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Braunschweig, 26.11.2018

Test report No. MAIC-2018-4944

(This test report replaces the test report MAIC-2016-1310 from 23.06.2016)

Object of the test: Investigations of the air cleaning effect of AIRY plant systems for formaldehyde.

Contents:

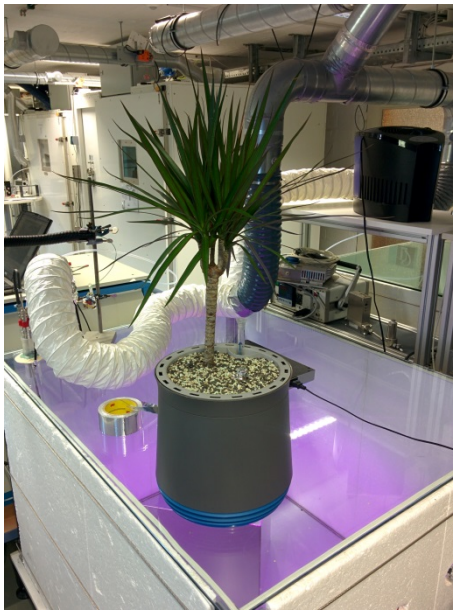
This report comprises 10 pages.

Sample description

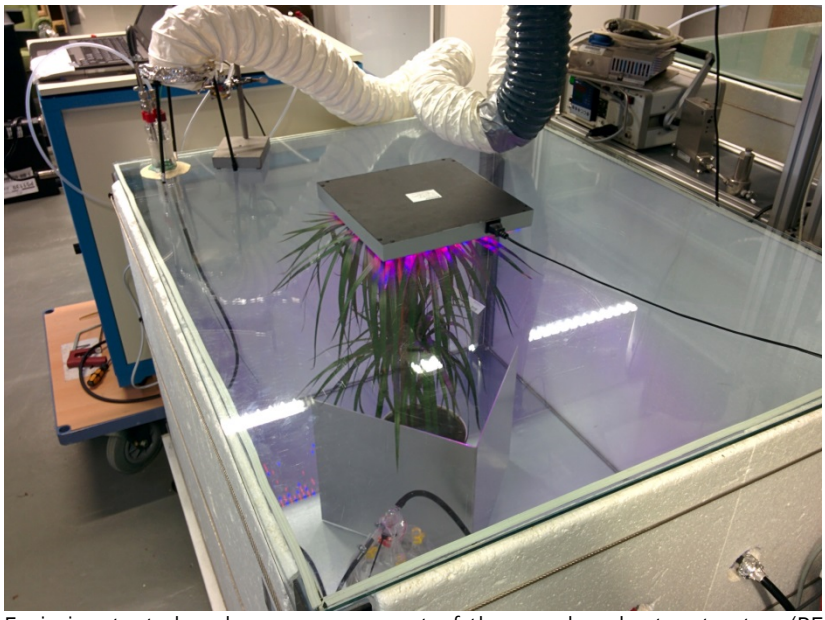
WKI No.	Sample received	Description	Product-No.	Supplier-Code	Date stamp
P51460	29.04.2016	AIRY system/soil/dragon tree	n.a.	n.a.	n.a.
P51461	29.04.2016	AIRY system/special substrate/dragon tree	n.a.	n.a.	n.a.
P51462	29.04.2016	Reg. plant pot/soil/dragon tree	n.a.	n.a.	n.a.

(Sample P51460: n.a./not packed; Sample P51461: n.a./not packed; Sample P51462: n.a./not packed)

Notice: Sample material for emission tests cannot be retained for repeated tests, it will only be stored for identification and documentation purposes.

Preparations for the experiments of the AIRY system with soil (left, P51461) and the AIRY system with special substrate (right, P51461).



Emission test chamber measurement of the regular plant pot setup (P51462)

Material and Methods

The three tested samples consist of a plant pot each equipped with two dragon tree plants. Due to the limit height of the emission test chamber, the higher plant had to be removed before the test. The remaining stump was sealed by emission-free aluminum tape.

