Test report

Testing the reduction of emissions when using SCAT SafetyCaps on solvent bottles in laboratories

Client:

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report by:

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Commision: 1500915-2

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1 . COMISSION

SGS Institut Fresenius GmbH received the written assigment from SCAT Europe GmbH to test the reduction of emissions achieved by the use of SCAT SafetyCaps. Therefore, 1000 ml solvent bottles were fitted with a SCAT SafetyCap and their emissions were compared over periods of up to 28 days with the emissions of an open bottle without any special closure cap.

Test cabinet trials were performed during which the amount of emissions in the atmosphere were checked regularly over a period of 7 days. A mixture of methanol/water (ratio: 80/20), acetonitrile and methanol were used as solvent components.

2 . TEST METHODS

2.1 Determining the changes in density and volume of solvent mixtures

One litre of a methanol/water mixture (80/20) was poured into each of two test bottles. One bottle was sealed with a SCAT SafetyCap, while the other was left open as a reference in order to compare the results. At various intervals throughout 8 days the change in density was determined by using a pyknometer. The change in volume was further determined by differential weighting of the volumetric proportion of methanol remaining in the bottle and by converting this by reference to the density.

2.2 Determining the change in volume of pure solvent

One litre of methanol or acetonitrile was poured into each of 2 bottles. One bottle was sealed with a SCAT SafetyCap and the other left open as a reference for purposes of comparison. The change in volume was measured after 7 days and again after 28 days.

2.3 Determining the atmospheric emissions by means of test cabinet trials

Test cabinet trials were performed to determine the emissions of methanol or acetonitrile into the atmosphere. For this purpose the test cabinets were operated under the following defined conditions (based on DIN EN ISO 16000-9):

Temperature: 23 °C

Atmospheric humidity: 50 %

Product loading factor: 1 m^2/m^3

Air exchange rate: 0.5 per h

Volume: 1000 ml bottle with or without an SCAT SafetyCap

Samples were taken at the outlet after 24 h, 3 days and 7 days, in order to determine the atmospheric concentration of methanol and acetonitrile. The determination was performed using a silica gel tube for methanol or an Anasorb-747 tube for acetonitrile. The analysis was performed according to NIOSH 2000 (methanol) and NIOSH 1606 (acetonitrile).

The adsorbed material was extracted by solvent, and the extracted material analysed by capillary gas chromatography using a thermal evaporator. The detection was performed using a GC-MS system (ion-trap), the selectivity was enhanced by chemical ionisation with water.

3. Measurements

3.1. Determination of the density and the change of volume of a methanol/water mixture

Day	Volume in %		Density in g/cm^3 *		Volumetric proportion of methanol	
	without cap	with cap	without cap	with cap	without cap	with cap
0	100	100	0.855	0.855	80	80.0
2	99.6	100	0.857	0.855	79.7	80.0
4	99.3	100	0.857	0.855	79.6	80.0
7	98.5	100	0.858	0.855	79.1	80.0
8	98.0	100	0.858	0.855	78.9	80.0

Performance at 20 °C

* rounded to 3 decimal places

3.2 Determination of the change in volume in methanol and acetonitrile

Day	Volume in %		Volume in %	
	Acetonitrile		Methanol	
	without cap	with cap	without cap	with cap
0	100	100	100	100
7	97.5	100	96.8	100
28	90.7	99.9	87.8	99.9

Performance at 20 °C

3.3 Determination of the atmospheric concentration of methanol or acetonitrile in a test cabinet

Time	**Acetonitrile** Test cabinet concentration in mg/m^3		**Methanol** Test cabinet concentration in mg/m^3	
	without cap	with cap	without cap	with cap
24 h	800	5	660	2
3d	770	3	640	1
7d	730	1	630	1

