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# Consumer Survey on the Olfactory Evaluation of Different Natural Gas Odorants

## Abstract

The odorants used in Germany to odorize natural gas are mostly organic sulfurous compounds, although sulfur-free odorants are used too. This raises the question as to whether all these odorants are perceived as gas-warning agents and differ discernibly from other everyday odors.

To answer this question a multi-phase consumer survey was conducted from November 2014 to March 2015.

In cooperation with the independent market research company Förster & Thelen GmbH Bochum, 750 consumers were surveyed in face-to-face interviews. The perception of the three odorants: Gasodor®-S-free, Tetrahydrothiophen (THT) and Tert-Butyl Mercaptan (TBM) was tested in comparison to other unpleasant odors typically encountered in day-to-day routines. Each agent was applied to smelling sticks in similar dosages and presented for evaluation. The sample included an equal number of men and women aged between 20 and 59 from four different regions of Germany.

The results of the survey clearly show that all three gas odorants are perceived as significantly different from other everyday odors. They are rated as significantly more unpleasant, stranger and far more dangerous than the bad odors of everyday life. The survey further demonstrates high correspondence between the profiles of the three odorants.

In conclusion, the survey proves that all of the three tested gas odorants perform their function excellently.

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## Keywords

Natural gas

Gasodor® S-free

Gas-warning agent

Odorant

Odorization

Sulfur

Sulfur-free

Sulfurous

Tert-Butyl Mercaptan (TBM)

Tetrahydrothiophen (THT)

Consumer survey

## Consumer Survey on the Olfactory Evaluation of Different Natural Gas Odorants

What's that funny smell here? Is everything ok? Is it dangerous? Can I stay here? Or would it be better to get as far away as possible? Should I call the fire brigade? As soon as we perceive an unusual smell, we ask ourselves these or similar questions.

Why is that?

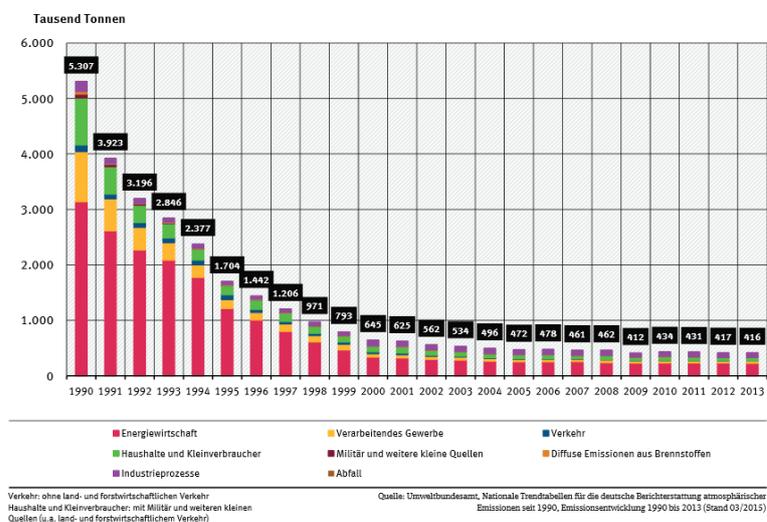
The sense of smell, the so-called olfactory perception, is one of our most important senses. It is largely developed at birth. One of its main biological functions is to distinguish whether a stimulus smells harmless or dangerous in order to judge whether a situation poses a risk or danger. In the latter case, running away could be the best strategy.

Odorizing – odorless – natural gas utilizes this alarm function of our sense of smell. Escaping gas should be perceived as a hazardous substance so that the appropriate actions are taken, i.e. reactions to protect your own life and that of others.

For many years, just sulfurous agents like THT (Tetrahydrothiophen) or the compound Tert-Butyl Mercaptan (TBM) were used for odorization – despite the negative impact on environment and industry. The Federal Environment Agency confirmed: “In high concentrations sulfur dioxide causes damage to humans, animals and plants. The oxidation products lead to “acid rain” which endangers sensitive eco-systems like forests and lakes as well as corroding buildings and materials.”<sup>1</sup>

Between 1990 and 2013, the sum of many initiatives led to a clear reduction of sulfur dioxide emissions. At 420,000 tons in 2013 emissions were 92.2% below the levels of 1990 (see figure 1: Emission trend from 1990 to 2013)<sup>2</sup>.