The experiments were performed in a 1 m³ emission test chamber made of glass. The chamber was operated at 25°C. The initial relative humidity of the chamber was 50%. The humidity in the chamber was differently affected by adding the plant systems into the chamber. Condensation on chamber surfaces was not observed. The chamber contained a formaldehyde reference source that emits formaldehyde at a well-defined emission rate from paraformaldehyde. The chamber was also equipped with a 15 W LED plant lamp (blue/red LED only) that was operated for 12 h a day. Prior to the experiment, the lamp was tested with a UV meter (Hönle UV Technology) in order to evaluate the light spectrum. Area sensors for UVA (UVA (330 nm - 400 nm), UVB (290 nm - 330 nm) and VIS (380 nm - 550 nm) were used. The analysis showed that the lamp did not emit UVA and UVB light. Only these light fractions can be absorbed from glass chamber. Thus, the lamp could be operated outside of the chamber to prevent interferences with lamp emissions (e.g. from circuit boards). In order to prevent a directed air flow at the plant pot and to achieve a well-mixed chamber air, a deflection plate was placed between sample and mixing fan (target velocity on sample surface of 0.3 m/s).

Each sample was tested for 120 h in the emission test chamber. The development of the formaldehyde concentration in the chamber air was monitored with a HCHO-Autoanalyzer (AeroLaser) at a time resolution of 5 min. After each test, the sample was removed from the chamber and the chamber was operated for 24 h in order to check the stability of the formaldehyde dosing (Fig. 1).

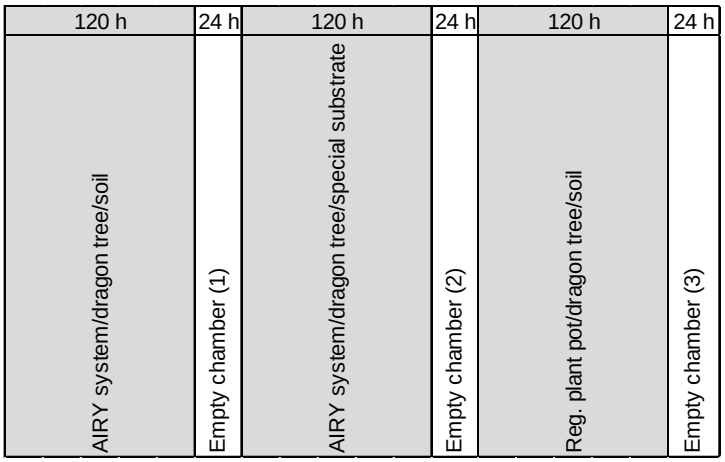


Figure 1: Flow chart of the measurements

The results of each test of the three samples were set in relation to the air concentrations in the empty chamber to calculate the specific reduction factor.

Results

The quantitative test results can be found on the next page.

Dosing

The development of the air concentration in the empty chamber provides insight into the efficiency of the formaldehyde dosing (Fig. 2). The stability of the formaldehyde emission rate was sufficient for the whole duration of the experiment. The air concentration of 350 ppb ranged slightly below the target concentration of 0.5 ppm but was still 3.5 times higher than the German indoor guideline value.