4 Results

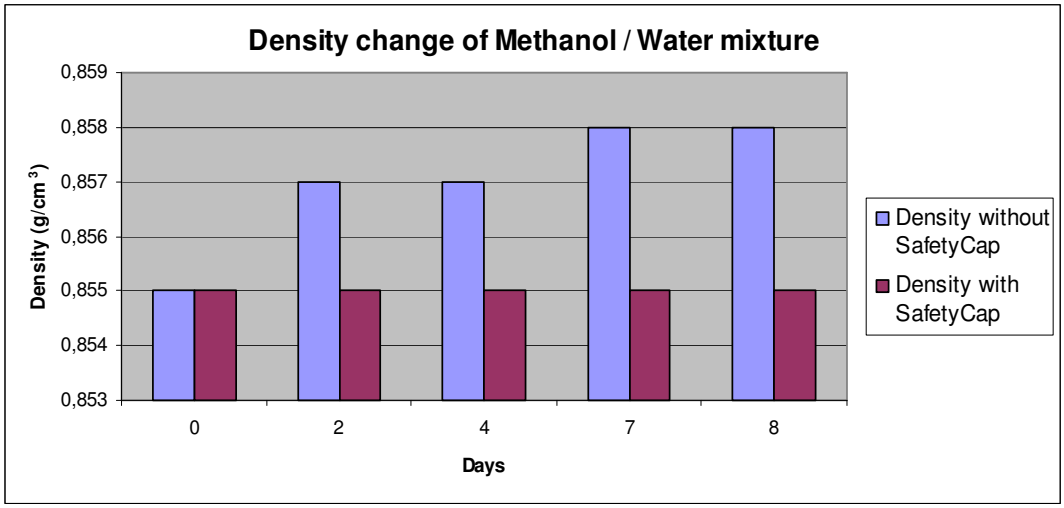
4.1 Characterisation of the changes in density and volume

SGS Institut Fresenius GmbH was authorised by SCAT Europe GmbH to assess more precisely the effectiveness of their SCAT SafetyCaps in comparison to a solvent bottle without SCAT SafetyCap.

The changes in density of a methanol/water mixture were investigated more detailed in order to determine whether the use of the SCAT SafetyCap could prevent a change in the mixture over an extended time of 8 days.

A comparison of the measured results shows that in a bottle fitted with the SCAT SafetyCap no change in density occurs, so that the initial density of 0.855 g/cm^3 stays constant throughout the entire 8 days of the test.

In contrast to this, the solvent bottle without a SCAT SafetyCap displayed a demonstrable change in density so that the initial value of 0.855 g/cm^3 of the solvent mixture rose to a density of 0.858 g/cm^3 (see diagram). An increase in density indicates that there has been a greater loss of methanol than water from the mixture.