Schwefeldioxid-Emissionen nach Quellkategorien



<sup>1</sup> Federal Environment Agency 2015

<sup>2</sup> Federal Environment Agency 2015

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Given the growing environmental awareness of society and consumers, there were already calls for a sulfur-free natural gas odorant in the 80s and 90s. This led scientists of the Engler-Bunte Institute to develop, together with Symrise AG, the sulfur-free natural gas odorant Gasodor® S-free. It was launched on the market in 2001 and is the only DVGW-tested sulfur-free odorant available to date. According to the manufacturer, Gasodor® S-free combines “environmental compatibility with the highest standards of safety, cost efficiency and technology”.<sup>3</sup>

Since market launch, many natural gas networks have switched over to this sulfur-free odorant.  
4 5 6

Despite undisputed advantages, there has been much pro and contra debate in the past on whether Gasodor® S-free is perceived as a gas-warning or alarm odor and differs discernibly from other everyday odors. Furthermore, do consumers find it just as alarming and activating as the sulfurous odorants THT and TBM?<sup>78</sup>

Whereas one party questions the suitability of Gasodor® S-free as a gas-warning odor, the gas alarm statistics speak a different language. It was concluded by Dr. Frank Graf from the DVGW Research Department of the Engler-Bunte Institute of the Karlsruhe Institute of Technology (KIT) at the information event “Prospects of centralized sulfur-free odorization in the network of Creos Germany” that Gasodor® S-free is discerned as a gas-warning odor and that there is no evidence of lower perception in the population after conversion to sulfur-free odorization.<sup>9</sup> Thomas Osthoff, press officer of the Dortmund Fire Brigade, reports: “The citizens call just as often as they did before the conversion. We would rather people call one time too many than one time too few. There have been no incidents so far.”<sup>10</sup>

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<sup>3</sup> Symrise AG 2015

<sup>4</sup> Gastip.de Lange: Warning odor of natural gas to be converted, 2009

<sup>5</sup> Wolfsburger Allgemeine Nachrichten tru: New odor warns of natural gas, 2011

<sup>6</sup> Peiner Allgemeine Zeitung ale: Natural gas now smells different in the Peine district, 2014

<sup>7</sup> Deutscher Energievertrieb N.N.: Is it gas with that smell?, 2014

<sup>8</sup> AZ Benecke: Gasodor is not for someone with weak nerves, 2010

<sup>9</sup> DVGW Graf: Investigations on the development of gas odor statistics on/after conversion to Gasodor S-Free, 2010

<sup>10</sup> Ruhr-Nachrichten Müller: Warning odor under criticism, 2009

## Consumer Survey 1999

As early as 1999, Haarmann & Reimer (today Symrise AG) commissioned the independent research company CoCoCe, Freiburg, with the exploration of these issues. In the survey "Experimental smell test of gas warning odors versus control condition", three different gas odors were tested against one another, against food odors, a floral smell as well as a control condition (empty container).

There were two research phases: in phase 1 the odors were tested blind, i.e. the background of the survey was not communicated; in phase 2 it was revealed that the purpose of the test was to distinguish gas odors from other odors (see figure 2). All the odors were tested in so-called smell containers.

In the course of the survey, 107 test persons (consumers) were asked to smell and evaluate the different odors in a container. For phase 1 CoCoCe reaches the conclusion that the three tested gas-warning odors do not differ significantly. All three are considered "unpleasant", "chemical", "strange/ irritating" and hence satisfied the essential warning properties. At the same time all three gas-warning odors differ from the everyday odors and the control condition (without odorization). In phase 2, i.e. with the gas context, all three gas-warning odors again differ from the control odors and excellently fulfil the gas-warning indications (aggressive, strange/ irritating, unpleasant, alarming, chemical). In the final analysis, both experimental designs arrive at the same conclusion.

## Consumer Survey 2014/2015

As part of managing its product Gasodor®-S-free, Symrise AG commissioned a multi-phase consumer survey that was conducted from November 2014 to March 2015.

In cooperation with the independent market research company Förster & Thelen GmbH Bochum, 750 consumers were surveyed in two waves of face-to-face interviews.

The sample included an equal number of men and women aged between 20 and 59 from four different regions of Germany. The high number of included persons allows the results to be considered scientifically valid.

### Untersuchungsdesign der CoCoCe-Studie 1999

Phase 1:	Phase 2:
Am Vormittag <b>OHNE</b> Identifizierung der Studienabsicht: <i>„Wir möchten untersuchen, wie gut/ schlecht normale Verbraucher verschiedene Gerüche wahrnehmen können.“</i>	Am Nachmittag <b>MIT</b> Identifizierung der Studienabsicht: <i>„Wir möchten untersuchen, wie gut/ schlecht normale Verbraucher verschiedene Gasgerüche wahrnehmen können.“</i>

The objective of the survey was to test the perception of the three odorants: Gasodor®-S-free, Tetrahydrothiophen (THT) and Tert-Butyl Mercaptan (TBM) in comparison to other unpleasant odors typically encountered in day-to-day routines (bathroom, ethyl acetate, garlic, kitchen, onion). The selection of everyday odors was based on the former CoCeCe research and other studies of this kind so they can be considered typical.

