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*Characteriaztion of the photocatalytic efficiency of the*

# *UVE 110-220 PHOTOCATALYST-CONTAINING ANTISEPTIC, ANTI-ODOUR AND AIR CLEANER HYGIENE DEVICE*

*via gas chromatography*

documented by:

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Our group performed the **characterization** of the gas-phase volatile organic compound-(VOC) elimination capabilities of the germicidal ***UVE 110-220 type*** UV **PHOTOCATALYST-CONTAINING ANTISEPTIC, ANTI-ODOUR AND AIR CLEANER HYGIENE DEVICE**, that is a photocatalytic **air sanitizer and air cleaner device**, provided by *Air-Filter Ltd.* for the **purpose of qualification**.

**Methodology:** During the characterization process, the device and the model compound with known initial concentration ($c_0$=0.02 mM) were kept inside a hermetically sealed reactor. By sampling the reactor space regularly, the decline in the concentration could be recorded as a function of time.

**The applied model volatile organic compound (VOC) was gas-phase ethanol (ethanol vapour).**

The gas chromatography (GC) measurements were performed applying a Shimadzu GC- 14B device, which can be seen in **Fig. 1. ábrán**.

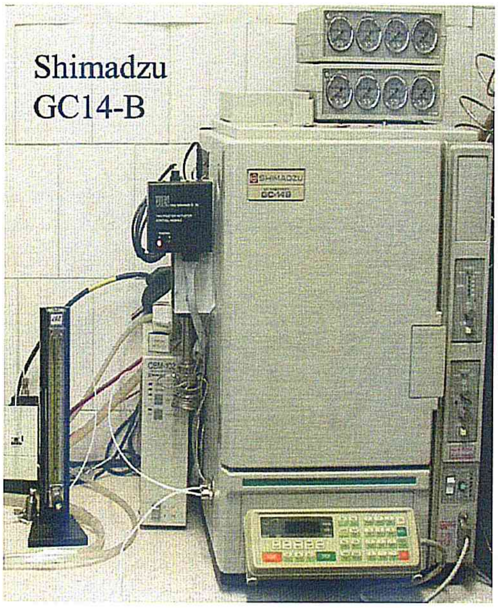


**Figure 1.** Shimadzu GC- 14B gas chromatograph

The product compounds of the photodegradation process were separated on a HayeSep Q packed column and could be analyzed by the help of the connected thermal conductivity (TCD) and flame ionization (FID) detectors.

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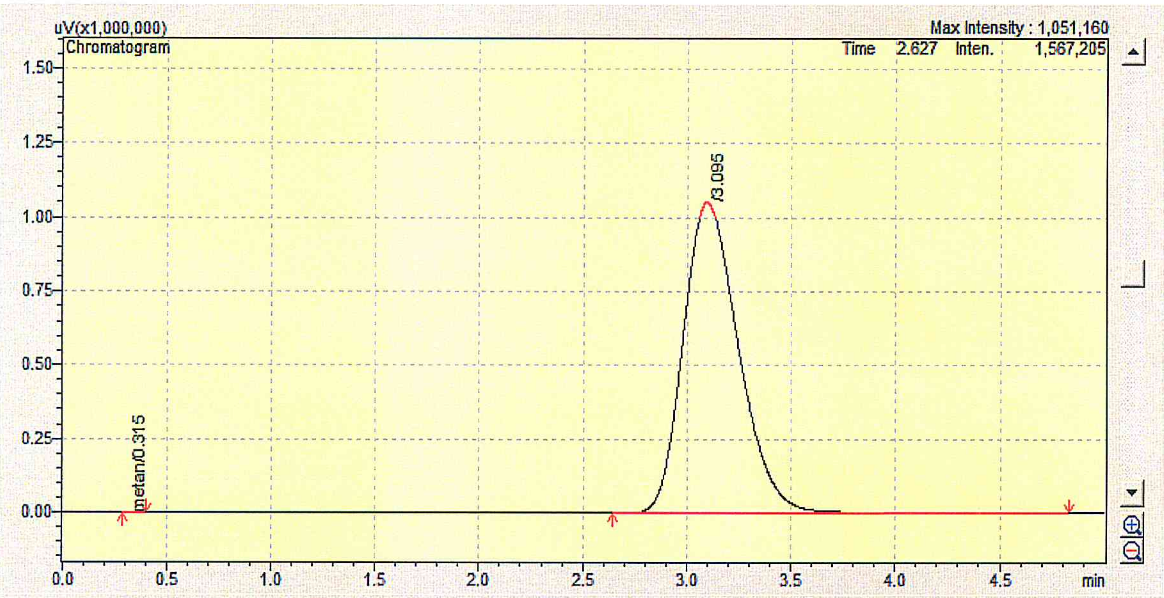
The resulting chromatograms (**Fig. 2.**) contain information on the product quality (retention times) and the quantity (area under a peak), as well. The relation between the peak areas and the concentration of a sample component is determined during a preliminary calibration process. During the measurements, we applied a HayeSep Q type column and a flame ionization detector (T=140°C), while the carrier gas was nitrogen.




