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Application of the standard Sniffin' Sticks method to the determination Odor Inpectors' olfactory sensitivity in Poland

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In Poland there is ongoing work on the prevention and odor control Policy. Thus, methods' standardization of determination of olfactory detection threshold of the Odor Inspectors is one of a key issue. Selection of assessors according to the standard EN: 13725:2003 (Air Quality – Determination of odor concentration by dynamic olfactometry) requires technical infrastructure and panel members, what can be too expensive in present economic conditions in Poland. Then, application of the standard Sniffin' Sticks can be an alternative method of the determination Odor Inspectors' olfactory sensitivity in Poland.

This paper will present some olfactory sensitivity data in the form of odor detection thresholds from two above mentioned methods: dynamic olfactometry (in accordance to the standard EN:13725:2003) and Sniffin' Sticks method. In the last one the package of pens (14) with different concentration of n-butanol (from pen No 1 with concentration of n-butanol 64,8 mg/m^3 to No 14 0,0079 mg/m^3 respectively) was used. Pens were presented to 50 volunteers, especially students, according to standard procedure for testing individual odor sensitivity (St. Croix Sensory, Inc.). For every individuals breaks between two different methods was at least 4 days.

One-time-made intercomparison study shows that olfactory detection threshold of the volunteers for Sniffin' Sticks methods ranged from 5 to 11,5 (pen number), with a mean of 7, while Z_{ITE} values obtained during measurements with TO8 olfactometer varied from 97 to 12269. Insignificant correlation between results from two methods (R^2=0.07) was observed.

The research should be continued. Repetition of the study, preferably several times on the same population would allow more accurate information and some interesting results and data for statistical analysis.

1. Introduction

There is a need in Poland for legal regulations to be introduced on the subject of odour nuissance (Kapusta 2007). The laws which have been introduced in other countries are not ideal (Nicell 2009, Mahin 2001, Both 2001). Work is continuing in

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Poland on drafting an act of parliament which would counteract odour nuissance. The provisions introduced ought to be simple, effective and cheap; otherwise they may fail to function as intended. On the assumption that the odour nuissance will be assessed by sensory methods, it is necessary to identify suitable persons as assessors. The methods for determination of odour concentration by a selected team of assessors as proposed in the PN-EN 13725:2007 standard “Air quality. Determination of odour concentration by dynamic olfactometry”, (Polish Standardization Committee 2007) are costly, and require adequate technical resources and a panel of assessors. According to the standard the panel of assessors, playing the role of a sensor, should have odour sensitivity within a band of specified width, significantly narrower than the variation found in the population. This criterion is met by selecting assessors with specified sensitivity to the reference odorant n-butanol, using an olfactometer. The purpose of this research was to evaluate the Sniffin’ Sticks methods and its usefulness in selecting a panel of assessors, compared with the method contained in the standard.

2. Methodology

The tests used an Odor Sensitivity Test Kit marker set and a T08 olfactometer. The Odor Sensitivity Test Kit is a commercially available test used for chemical evaluation of sensitivity of smell (St. Croix Sensory 2005). Marker tests have been used medically to evaluate the sensitivity of patients’ sense of smell and to determine the distribution of odour sensitivity depending on sex, age, part of the world and cigarette smoking (Hummel et al. 2007, Hummel et al. 1997, Kobal et al. 1996, Kobayashi et al. 2006, Shu, Yuan 2008). Research on the use of the marker method in selecting assessors was proposed by Alice M. Lay and Charles M. McGinley, P.E. (Lay, McGinley 2004). In their research they did not make any reference to standards.

The test is based on a determination of the sensitivity of the subject’s sense of smell using a triangular forced-choice method (figure 1). The test kit consists of 14 markers saturated with various concentrations of n-butanol, and two “blind” markers (figure 2). The concentrations of n-butanol in the various markers are given in Table 1. A test consists of three rounds, the first serving as a warm-up. The markers are presented to the subject in series of three, of which one is saturated with the reference substance. The subject must select one of the markers as apparently saturated with n-butanol. The test is arranged so that the markers with n-butanol in each series go from the lowest concentration (2.44 ppm) to the highest (2%). The round ends when the marker with n-butanol is correctly selected in two consecutive series. The result reported is the average of the numbers of the markers identified in the second and third rounds. The tests were performed in accordance with the standard procedure for determining individual odour sensitivity, developed by St. Croix Sensory, Inc. (St. Croix Sensory 2006).

Figure 1. Sniffin' Sticks methods in progress

Figure 2. Odor Sensitivity Test Kit

Tests using an olfactometer were performed in accordance with the procedure contained in the standard (Polish Standardization Committee 2007). For dilution, n-butanol at a concentration of 59.8 ppm was used. The tests were performed at time intervals of not less than 4 days.

Table 1. Concentrations of n-butanol in the markers.

Pen number	Concentrations of n-butanol	Concentrations of n-butanol [mg/m^3]
2	2%	64,8
3	1%	32,4
4	0,50%	16,2
5	0,25%	8,1
6	0,125%	4,05
7	0,0625%	2,025
8	0,03125%	1,0125
9	0,015625%	0,50625
10	78,13 ppm	0,253125
11	39,06 ppm	0,126563
12	19,53 ppm	0,063281
13	9,77 ppm	0,031641
14	4,88 ppm	0,01582
15	2,44 ppm	0,00791

3. Scope of the test

The tests were carried out on a population 50 persons, mainly students, using a marker test and an olfactometer. Some of the assessors were tested twice. The interval between the two test sessions was three months. The marker tests were carried out by four operators. A single marker test lasted approximately 30 minutes. The tests were conducted in an olfactometric laboratory meeting the requirements of the PN-EN 13725:2007 standard.

