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Holzforschung

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Braunschweig,
April 26, 2002

WKI Test Report No. 616/02

Customer: SHARP ELECTRONICS (EUROPE) GmbH

Object: Testing of SHARP AIR PURIFIER FU-40SE

Content:

This test report comprises 9 pages.

1. Introduction

With message dated March 26, 2002 SHARP ELECTRONICS EUROPE GmbH gave order to the Wilhelm-Klauditz-Institut (WKI), Fraunhofer-Institut für Holzforschung, to perform a chamber test on the SHARP AIR PURIFIER FU-40SE (PLASMA CLUSTER) including charcoal filter. The device was delivered March 28, 2002.

2. Experimental

The experiment was carried out in a self constructed 1 m^3 glass chamber (Salthammer and Wensing, 1999) according to the European Standard for emission test chambers ENV 13419-1 (1999). The chamber is purged by compressed air, which is passed through an oil separator, activated charcoal and dust filter for purification. The air flow is steadily controlled by a mass-flow-controller (MKS 147). The required humidity is regulated by mixing dry and wet air. The air in the chamber is mixed by a rotating cylinder, which also contains the heating unit. The temperature is measured by use of a Pt 100-thermocouple (Juchheim). To avoid temperature gradients, the chamber is covered with aluminium foil and insulating boards (see Figure 1). Before the test the chamber was heated to 70°C for 48 h to reduce memory effects and keep the chamber blank low. The effectiveness of thermal cleaning process was controlled by measuring a blank value before each experiment.

The chamber experiment was performed April 11, 2002. The test conditions summarized in Table 1 were applied:

Table 1: Test conditions in the 1 m^3 - chamber.

T (°C)	relative humidity (%)	air exchange (h^{-1})	air velocity (m/s)	loading
22.5	41 – 47	---	---	1 Air Purifier

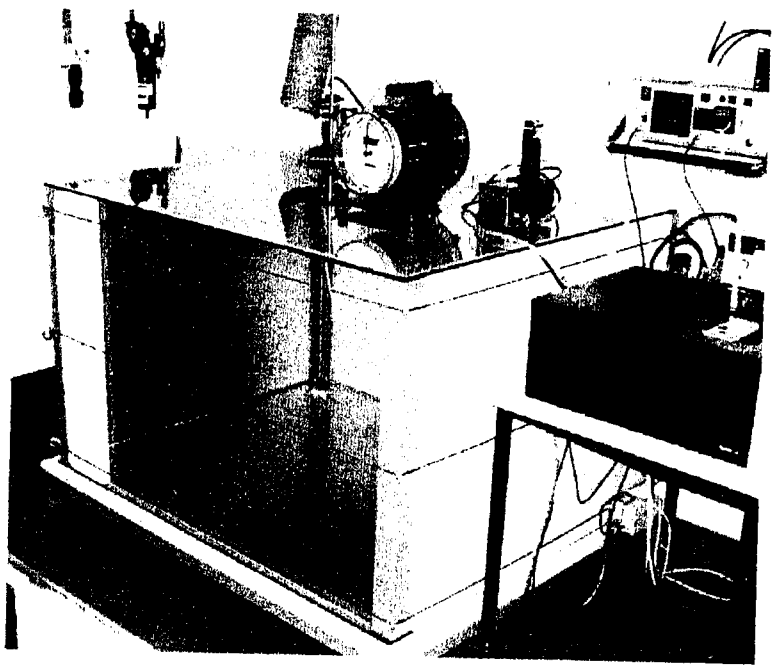

Figure 1: View of the 1 m³ test chamber.