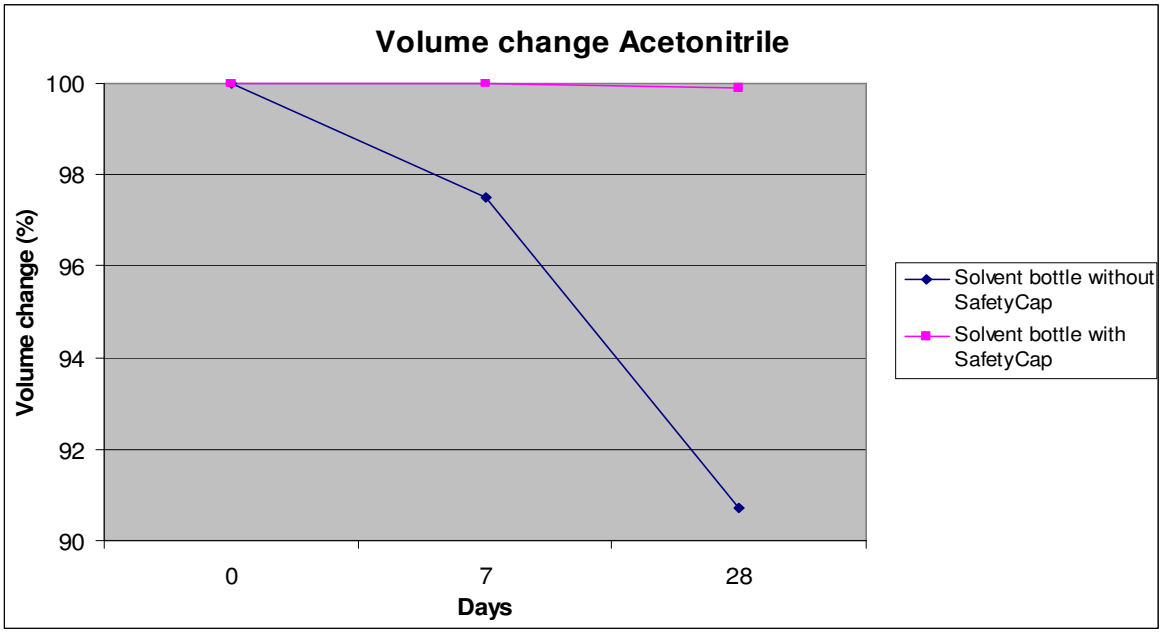


As the loss does not occur in the same ratio as the mixture, this leads to a change in the ratio of the methanol/water mixture which then can result in errors in measured values e.g. retention times under laboratory conditions. In contrast to this, in the solvent bottle with the SCAT SafetyCap no change in the mixture ratio was found so that errors in measured values due to a change in the solvent mixture can be excluded.

4.2 Characterisation of the change in volume in methanol and acetonitrile

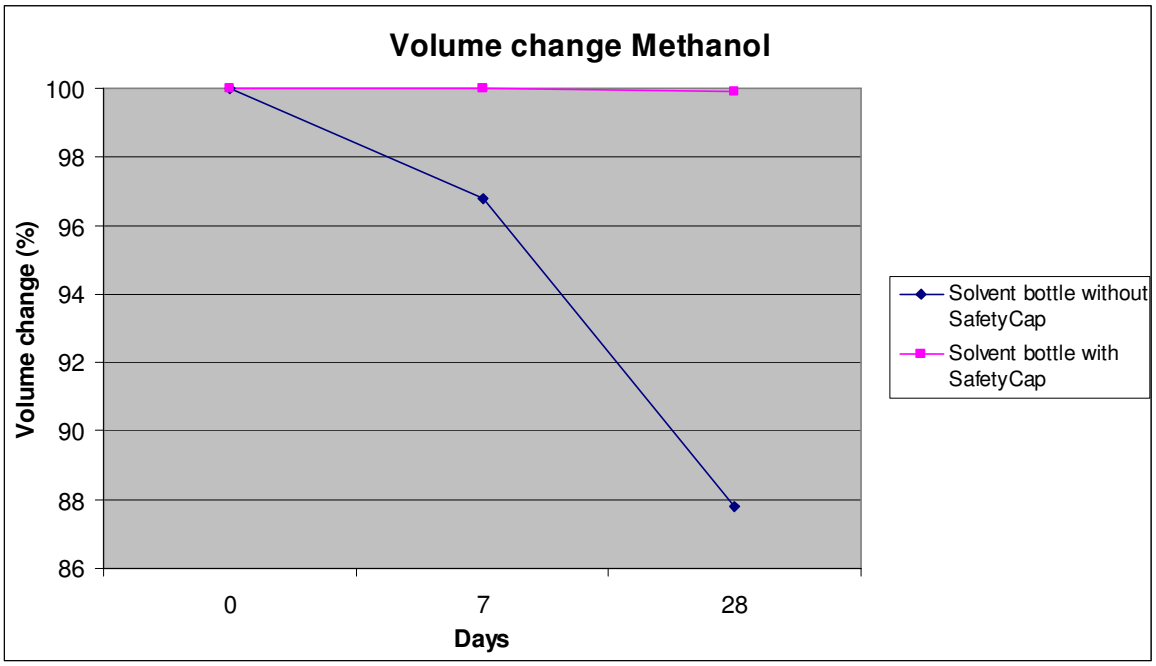
For this purpose the change in volume was determined by means of differential weighting within a 28-day pilot study in which both acetonitrile and methanol were used as solvents. These two solvents were used to generate the best possible comparison with real on-site conditions in a HPLC laboratory.