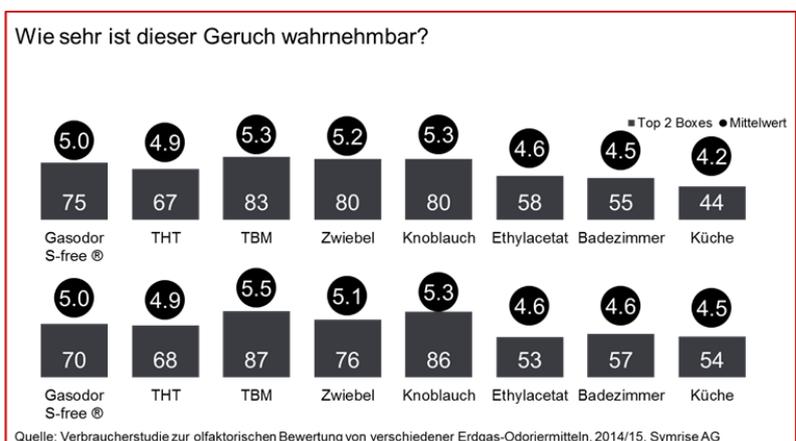
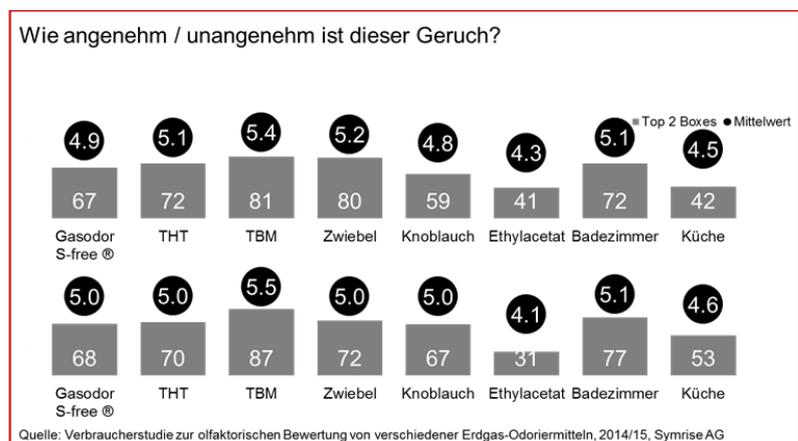
The test protocol specified that all agents must be applied to smelling sticks in similar dosages and presented for evaluation. Each consumer was given four different agents to evaluate in a blind test, i.e. they were not told which agents were being smelt or that the survey was about gas odors or gas odorants.

### Acceptance and Perception of the Odorants compared to Everyday Odors

Both consumer tests consistently show that the gas odorants as well as the agents from the onion family (garlic and onion) are perceived to be significantly more unpleasant than the other everyday odors ethyl acetate, bathroom and kitchen (see figure 3).

The same applies to the strength of perception (see figure 4). Here again the tested odors clearly differ from one another.

Consistent results could be observed across both tests; test reliability is thus ensured.



## Characterization of the Gas-Warning Agents by Odor Profiles

It is now interesting to see whether the odors in the test have gas-warning properties and the extent to which these properties call to action. To answer this question, a number of properties were selected on the basis of other comparable tests. Therefore, the method of odor characterization can be assumed to be valid.

In the final questioning, the following attributes were included and put to the consumers:

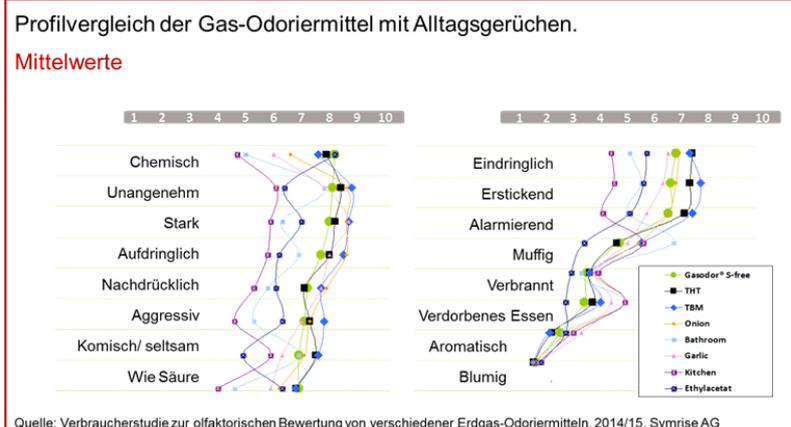
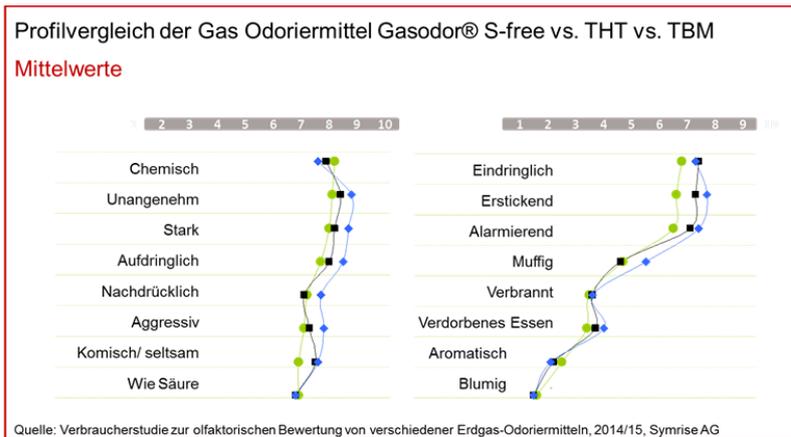
*chemical, unpleasant, strong, obtrusive, forceful, aggressive, strange/ weird, like acid, insistent, choking, alarming, musty, burnt, like rotten food, aromatic, floral*

The odor profiles reveal a clear result. Firstly, all three odorants have similar and hence comparable profiles for the most part (see figure 5).

This leads to the reliable conclusion that all three gas-warning odors are comparable. In addition, the consumers confirm the significant superiority of all three odorants over the everyday odors – including the odors from the onion family.

Finally, the question about the call to action was checked with

the statements which have proven their validity from our own research. All statements enable a description of odor perception and related actions:

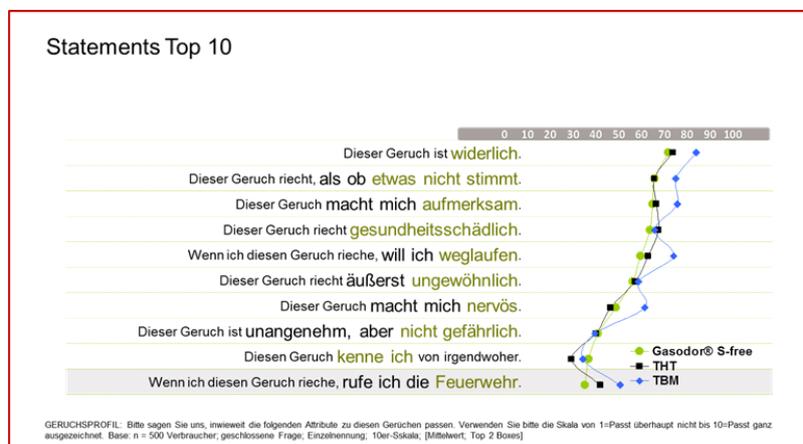


- This odor is **revolting**.
- This odor smells as if **something is wrong**.
- This odor **alerts** me.
- This odor smells **bad for the health**.
- When I smell this odor, I want to **run away**.
- This odor smells extremely **unusual**.
- This odor makes me **nervous**.
- This odor is **unpleasant**, but not dangerous.
- **I know** this odor from somewhere.
- When I smell this odor, I'd call the **fire brigade**.

The highest levels are reached for the two statements “This odor is revolting.” and “This odor smells as if something is wrong.”. With regard to the statements named the next most frequently, “This odor alerts me.” as well as – and here there is not the slightest difference between the agents

– “This odor is bad for the health.”, all three odorants provoke an action to guarantee personal safety. Many of the respondents agree with the statement:

“When I smell this odor, I want to run away.”. Consequently, this means that all three gas odors trigger alarm in basically equal measure (see figure 6).



To summarize, there is clear evidence on the basis of this consumer survey with 750 respondents that consumers perceive all three gas odorants as significantly different from everyday odors. Furthermore, all three gas odorants are rated as significantly more unpleasant, more alarming, stranger and more dangerous than everyday odors.

In the final analysis, the survey demonstrates that all of the three tested gas odorants perform their function excellently.

Karin Rita Fries, 6<sup>th</sup> December 2015

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## Short Profile of Karin Rita Fries



**Karin Rita Fries**, Regional Director Consumer & Market Insights, has devoted herself to market research after taking her degree in psychology. She has worked for large market research companies like e.g. GfK AG, managed the Institute for Youth Research in Munich for many years and conducted agricultural market research in China before joining the Symrise team in 2011. Today she investigates the fragrance preferences of consumers in Europa, Africa and the Middle East, and is always hunting for the latest fragrance trends.

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Book publication: Expensive Youth

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