Results - Peak Table

Peak Table | Compound | Group | Calibration Curve

| Peak# | Ret.Time | Area | Height | Conc. | Units | Mark | Compound ID# | Compound Name | Resolution |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.315 | 3031.7 | 1840.7 | 0.00000 | ppm | | 2 | metan | -- |
| 2 | 3.095 | 19459360.8 | 1049984.2 | 0.00000 | | E | | | 10.623 |

**Figure 2.** Chromatogram of ethanol, detected at 140°C

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The data, obtained through the application of the above described methodology is depicted as a function of illumination (measurement) time in **Fig. 3.** To give a comparison, the measurement was performed without using the air cleaner unit, as well (control).

The following results indicate, that **the tested photocatalytic device is capable of the photooxidative elimination of organic compounds with high efficiency**.

According to our measurements, **the device decomposed the initial 0.02 mM ethanol by 40% during the six-hour illumination period.**

However, it is important to note, that the applied 0.02 mM *(~0.88 g/m³)* initial concentration is much higher (by 3-4 orders of magnitude) than the average VOC concentration of the ambient air (**Table 1.**).

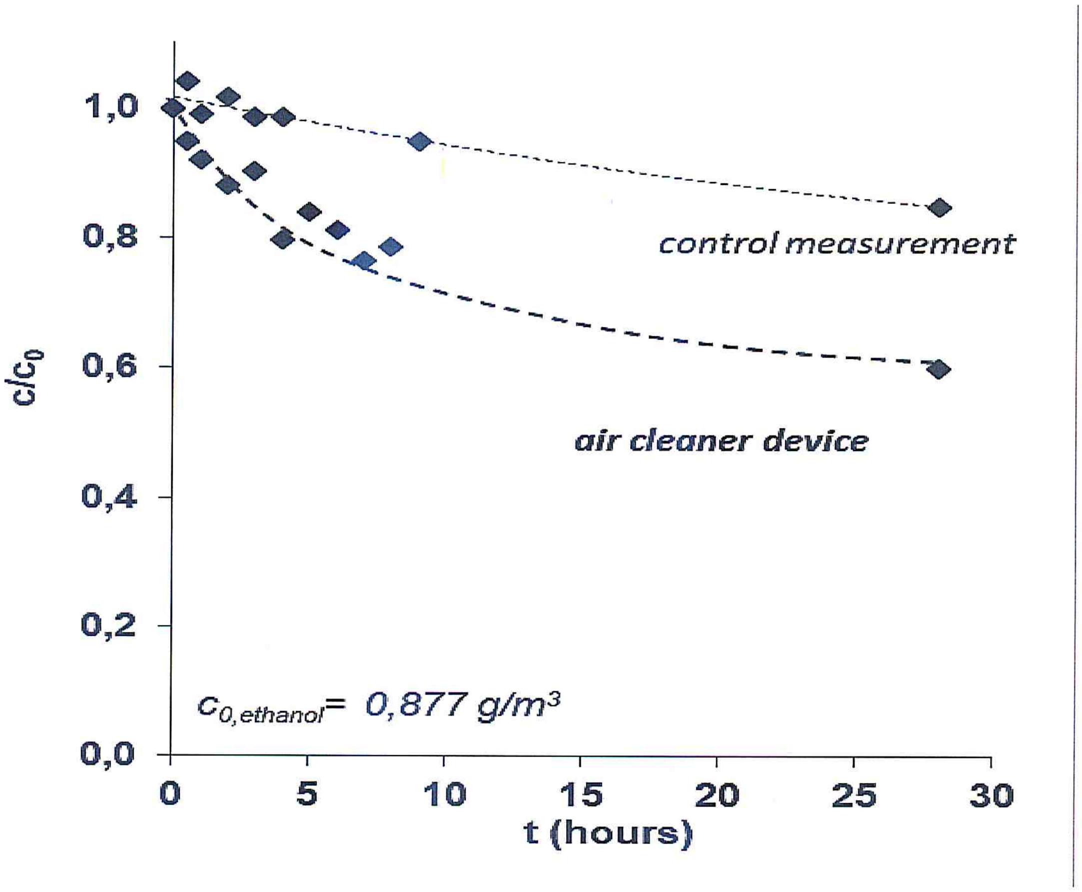


**Fig. 3.** Decreasing relative concentrations of the ethanol test molecules during the operation of the air cleaning device

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**Table 1.** Average concentration values of different volatile organic compounds (VOC) in air. (*source: Montero-Montoya R, et al. Volatile Organic Compounds in Air: Sources, Distribution, Exposure and Associated Illnesses in Children. Annals of Global Health. 2018; 84(2), pp. 225–238. DOI: https://doi.org/10.29024/aogh.910*)

| *Benzene µg/m³ | Toluene µg/m³ | Ethylbenzene µg/m³ | o-xylene µg/m³ | m, p-xylene µg/m³ | Country | Type of measurement | Reference |
|---|---|---|---|---|---|---|---|