Based on the measurement results it is evident that in both series of trials with the SCAT SafetyCap, scarcely any change in volume over the period of 28 days was observed. In comparison to this, without the SCAT SafetyCap, a significant reduction in the given volume of 1 litre was found within the period of the trial.



In the acetonitrile bottle without a SafetyCap, a reduction in volume of almost 10 % occurred so that after 28 days, only 90 % of the initial volume remained in the solvent bottle. Consequently, after 4 weeks, almost 10% of the solvent quantity was lost, having escaped unfiltered into the atmosphere.

This significantly greater reduction in volume after 28 days is due to the increased length of time between the first measurement at 7 days and the second measurement at 28 days.

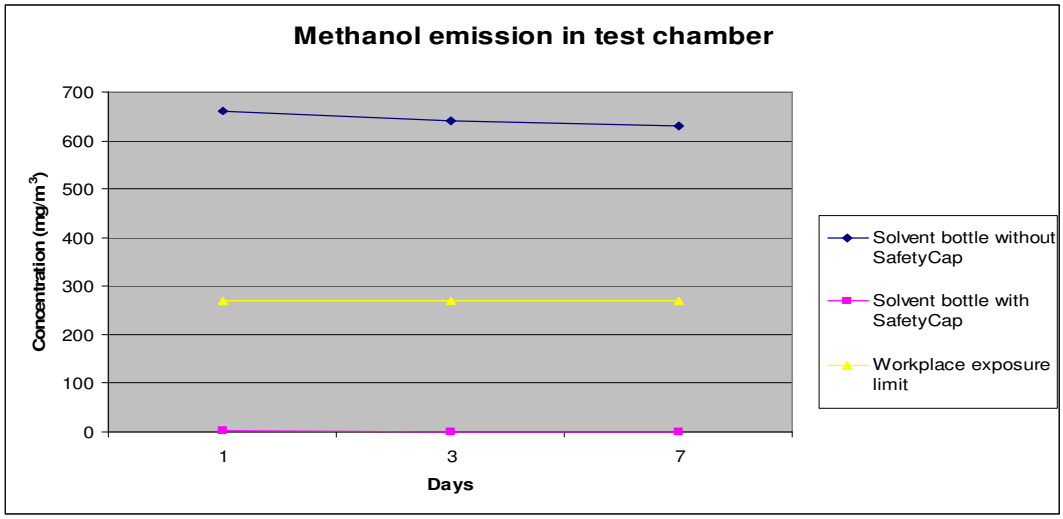


During the determination of the change in volume of methanol, it was evident that an even more significant reduction had occurred in the solvent bottle not fitted with a SCAT SafetyCap: after 28 days, only 87.8 % of the initial volume remained in the open solvent bottle, compared with 100 % of the initial volume remaining in the solvent bottle equipped with the SCAT SafetyCap.

