas is found to contain other gases and vapors in addition to the actual fumigants. Typical examples are the solvents and chemicals that are released from various goods. "Most of the contaminated containers contain a dangerous cocktail of different substances," said Prof. Baur in summary of the experience gleaned at the North Sea port.

Inadequate protection

The Technical Rule for Hazardous Substances (TRGS) 512, Fumigations, regulates the handling of fumigated containers in Germany in details. This document regulates release measurements, with strict limits for methyl bromide (0.5 ppm), hydrocyanic acid (2.0 ppm), phosphine (0.01 ppm), and sulfuryl difluoride (1.0 ppm) as well as the labeling of fumigated containers. A more recent requirement is that most of the chemicals used to fumigate containers must be recovered. At the port of Hamburg, for example, mobile waste gas scrubbers equipped with activated carbon filters have been used since 2008 to recover roughly 80 percent of the methyl bromide remaining in the container after exposure time. The experts at Rotterdam harbor say that such standards either do not exist or are not applied to a sufficient extent in the Asian countries from which most of the containers come.

Detlef Boels, physicist and department head at the Hamburg Office for Occupational Safety, says that regularly fumigated and appropriately labeled import containers are actually in the minority of the total number of containers arriving at European ports from overseas with higher concentrations of harmful substances. In his article "Gefahren aus Import-Containern" ("Hazards of Import Containers") published in the "Zentralblatt für Arbeitsmedizin, Arbeitsschutz und Ergonomie" (Central Journal for Occupational Medicine, Occupational Safety and Ergonomics) in 2009, the physicist describes the wide range of harmful substances found in containers and calls for the regulation of release measurements that go beyond the analysis of the classic fumigants. "We need uniform criteria for the expert evaluation of harmful substance loads and clear mandates to measuring institutes," writes Boels in his article. Boels, who points out that around 18 per cent of the containers arriving in Hamburg have higher concentrations of harmful substances, also underlines the risk resulting from the release of harmful substances from goods and packaging.

Propper risk assessment

This risk affects not only the logistics workers and customs agents at the port, but also the employees at the company receiving the shipment. Dräger therefore trains employees at Dutch companies how to properly use gas detection technology in import containers. Release measurement training is particularly beneficial to end customers who unload their own containers. The theoretical part is performed at Dräger; the practical part takes place under realistic conditions at Rotterdam harbor. Participants have come from a wide range of industries, including the food and beverage, textile, and furniture industries. A 2007 accident in Munich in which gases from a container poisoned 32 people shows just how important such training is. The container contained machine parts from India and had been treated with methyl bromide.

The contamination of imported goods with gases is a new phenomenon that appeared in conjunction with the use of shipping containers. Whereas the holds of classic general cargo ships were usually well ventilated, there is relatively little air exchange in the large metal boxes, which have long become the gold standard in international goods traffic. Mold prevention is therefore one important reason for treating the containers with gas. Another reason is to protect against pests and pathogens that can be brought in with the goods or wooden packaging. To enhance the efficacy of these agents, many containers are also taped up before they are loaded onto ships at the port of export. If freshly manufactured or processed goods then release various industrial chemicals while in these sealed containers, these substances also accumulate in the atmosphere.

TRGS 512 cites taped or sealed ventilation slots and pallets and crates of fresh wood as typical indications of a fumigated container, even if the container is not labeled as such. Even clearer indications of fumigation are the corresponding carrier media, say the Dutch experts. These could be bags, powders or bars. But the top precept of the experts is to take no risks, whether out of habit or complacency. The Rotterdam "gas detectives" therefore keep their personal protective equipment, including compressed air breathing apparatus, at the ready in their vehicle so that they can open contaminated containers. The measurement has told them what substance they are dealing with and in what concentration it is present. Forewarned and thus forearmed, the danger can now be avoided. **Peter Thomas**

Further information online, including:
Dräger-Tubes & CMS Manual
www.draeger.com/98/tubes

The all-purpose kit

The Dräger "Fumigation Kit" contains everything a layperson needs to perform a reliable test for dangerous gases in the field. The heart of the kit is the set of proven Dräger tubes, which enjoy a decades-long reputation for easy handling and accurate measurement.

In combination with the Dräger accuro hand pump and the Dräger probe, the concentration of the gas in question can be determined by observing the change in color of the corresponding tube. In scenarios involving unknown gases, the Dräger "Simultaneous Test Set" allows the simultaneous detection of five fumigants, including hydrocyanic acid, formaldehyde, and methyl bromide. Other Dräger tubes are available for the detection of ethylene oxide, carbon dioxide, and sulfuryl fluoride. And don't forget: Even after the container has been flushed with air, check the load again just to be on the safe side!