

What is an offensiveness threshold value and complaint threshold value, and what is their correlation with the detection threshold value

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There are several threshold values commonly determined and used by researchers. Odour Threshold Value were developed in the 1970's when odour was first mentioned, and for so many years, they only referred to Odour Detection Threshold Values. However, there are different odour threshold values, such as: a detection threshold value, which is the most common threshold value used around the world and a recognition threshold value, which is used mostly in the United States.

The first official name of other threshold values was introduced during the 2004 Odour Conference in Cologne, Germany in a paper entitled, "Odour Assessment of Land Applied Materials," authored by A. Bokowa. However, ORTECH has used other values in the past.

This paper is an introduction to the new threshold values which include the Odour Offensiveness Threshold Values (OFTV) and Odour Complaint Threshold Values (OCTV) commonly used by ORTECH and which have even been adopted by the Ontario Ministry of the Environment. These values, together with the standard Odour Detection Threshold Values (ODTV) are the tools needed for assessing odours properly. OFTV is a point when fifty percent of the population indicates that the odour is offensive. OCTV is the point when fifty percent of the population will complain about the odour. These three parameters are commonly used in Ontario even by the Ontario Ministry of Environment upon introduction by ORTECH for assessing odours and in the future will help to establish if the odour is offensive and will help to predict the level of complaints by the residents. The correlation between the ODTV and OFTV, and the OCTV are also introduced in this paper, as is the calculation of the emission rates based on OFTV or OCTV. The off-site odour concentration can be predicted not only by the Detection Threshold Value but also by Complaint Threshold Value, therefore in the future, we might establish a method of predicting complaints.

Introduction

Common approach for assessing odours is to collect the samples from the source and perform evaluation on the bags for odour detection threshold value. In 1970 when odour was introduced and some researchers published articles related to odour, there

was only a brief mention about threshold value (OTV) and a list of the threshold values were established for most of the pure compounds. However, that list only mentioned a threshold value (OTV) and was probably referring to the odour detection threshold value (ODTV). In the United States, a recognition threshold value was added with time, just to differentiate the detection threshold value which represents fifty percent of the population detecting odour and the recognition threshold value, which represent fifty percent of population recognizing an odour already detected. Therefore, the odour recognition threshold value was in most cases a lower value than the odour detection threshold value.

In recent years, there is a reference to “FIDO,” or “FIDOL”. What is FIDO? or “FIDOL?”

- F - refers to the frequency of the detected odour, meaning how often odour is detectable, once a week or once a month
- I - refers to intensity of the odour
- D - refers to the duration, meaning odour detected for a whole day or only for a few minutes
- O - refers to the offensiveness, but the most confusing factor is that most of the people refers to pleasant smell as “bakery” or offensive as “rotten eggs” – most common descriptor for hydrogen sulphide.
- L - refers to location, meaning detection of odour in the living room or when walking in the park.

Frequency and Duration need to be considered together when assessing an odour situation. Both parameters will depend on wind direction and the footprint of the odour source as it affects those in the path. However, the offensiveness is a parameter which is the most confusing aspect, even by researchers. Offensiveness is often measured by criteria called “hedonic tone.” Hedonics is a branch of psychology dealing with pleasant and unpleasant feelings. When someone says “offensive,” most of the people think about a not pleasant smell such as rotten eggs. I have even found that some of the consultants are using the word offensiveness as a descriptor. Yet, is this accurate? Even pleasant odours if they persist long enough or are frequently present may become offensive or objectionable. A bakery or coffee smell may be offensive if exposed frequently for a certain period of time and sometimes, even not a long time. Therefore, the most second important parameter, after odour detection threshold value is frequency, because after a certain frequency if person is even exposed to any odour, pleasant, or unpleasant for a very short time, it might trigger complaints. For example, if person lives downwind from the dominant wind direction of coffee or bakery facility, which is obviously a very pleasant smell, and the exposure of that person is sixty to seventy percent of the time, even a short time of exposure (a few minutes) might trigger complaints. Therefore, it is important that new parameters such as OFTV and OCTV are considered in order to establish future complaint levels.

It is also important to establish a level of offensiveness when controlling odours. In some cases such as Waste Water Treatment Plants when the amount of the hydrogen sulphide and total reduced sulphur compounds were reduced by the scrubber, however, a reduction resulted in a production of the sulphur dioxide which is also odorous and results may be lower levels of the major components but might not change the level of the offensiveness and complaints.

Methodology

During the standard odour evaluation using a dynamic olfactometry, the panelists are asked if they can detect an odour and that value is recorded as an odour detection threshold value (ODTV). However, the same panelists are also asked if the detected odour is offensive and if they would complaint to the Ministry or other authorities about the detected odour. Therefore, when ODTV is calculated as fifty percent of the population/panelists detecting an odour, the offensiveness threshold value (OFTV), a value first established by the author and representing fifty percent of population/panelists indicates the detected odour is offensive. For the offensive odour, odour might be pleasant or unpleasant, meaning that the pleasant odour might be offensive after frequent or long exposure. During the same evaluation, the panelists are also asked if they would complain about the detected odour and that value is recorded as odour complaint threshold value (OCTV) and represents the level when fifty percent of population/panel will complain to the Ministry or other authorities about the odour.