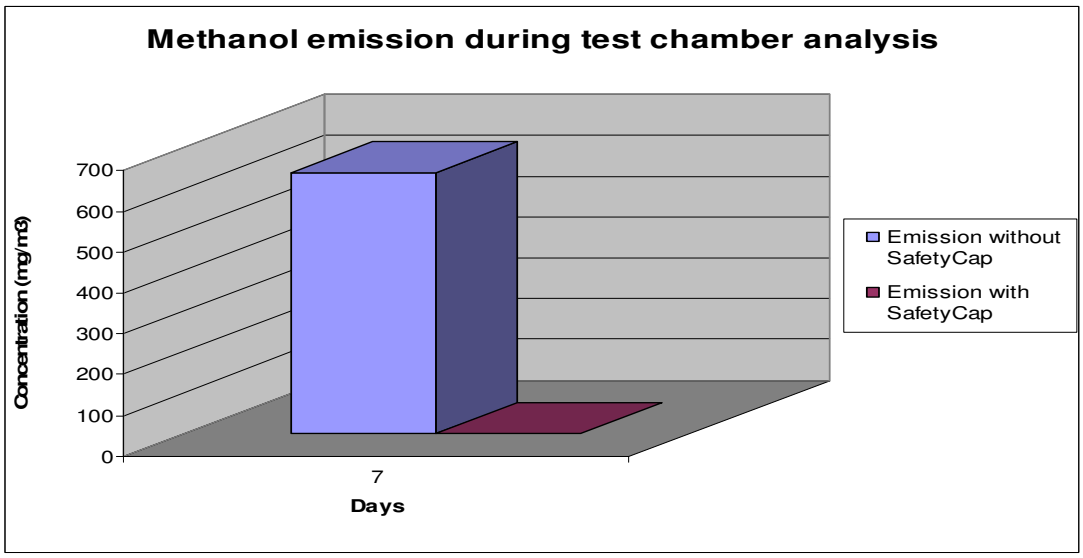
It is obvious that almost 13% of the used solvent quantity are lost, having escaped into the atmosphere.

4.3 Assessment of the atmospheric concentrations determined during the test cabinet trials

To determine the emissions from an open solvent bottle in comparison to a solvent bottle closed with a SCAT SafetyWasteCap, each solvent bottle was placed in a test cabinet and the emissions of methanol or acetonitrile were measured after 1 day, 3 days and 7 days.

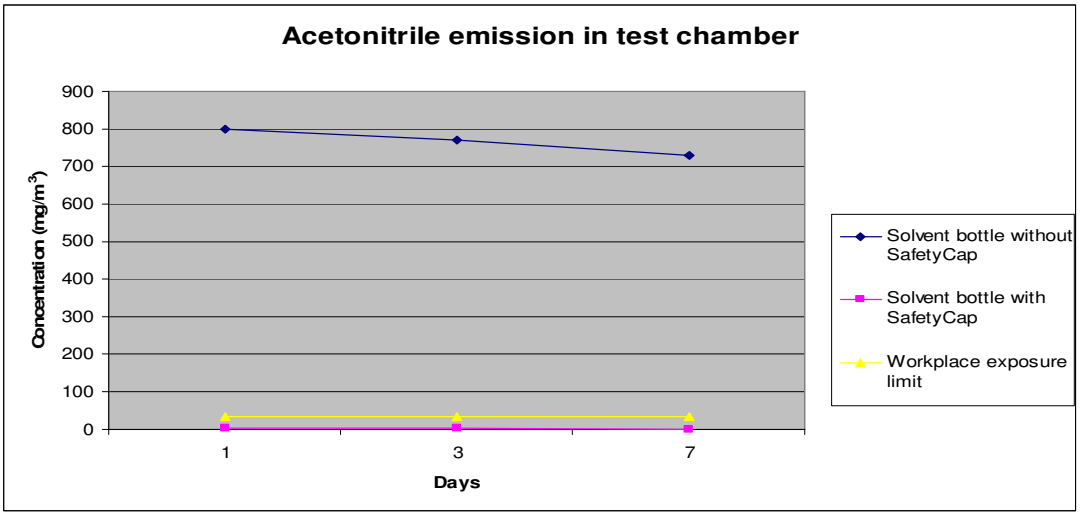


It becomes evident that with a solvent bottle without a SafetyCap in the test cabinet, despite a continual air change, a concentration of methanol of 630 — 660 mg/m^3 could be established, whereas with a solvent bottle with SafetyCap the results showed concentration of only 1 - 2 mg/m^3.

