GDA2 Fumigation

AIRSENSE ANALYTICS GMBH

Detection of Dangerous Gases from Containers

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Introduction

To avoid the spread of vermin and other organisms from distant regions into the receiving countries, the transportation of goods is secured by applying specific treatments to the freight containers.

It became generally accepted that containers should be gassed with toxic substances prior to the journey. In that way, the container should also be seen as a potentially dangerous environment due to his confinement.

If there is usually a range of standard substances used to fumigate containers (you can see some of them in the list below), many are the cases where the sender uses indiscriminately other chemicals – the *cheapest* or the *possible* ones, meaning that toxicity is just a question of concentration.

Since hazardous concentrations differ from container to container, many are the cases where the applied preventive safety measures are not enough to clear away the complete danger, or they are too much exaggerated. That is to say, it is time consuming and partially cost ineffective.

Containers with chemical gases in high concentrations represent thus a danger for the receiver.

Summing up:
Due to different causes, containers may carry chemical gases in different concentrations, representing therefore a risk for those along the logistic chain once after the container arrives to the destination port.

The latest studies carried in the port of Hamburg have shown that each third container has a very high concentration of some gaseous chemical substances, by taking in account the actual limit values for working environments.

Customs officers are one of those risk groups, since it is under their functions to open, inspect and verify the cargo in the containers. But also other customers in Germany and other countries can also be seen as a target group of these in-transit hazardous environments.

The above described conditions oblige therefore to look after special requirements and to search for the most adequate measuring technique, which is serving the protection of people dealing with containers.

The GDA2 *Fumigation* is a portable detector which is operated directly at the container and able to respond within seconds if dangerous concentrations of hazard chemical substances can be found there or not.

The GDA2 is composed by a so called Hybrid Sensor Array, meaning that the detection will occur simultaneously through several sensors. By using the different sensors it is possible to obtain the necessary broad range for measuring the necessary chemicals.

For example, it is possible to measure very light and hazardous chemicals like chlorine gas, phosphine or hydrogen cyanide among others, as it is possible to detect more complex organic gases like chloropicrin or benzene. This is something that no other sort of detector alone can do.

After several studies the authorities from the Hamburg Customs have developed the optimized procedures on how to set up the instrument.

Important to remark that when employed in continuous measurement, the GDA2 has shown good results in comparison with other procedures proving the high level of safety provided also fundamental to win the confidence from the users.

Entering the Container

The highest security demands are required every time that a container is to be opened and entered.
Officers from Customs service take the GDA2 with them in order to evaluate the atmosphere inside the container without the specific need of opening it.

- A measuring probe is introduced inside the container through the rubber lips of the door. The GDA2 takes a sample.
- Within some seconds the instrument shows the reponse: a bar indicator shows the response from the different detectors.
- Observing the results it is possible to immediately decide with the highest security if hazardous gases are to be found inside the container. It can also be decided about the next steps to take.

Bild 1: Sampling and analysis with the GDA2. (foto: Quelle)

The GDA provides as well a security feeling from the fact that the instrument is indicating what really can be found in the container. Not only there are no false negatives as the rate of false positives has been proved to be very low. Also other potentially dangerous gases can be detecte besides the target fumigants.

Measuring Containers from the Outside

Bild 2: Analysis and protocol of the results shown by the GDA2. (Customs service, Hamburg)

So that the user avoids the contact with the dangerous environment from the container, the measurement has to be done from the outside.

A measuring probe made from stainless steel is pushed inside the container through the door's rubber lips. Autonomously the GDA2 will take a sample by using its internal pumping system.

Based on the different information from the 8 channels represented on the display the user can take a decision. The channels respond in seconds to the measured gases.

Important! Observing the fast answer of the instrument it becomes possible to measure several containers without interruption.

Picture 3: Opening a container under security measures (Fire brigade Frankfurt)

Using the GDA2

Bild 4: Special units from the Hamburg Customs receiving a quick training on the GDA

The GDA2 *Fumigation* has been optimized for being considered as an easy-to-use instrument.
After a short training step, any user will be able to carry the necessary actions for taking a measurement and find a safe decision.
The instrument is able to control when it is ready to measure and through an additional test function it is possible to check if the gas detector array is completely functional.

GDA2, Display and Alarm with Fumigants

The GDA2 *Fumigation* shows the results from the analysis by describing the response of the sensors through the 8 channels that can be seen on the display.

At the detection of a dangerous substance the eight channels will respond differently and depending on the determined limit from each one of them, it will be possible to determine if the container shall be considered as “dangerous” (alarm) or free to go.

The sensitivity of the instrument is high. The substances are detected in the ppb up to upper ppm[1] range, depending on the substance.

The range of alarm that is provided in the GDA2 is programmed in such a way that the current alarm values are observed. Besides the alarm values which may vary from country to country, also the experience of the user may play an important role.

GDA2 Channel	Substances (only some examples)	Formula
A	Ammonia	NH_3
B	Methyl Bromide Chloropicrin Chloroform Prussic Acid 1,2 – Dichlorethane	CH_3Br $CCINO_2$ $CHCl_3$ HCN $C_2H_4Cl_2$
C	Ethylene Oxide	C_2H_4O
D	Carbon Disulfide	CS_2
E	Formaldehyde	H_2CO
F		
G	Phosphine	PH_3
H	Benzene	C_6H_6

Table 1: The displayed channels and examples from the substances shown in each of them.

Along the time of use of the GDA2 by the Hamburg Customs it was possible to optimize the alarm levels of the instrument in comparison with other laboratory methods.

Software, Display and reaction to Substances

The GDA is able to save the information from the measurements to the memory logger.
At anytime it is possible to visualize the measurements by using the special software WinMuster.