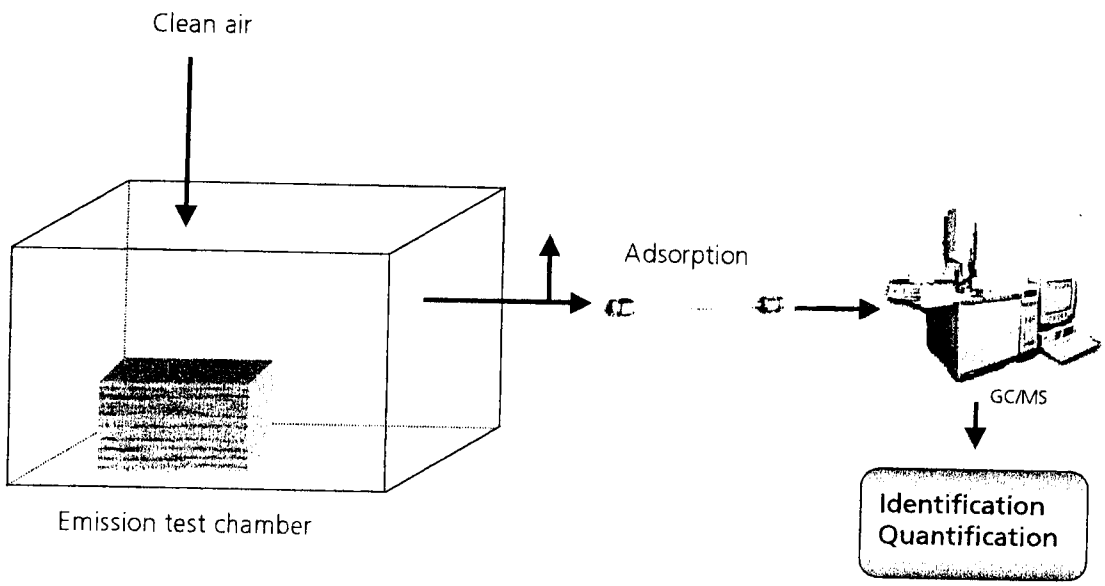

Figure 2: Principle of chamber testing with sampling on Tenax TA and GC/MS analysis.

Volatile organic compounds in the chamber air were identified and quantified via GC/MS (Hewlett Packard 6890) after collection on Tenax TA (2 - 3 l) and thermal desorption (Perkin Elmer ATD 400). The experimental setup is shown in Figure 2.

The Molhave mixture (Molhave, 1991) was used for testing. The 22 compounds (see Table 2) were mixed in a 10 ml flask. To achieve indoor typical VOC-concentrations in the test chamber (50 – 300 µg/m³) the amount of each compound was 100 µl. From the mixture, 4 µl were injected into the test chamber by use of a microsyringe.

The performance of the test was as follows:
The test has been carried out including charcoal filter.

1) Measurement of chamber blank value
2) Loading of chamber with SHARP AIR PURIFIER (power off)
3) Measurement of VOC-concentration in the chamber after 60 min
4) Injection of 4 µl VOC-mixture
5) SHARP AIR PURIFIER power off
6) Measurement of VOC - concentration in the chamber immediately after injection and after 10 min
7) SHARP AIR PURIFIER power on (stand by)
8) Measurement of VOC- concentration in the chamber after 20, 30 and 45 min
9) SHARP AIR PURIFIER operation mode (plasma on)
10) Measurement of VOC- concentration in the chamber after 60, 75, 95, 110 and 125 min

3. Results

It was the aim of this experiment to investigate the influence of the SHARP AIR PURIFIER on VOC-concentrations in the gas phase.

All compounds identified in the chamber air are compiled in Table 2. In addition to the 22 components of the Molhave-mixture, ethanol appeared in the chamber air. Decreasing (↓) or constant (→) VOC-concentrations are indicated by an arrow.

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The chamber concentrations (static conditions) in the time range from 0 – 125 minutes are given in Table 3. Figures 3 shows the time versus concentration curves for 2-propanol, ethanol and the ΣVOC-value.

Neither ethanol nor 2-propanol are classified as hazardous compounds (Streit, 1994). Ethanol is produced during fermentation and therefore part of alcoholic beverages. 2-Propanol is mainly used for cleaning and ingredient of many household and consumer products (Salthammer, 1999).

For ethanol, 2-propanol and ΣVOC the chamber concentration can be regarded as low. However, it is not possible to extract specific emission rates according to ENV 13419-1 because the chamber was operated under static conditions.

4. Conclusion

The SHARP AIR PURIFIER Model FU-40SE (including charcoal filter) was tested for the ability to remove volatile organic indoor air pollutants (VOC). The test was carried out under static conditions (no air exchange) in a 1 m³ test chamber by use of the Molhave-mixture. For most of the target compounds, operation of the SHARP AIR PURIFIER had a distinct effect on the chamber concentration. In nearly all cases chamber concentrations decayed below the detection limit within 1 hour. Only two components (ethanol and 2-propanol) could be detected in the chamber air in low concentrations.