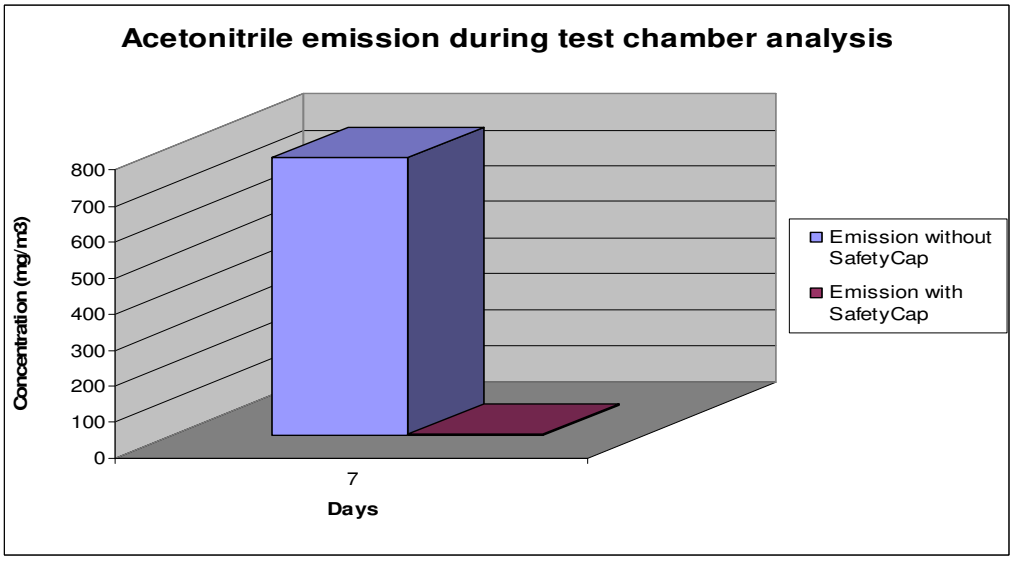


This shows that with the SCAT SafetyCap a significant reduction, almost to 0, of the methanol concentration in the test cabinet was achieved, thus falling significantly short of the workplace exposure limit TRGS 900 of 270 mg/m^3. In contrast to this, when the SCAT SafetyCap was not fitted, the methanol concentration in the test cabinet was 630 - 660 mg/m^3, which is significantly higher than the workplace exposure limit, resulting in an exposure which can affect the health of the employees in the laboratory.

Similar results were achieved in the test chamber measurements with Acetonitrile.



Using a SCAT SafetyWasteCap, a concentration of 1 – 5 mg/m^3 could be observed, while on the contrary, with the bottle without any SafetyCap, the Acetonitrile concentration, despite a continual air change, was 730 - 800 mg/m^3.



A comparison of the test cabinet emission results with the acetonitrile limit value to TRGS 900 of 34 mg/m^3 shows that without the SCAT cap, the acetonitrile concentration is significantly higher than the workplace exposure limit. In contrast to this, when the SCAT SafetyCap is fitted to the bottle of solvent, the acetonitrile concentration is significantly minimised, so that it is considerably lower than the workplace exposure limit to TRGS 900 of 34 mg/m^3.

Summary

In summary, it is evident that the solvent emissions could be significantly reduced by the SCAT SafetyCaps. In this respect, the use of SCAT SafetyCaps can be expected to lead to a clear reduction of the exposure of solvents in the atmosphere in a laboratory.

In this connection the reduction in the solvent concentration in the atmosphere can be assumed to be of a similar proportion as was described above, leading to a significantly lower health risk for the employees concerned.

Furthermore, SCAT SafetyCaps significantly minimise the risk of contamination of solvent-free blank samples in laboratories, so the use of SCAT SafetyCaps can also be considered a measure of quality assurance.

Please do not hesitate to contact us in the event of queries.

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