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Discussion Paper

The method to measure the UV emittance of low-pressure-lamps: a commentary on Schmalwieser *et al*. (2021)

Lianfeng Zhang

Laboratory of Ecology and Environmental Protection, Research Institute of Tsinghua University in Shenzhen, 7th Way of Gaoxin South, Nanshan District, Shenzhen, Guangdong 518057, China
E-mail: ofc@tsinghua-sz.org; tyou6@hotmail.com

ABSTRACT

In the paper by Schmalwieser and colleagues, the irradiance on the wall of a cylindrical UV reactor for water disinfection was measured. This is a useful way to measure/evaluate such UV devices. However, this measurement is not a solution for measuring the UV emittance of low-pressure-lamps. In fact, throughout the paper, the method and the emittance measurements that the title claimed were not really provided. The title of the paper claiming to be a 'standardized method to measure the longitudinal UV emittance' is misleading.

Key words: emittance, irradiance, lamp, measurement, UV

HIGHLIGHTS

- 'A standardized method to measure the longitudinal UV emittance' claimed in the title of the paper was not really provided throughout the paper.
- The measurement data of the emittance were not really provided throughout the paper.

Dear Editor:

Schmalwieser *et al*. (2021) contributed a paper, titled 'A standardized method to measure the longitudinal UV emittance of low-pressure-lamps in dependence of water temperature'. It provided the irradiance data measured on the wall of a cylindrical UV reactor for water disinfection. Their main contribution was the installation of the quartz windows on the wall of the cylinder. This is a useful way to evaluate/analyze such UV devices. However, this measurement is not a solution for measuring the emittance of UV lamps. The title of the paper has nothing to do with the content (text) of the paper, that is, the paper did not really provide the method and the measurement data of the emittance that the title claimed.

1. The emittance and the 'emittance (cos α_i)'

In the paper, the lamp was assumed as Lambertian source, $\varepsilon(\alpha_i) = \cos\alpha_i$ (Equation (12)), then such $\varepsilon(\alpha_i)$ was called 'emittance (cos α_i)' (Line 11, below Figure 3 on Page 910). Table 2 gave the data of such 'emittance (cos α_i)'. However, such 'emittance (cos α_i)' is not the emittance claimed in the title of the paper because:

(1) In the paper, the emittance was defined as 'radiant flux per unit area' (Line 1 of last paragraph on Page 910), independent of Lambertian emission, $\varepsilon(\alpha_i) = \cos\alpha_i$.
(2) We consider the 'radiant flux per unit area' (Line 1 of last paragraph on Page 910) to be the same as the general definition of academia/industry. As we all know, the emittance is a numerical value, the unit is mW/cm^2. It can be greater or less than or equal to 1. However, in this paper, the expressed value of 'emittance (cos α_i)' was always less than 1 without units.
(3) The data of the 'emittance (cos α_i)' in Table 2 are not measured data. This clearly indicates that 'emittance (cos α_i)' are not the emittance claimed in the title of the paper.

2. The emittance and the irradiance

The experimental data presented in this paper are irradiances or relative irradiances (Figures 5–8). The measured behaviors of irradiance were interpreted as the behaviors of emittance (Lines 3, 9, 18 of this section on Page 915). That is incorrect

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because the measured irradiances are not the emittance claimed in the title. Emittance and irradiance are completely different physical conceptions, see in the following.

(1) The definition of emittance in the paper is 'radiant flux per unit area' (Line 1 of last paragraph on Page 910). According to common understanding, the 'area' should be the surface area of the UV lamp.
(2) The irradiance was not clearly defined in the paper. Only relevant sentences such as 'measured by the device radiometer (W/m^2)' (Line 4 of the second paragraph on Page 901), 'at a defined position' (Line 9, Page 902) and 'at position n' (Line 6 after Equation (2b) on Page 905) can be found. All relevant correction factors are 'at position n' (The line above Equation (1) on Page 904; Line 2 after Equation (12) on Page 904; Line 9 on Page 906; Line 4 after Equation (12) on Page 907; Line 12 after Equation (19b) on Page 912). Based on the above information, and the authors did not give a new definition of irradiance, it can be considered that the authors still use the conventional definition of irradiance, which is 'the total radiant power from all directions incident on an infinitesimal element of surface area dS containing the point under consideration, divided by dS' (Bolton 2000).
(3) Emittance is a characteristic of a lamp, characterized by 'to irradiate'. Irradiance, on the other hand, is independent of any light sources, characterized by 'to be irradiated' on an infinitesimal element of the surface. In short, emittance and irradiance are completely different physical conceptions that need to be clearly defined and differentiated.

In conclusion, though claimed in the title, the paper by Schmalwieser *et al.* (2021) did not really provide a 'standardized method to measure the longitudinal UV emittance of low-pressure-lamps'. Since the 'standardized method' holds significant importance in the field of UV technology, it is necessary to clarify such a point.

Sincerely,
Lianfeng Zhang

DATA AVAILABILITY STATEMENT

All relevant data are included in the paper.

REFERENCES

Bolton, J. R. 2000 Calculation of ultraviolet fluence rate distributions in an annular reactor: Significance of refraction and reflection. *Water Research* **34**, 3315–3324.

Schmalwieser, A. W., Hirschmann, G., Eggers, J. & Sommer, R. 2021 A standardized method to measure the longitudinal UV emittance of low-pressure-lamps in dependence of water temperature. *Water Supply* **22** (1), 901–915.

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