| **1.21** | 14.33 | 2.55 | 2.16 | 5.97 | USA population | Personal exposure | [66] |
| 0.63 | 1.09 | 0.32 | 0.26 | - | Canada | Outdoor levels | [67] |
| 0.78–0.88 | - | - | - | - | Stenungsund, Sweden, Petrochemical area | Outdoor levels | [68] |
| **2.15** | 6.83 | 1.28 | 1.46 | 3.56 | USA population | Outdoor levels | [21] |
| **3.64** | 19.2 | 2.78 | 2.87 | 8.07 | USA population | Personal exposure | [21] |
| **1.5–6.95** | 7.17–26.9 | 0.59–2.06 | 0.94–4.16 | 3.07–13.3 | Review of studies in the world | Outdoor levels | [10] |
| **1.21–2.8** | 14.33 | 2.55 | 2.16 | 5.97 | Review of studies in the world | Personal exposure | [10] |
| **15.07** | 139.35 | 24.68 | 13.39 | 27.88 | Kwai Chung in Hong Kong industrial area | Outdoor levels | [8] |
| 0.7–3.5 | 2.3–6.0 | 0.4–5 | - | 1.9–2.3 | Viseu, Portugal | Outdoor levels | [40] |
| **13.42** | 18.9 | 1.8 | 2.3 | 10.91 | La Plata industrial area, Argentina | Outdoor levels | [69] |
| 0.58–3.0 | 2.8–5.9 | 0.2–1.6 | 0.26–1.3 | 1.3–3.5 | Curitiba, Brazil, suburban area | Outdoor levels | [70] |
| 0.58–6.0 | 4.3–73 | 0.19–2.5 | 0.24–45 | 1.3–6.9 | Curitiba, Brazil, suburban area | Personal exposure | [70] |
| **5.9** | 37.9 | 5 | 5.9 | 14.9 | Mexico City | Outdoor levels | [24] |
| **10.6** | 86.1 | 8.1 | 9.1 | 25.2 | Mexico City | Personal exposure | [24] |
| **2.18–3.7** | 17.17–46.9 | 2.4–7.2 | 2.8–11.3 | 3.8–11.7 | Mexico City | Outdoor levels | [17] |
| **1.1–5.3** | 2.3–14.0 | 0.4–2.2 | 0.5–3.2 | 1.4–8.0 | Industrial area, Tlaxcala, Mexico | Outdoor levels | [74] |
| *0.03* | *5* | *1* | *0.1* | *0.1* | *USA* | *Outdoor levels* | *Rfc (mg/m³)* [71] |
| *1.01* | *6.95* | *1.5* | *1.5* | *4.1* | *Global* | *Personal exposure* | ** *µg/m³* |

* Bold numbers in the benzene column represent increased risk of leukemia for those populations.
** Lowest concentrations found to produce health effects [10].

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