The OFTV and OCTV are determined simultaneously with the ODTV for each sample and the results for the OCTV are calculated in the same way as the ODTV using regression analysis of the log of the dilution level versus the probit value of the percentage of the panel responding.

What is the relationship between all three values? To answer that question in the best way, is by introducing a few studies performed by ORTECH when all three values were used.

Case Study 1

This study was an extensive study for developing procedures for the odour evaluation of land-applied materials and a preliminary odour classification (odour index) of land applied materials. In this program, seventeen land applied materials were tested including liquid and solid materials.

The program was initiated as a result of the new Ontario Nutrient Management Act which addresses the effects of management practices on land-applied materials. Results from this program were used to incorporate the odour emission potential of the land-applied materials into the management practices. During that program it was important to establish the level of detection for each tested material but also the level of offensiveness and complaint when the material is spread on the field. Therefore, it was important to establish all three values: ODTV, OFTV, OCTV and seek a correlation between three of them.

Figure 1a: ODTV, OFTV and OCTV for Hog Feeders Underbarn Samples

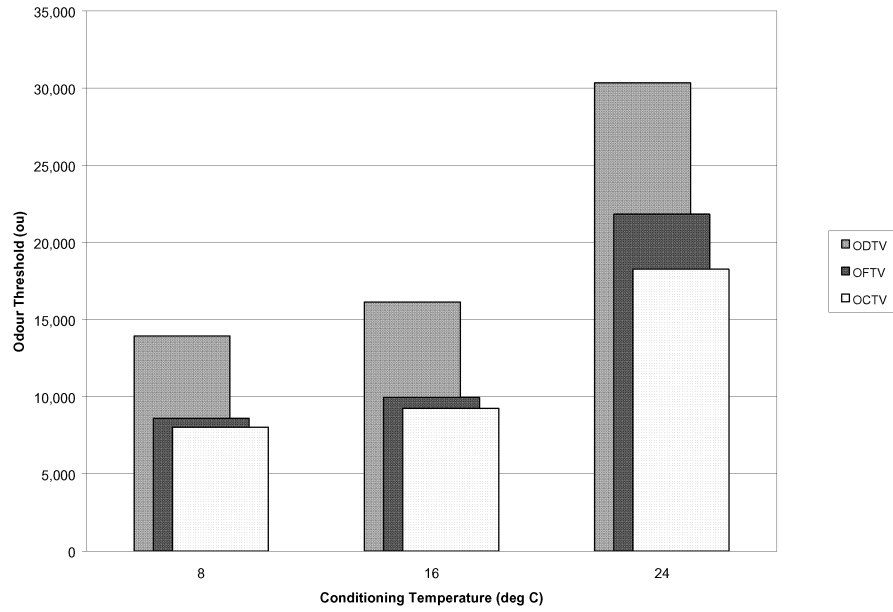


Figure 1b: ODTV, OFTV and OCTV for Sewage Biosolids Liquid Anaerobic

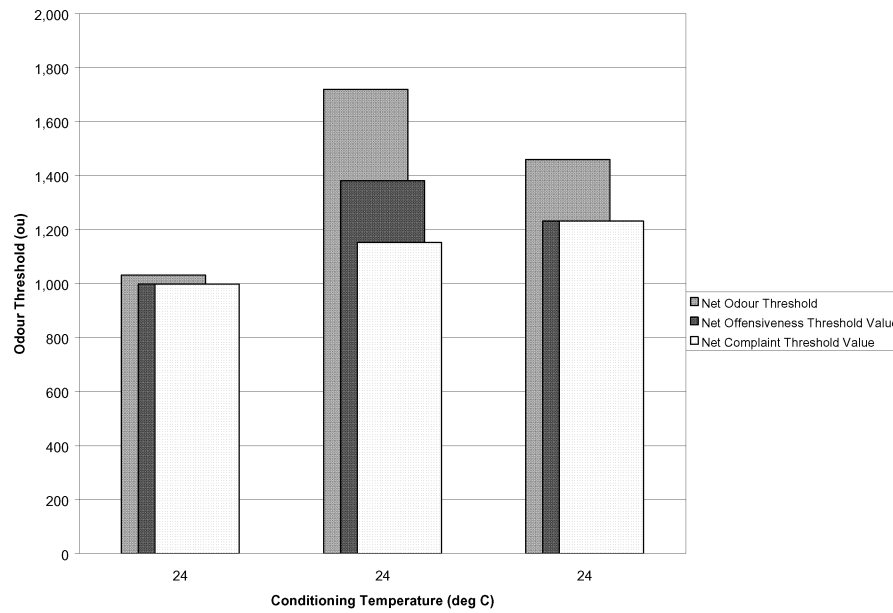


Figure 1a and Figure 1b present the graph for two different tested materials (hog feeders underbarn and sewage biosolids liquid anaerobic.). ODTV, OFTV and OCTV were established for each type of material at three different temperatures. As shown on the diagrams, for some of the materials (sewage biosolids liquid anaerobic – see Fig 1b) the