The tested device is an efficient tool for removal of VOC from indoor air.

Officer in Charge

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Head of Department

Dr. T. Salthammer

References

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Salthammer T. (1999) Volatile ingredients of household and consumer products. In Salthammer T. (Ed.): Organic Indoor Air Pollutants. WILEY-VCH, Weinheim, 219-232.

Salthammer T. and Wensing M. (1999) Emissionsprüfkammern und –zellen zur Charakterisierung der Freisetzung flüchtiger organischer Verbindungen aus Produkten für den Innenraum. In Moriske H.-J. and Turowki E. (Eds.): Handbuch für Bioklima und Lufthygiene, Landsberg, Ecomed-Verlag, III-6.4.1.

Streit B. (1994) Lexikon Ökotoxikologie. VCH, Weinheim.

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Table 2: Concentration of VOC in the chamber air (→: constant concentration, ↓: decreasing concentration).

Molhave-mixture		new components	
compound	**concentration**	**compound**	**concentration**
2-Propanol	→	Ethanol	→
MEK	↓		
Hexane	↓		
1,2-Dichloroethane	↓		
3-Methyl-2-butanone	↓		
1-Butanol	↓		
Pentanal	↓		
MIBK	↓		
1-Octene	↓		
Hexanal	↓		
Butylacetate	↓		
Ethylbenzene	↓		
p-Xylene	↓		
Nonane	↓		
Ethoxyethylacetate	↓		
α-Pinene	↓		
Propylbenzene	↓		
1,3,5-Trimethylbenzene	↓		
1-Decene	↓		
Decane	↓		
Undecane	↓		

Table 3: VOC – concentrations in the test chamber

Compound	Concentration in µg/m³ after									
	0 min	10 min	20 min	30 min	45 min	60 min	75 min	95 min	110 min	125 min
Ethanol /Propanol	<1	<1	52	81	41	38	54	32	46	53
2-Propanol/Propanol	192	174	71	104	78	72	76	65	88	79
MEK /Ion 72	76	36	<1	<1	<1	<1	<1	<1	<1	<1
Dichloroethane	124	63	<1	<1	<1	<1	<1	<1	<1	<1
3-Methyl-2-butanone/Ion 86	88	44	<1	<1	<1	<1	<1	<1	<1	<1
n-Butanol	70	31	<1	<1	<1	<1	<1	<1	<1	<1
Pentanal	42	20	<1	<1	<1	<1	<1	<1	<1	<1
MIBK	84	40	<1	<1	<1	<1	<1	<1	<1	<1
Octene	81	39	<1	<1	<1	<1	<1	<1	<1	<1
Hexanal	65	29	<1	<1	<1	<1	<1	<1	<1	<1
n-Butylacetate	97	46	<1	<1	<1	<1	<1	<1	<1	<1
Ethylbenzene	106	51	1	<1	<1	<1	<1	<1	<1	<1
p-Xylene	103	49	1	<1	<1	<1	<1	<1	<1	<1
Nonane	94	46	2	<1	<1	<1	<1	<1	<1	<1
Ethoxyethylacetate	97	45	<1	<1	<1	<1	<1	<1	<1	<1
α-Pinen	103	50	<1	<1	<1	<1	<1	<1	<1	<1
Benzaldehyde/Ion 77	4	3	2	2	2	3	1	1	1	1
Propylbenzene	101	48	2	<1	<1	<1	<1	<1	<1	<1
Mesitylene	99	46	2	<1	<1	<1	<1	<1	<1	<1
Decene	80	36	<1	<1	<1	<1	<1	<1	<1	<1
Decane	83	41	4	2	2	<1	<1	<1	<1	<1
Undecane	71	32	4	2	1	<1	<1	<1	<1	<1
Hexane	69	39	<1	<1	<1	<1	<1	<1	<1	<1
Cyclohexane	46	53	<1	<1	<1	<1	<1	<1	<1	<1
Σ VOC	1976	1061	142	192	123	113	132	99	136	133

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