4. Results and analysis

Analysis of the test results showed that the results obtained using the marker method do not correlate with the results obtained using olfactometry. The correlation coefficient for the two methods takes the value R^2=0,072 (Figure 3). The correlation coefficient was determined based on the results from both test sessions. The results for persons tested twice were not averaged, but were treated as two independent results. Figure 4 shows the relationship between the results obtained from olfactometry – individual threshold estimate, expressed as a degree of dilution – and results obtained using the Sniffin' Sticks methods, expressed as a marker number (average value obtained in the second and third round).

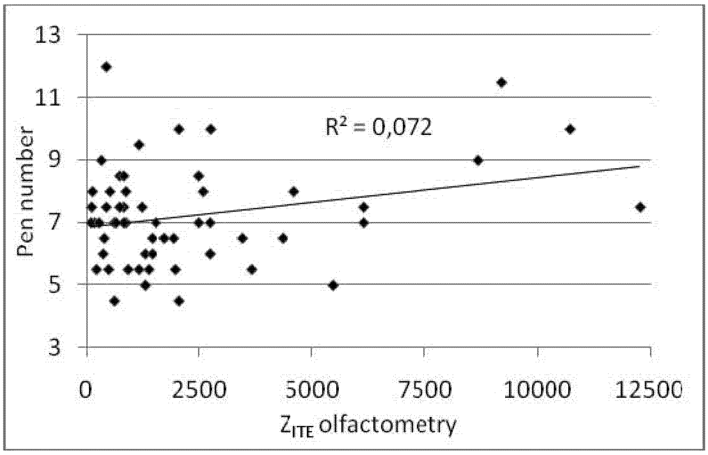

Figure 3. Relationship between results obtained using the marker test and olfactometry.

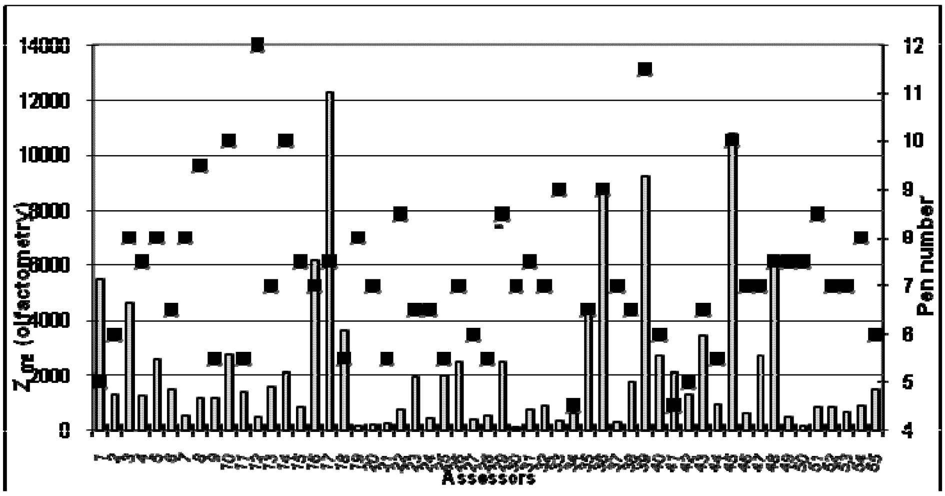

Figure 4. Comparison of evaluations of individual threshold, expressed as a degree of dilution, and results from the Sniffin' Sticks methods expressed as a marker number.

In order to check whether the results are influenced by the operator, individual correlation coefficients were determined for each operator. Operator 1 tested 18 assessors, operator 2, 3 and 4 tested 20, 7 and 8 assessors respectively. The values of the correlation coefficients for the operators were respectively as follows: $R_1^2=0.27$; $R_2^2=0.02$; $R_3^2=0.01$; $R_4^2=0.17$. Analysing these values, it can be stated that the absence of significant correlation between the results obtained by the two methods is not dependent on the operator conducting the Sniffin' Sticks test.

A separate analysis was made of the results obtained for persons who are qualified to judge samples of odorous gas, using dynamic olfactometry within the scope of this standard. For 14 persons, a comparison was made with the marker results. No significant correlation was observed. The correlation coefficient was $R^2=0.00003$. The persons meeting the criteria in the marker test obtained results ranging from 4.5 to 9.

5. Conclusions

A single marker test cannot be used for proper selection of a person to take part in odorimetric tests according to the EN 13725 standard ("Air quality. Determination of odour concentration by dynamic olfactometry"). An insignificant correlation was observed between the results obtained using the two methods (correlation coefficient $R^2=0.07$).

Results obtained by the two methods is not dependent on the operator conducting the Sniffin' Sticks test.

The markers identified by the test subjects ranged from 4.5 to 11.5, with an average of 7 (marker number). The persons meeting the criteria for team members according to the standard obtained marker test results ranging from 4.5 to 9.

To take advantage of Sniffin' Stick method in the legal act the procedure should be better describe. Some research should be done which give an answer in which conditions results of pen test will be acceptable for using in legal regulations.

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