offensiveness threshold values and complaint threshold values are close to the detection threshold values, where in some cases the offensiveness threshold value is two third of the detection threshold value (hog feeders underbarn-see Figure 1a) . Again, both samples are not pleasant, however their offensiveness threshold values and complaint threshold values are different, therefore it would be expected that with sewage biosolids liquid anaerobic, complaints might occur sooner and at the level close to detection level after detection of the odour. Based on the diagram with hog feeders underbarn when spread, the complaint might occur at the level close to two third of the detection of the odour.

Case Study 2

During the assessment of one of the waste water treatment plants, odour samples were collected at several sources marked as Location 1 to Location 5. Samples were evaluated for ODTV, OFTV and OCTV. The off-site odour concentrations were predicted by model based on ODTV and OFTV.

Two separate emission rates were calculated for each source based on the detection threshold values and on the offensiveness threshold values. Both emission rates were used for dispersion modelling analysis.

Table 2 present the summary of the emission rates calculated based on the detection threshold values and offensiveness threshold values.

Table 2: Odour Emission Rates (ER) and Their Ratio

Location	ODTV ER (ou/s) m ³ Basis	OFTV ER (ou/s) m ³ Basis	Ratio ER (OFTV/ODTV)
1	1226	729	0.59
2	3121	1845	0.59
3	8086	3782	0.47
4	74	63	0.85
5	2640	1662	0.63

As shown in the Table 2, the emission rates based on the OFTV for some of the sources are close to a half of the emissions based on the detection threshold value. However, for some of the sources the emissions based on OFTV are very close to the emission rates based on ODTV, meaning when the odour is detected it is almost offensive.

Case Study 3

During the assessment of the emissions from the recycling facility two separate emission rates were calculated for each source based on the detection threshold values and on the complaint threshold values. Both emission rates were used for dispersion modelling analysis.

Table 3 present the summary of the emission rates (ER) calculated based on the detection threshold values and complaint threshold values.

Table 3: Odour Emission Rates (ER) and Their Ratio

Emission Source	OCTV ER (ou/s) m ³ Basis	ODTV ER (ou/s) m ³ Basis	Ratio ER (OCTV/ODTV)
Location 1	12961	13141	0.99
Location 2	2520	3690	0.68
Location 3	9901	10801	0.92
Location 4	34866	38099	0.92
Location 5	2618	2744	0.95
Location 6	6119	7628	0.80
Location 7	106256	108582	0.98
Location 8	9057	15317	0.59

In most locations/sources, the ratio of the ER based on OCTV to ER based on ODTV is between 0.8 to 0.99. Therefore, it is expected that the complaints will occur just automatically upon detection of the odour. However at Locations 2 and Location 8 the complaint threshold value is more than half of the detection threshold value. It is expected that for these two sources the complaint will not occur upon detection.

Case Study 4

This study is based on an assessment at one of the facilities which had a lot of complaints, therefore, the facility was willing to control odours at the stack by adding one of the available odour control agent (product). During the study odour samples were collected during two conditions: when the product was added (Product ON) and without the product (Product OFF). All collected samples were evaluated for ODTV, OFTV and OCTV.

Table 4 presents the results for this study.

Table 4: ODTV, OFTV and OCTV

Condition	Sample ID	GM ODTV (ou)	GM OFTV (ou)	GM OCTV (ou)
Product OFF	1	9874	5055	4972
	2			
	3			
Product ON	1	8205	5629	5252
	2			
	3			

GM-geometric mean taken from three samples

It is shown that with the Product OFF the ODTV was 9874 ou. However, when the Product was ON, ODTV was at the range of 8205 ou. It means by adding Product, ODTV was slightly lower. However, OFTV and OCTV were higher with Product ON than without. It is clear that by adding the product, the odour became more offensive. Again tested product had a pleasant sweet smell.

Conclusions

When assessing odours it is important to establish the Odour Detection Threshold Value (ODTV) as well as the other parameters such as Offensiveness Threshold Value (OFTV) or Complaint Threshold Value(OCTV).

There is a correlation between these values and for some of the sources the odour is offensive upon detection which leads to complaints and in some cases the OFTV and OCTV are two third or half of the ODTV. Complaints will usually occur upon the time when the odour became offensive; however, it might not necessarily correspond to an unpleasant smell.

References

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