Thought for more skilled users, the WinMuster allows visualizing in detail the individual response from the sensors and obtaining more information on the measurement.

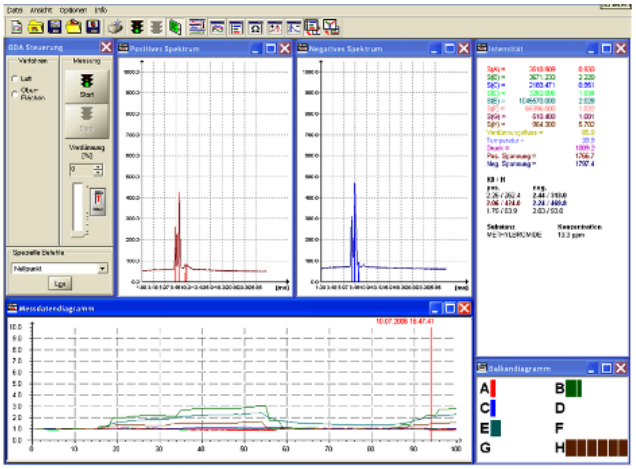

Bild 5: Analisis from WinMuster and the response from the GDA to the detection of methyl bromide.

When the analysis is clear enough, it is possible to observe the name of the identified substances on the text box (above right).

[1] Designation of concentration units for gases: ppm/ppb = parts per million / billion.

Case Study: Hamburg Customs & GDA2

Picture 6: Monitoring the chemical content while unloading the container.

After completing a 2 years study the GDA2 has been in daily use by the Hamburg Customs office' officers for the analysis of containers.

During the test period the results from the GDA were compared with results from more complex methods of analysis, especially GC/MS (transportable instruments and in laboratory). The GDA has proved to be the quickest method of analysis and also the one with the lowest false alarm rate. This positive result together with the availability of the instrument and the easiness for operating it, were fundamental reasons for the election of the GDA as a standard measurement method.

The short time needed for measuring and deciding based on the GDA is of a great advantage since makes possible to analyze more containers within the same time and therefore to minimize the waiting time for the lorry drivers and the traffic queues at the terminals.

Besides other criteria as the speed of analysis, easiness to use, robustness and handling, the most important is the broad band of detection and sensitivity in the analysis.

Picture 7: Transport trucks in stand-by waiting for the control measurement from the Customs officials.

It was confirmed that containers transport a multiplicity of gases besides fumigants which can also be detected by the GDA.

To provide safety, the procedure of unloading potentially hazardous containers is continuously monitored by the GDA, in such a way that dangerous situations can be immediately detected and alarmed.

As additional information from this study we have attached an official statement from the Hamburg Customs office to this application note.

GDA2 *Fumigation*

Facts and Information

Some important characteristics from the GDA2:

- The instrument is portable (about 4,5 kg)
- Security by detecting a very wide range of chemical substances: the hazardous substances will be definitively detected. Besides the defined fumigants the GDA2 is able to detect other substances.
- Easy to use
- Results are given within seconds (about 10s.) 20-30 containers may be measured within an hour.
- Wide dynamic detection range (ppb up to upper ppm)
- Security at alarming: no false negative alarms, very low false positive rate)
- Short training and Instruction time needed
- Continuous operation
- Time win when comparing this with other measurement procedures (GC/MS or colorimetric tubes...); no sample degradation;

Foto 8 & 9:
In the harbour of Basel, CH

Foto 10 & 11:
QUELLE Logistic Center, Leipzig, DE

Attachment

Report from the Customs Office in Hamburg writing about the use of the GDA2 for measuring containers

Hauptzollamt Hamburg – Hafen
– Der Vorsteher –
GZ P 1119 B - A 9
(bei Antwort bitte angeben)

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DATUM 29. Februar 2008

AIRSENSE Analytics GmbH
Attn: Mr. Mario Schmidt

Report about the results by using a GDA II
Protection for Customs Authorities against harmful components in containers
Attachments: Table shows performed measurements in different containers

Dear Mr. Schmidt,

After testing a GDA II for $1^{1/2}$ year at the Customs in Hamburg Waltershof a new GDA II system was bought in January 2008. The GDA II is used to provide safety for the customs authorities against harmful components in containers before entering them. Until February 26th 2008 150 containers have been measured before entered by the customs authorities. Measurements are performed from outside the container by using a sampling tube made from steel which is connected to the GDA II gas inlet and entered between the container doors. The instrument displays the results which can be noticed by the customs officer immediately. In case of a response, exceeding a threshold on channel H of the GDA, containers are ventilated. After 30 minutes measurements are repeated again. The GDA II is used continuously while working inside the container in order to provide safety for the customs authorities. In the last weeks 6 containers had to be investigated by the GDA II. The results have been compared with a GC/MS system. All results given by the GDA II have been confirmed as correct results. In attached file investigated containers have been marked yellow. The use of the GDA is described by the customs authorities as being very easily and without problems. The biggest advantage of the GDA II is the capability to use it continuously. Customs authorities feel safe while working in – or outside the containers because results are given immediately. After a short training each user is able to handle and operate the GDA II in real operation.

Best Regards
by order of

Riemann

Contact AIRSENSE:

AIRSENSE was founded by two former students from the University TU Hamburg-Harburg (Germany). Up to the present times, AIRSENSE is still exchanging scientific knowledge in many areas with this university. Since 1996 this company has been consolidating his position as designer and manufacturer of analytical measuring equipment for chemicals. The measurement of gases from containers is one specialty from AIRSENSE but we also explore other areas, like the chemicals that are relevant for the first responders like liquids, solids, explosives and chemical warfare agents. AIRSENSE is one of the market leading world security providers for gas detection. Our customers can find AIRSENSE all over the world!

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