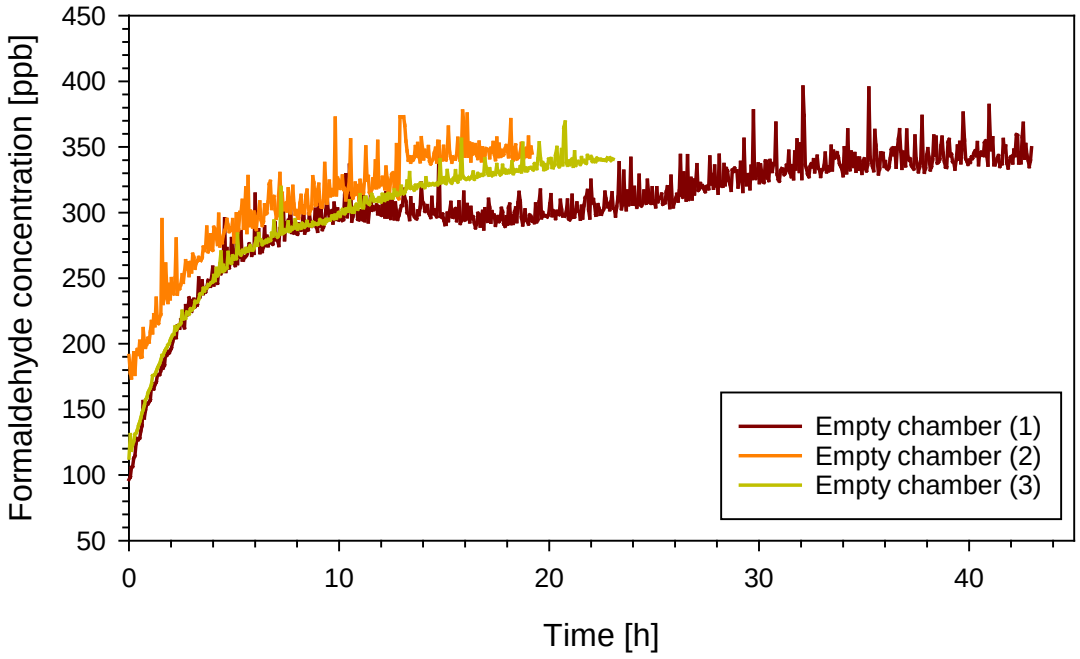


Figure 2: Development of the formaldehyde concentration in the empty chamber after removing the sample.

Formaldehyde exposure experiment

Each of the three tested systems caused a reduction of formaldehyde in the chamber air (see Tab. 1). The quantification of the reduction effect is performed on the basis of the concentrations medians in this case. The AIRY plant pot with soil and dragon tree caused a reduction of the formaldehyde concentration of 63% and, thus, had the highest reduction effect among the tested systems. The AIRY plant pot with special substrate reduced the formaldehyde concentration by 49% and the regular plant pot with soil reduced the concentration by 30%.

Tab. 1: Statistics of the formaldehyde concentration [ppb] and climatic parameters in the test chamber.

	Median [ppb]	Mean* / Standard deviation [ppb]	T [°C]	Rel. humidity [%]
AIRY system/soil	124.9	123.1 ± 18.4 (15%)	25.1 ± 0.3 (1%)	64.9 ± 9.6
Empty chamber (1)	340.2	342.2 ± 10.9 (3%)	24.7 ± 0.1 (<1%)	55.0 ± 0.1
AIRY system/special substrate	178.6	178.1 ± 17.3 (10%)	24.8 ± 0.1 (<1%)	42.7 ± 3.9
Empty chamber (2)	352.5	353.9 ± 9.6 (3%)	24.5 ± 0.1 (<1%)	36.2 ± 0.5
Reg. plant pot/soil	216.5	216.3 ± 12.8 (6%)	24.8 ± 0.1 (<1%)	54.7 ± 3.6
Empty chamber (3)	309.3	291.8 ± 52.4 (18%)	24.6 ± 0.1 (<1%)	45.2 ± 0.4

* including increase of concentration; analysis is not limited to the equilibrium concentration.

The reduction of formaldehyde can be explained mechanistically by the rapid uptake of formaldehyde in water. Wet surfaces and water vessels reduce the formaldehyde concentration without noticeable saturation effects due to the high solubility of formaldehyde in water. The analysis of the formaldehyde concentration in the chamber air follows the same principle in the present experiment. This explains the high efficiency of the AIRY system because it contains an internal water reservoir. In case of the regular plant pot, the uptake is only possible via the wet surface. A change in uptake, like, e.g a trend in the concentration development, was not observed within the 120 h interval.

The Box-Whisker-plots used in Fig. 3-5 show the 95th percentile (this means that 5% of the data points are smaller or equal to this value) and the 5th percentile with the two dots. The box and the two whiskers show (from high to low) the 90th percentile, the 75th percentile, the median (50th percentile), the 25th percentile and the 10th percentile.

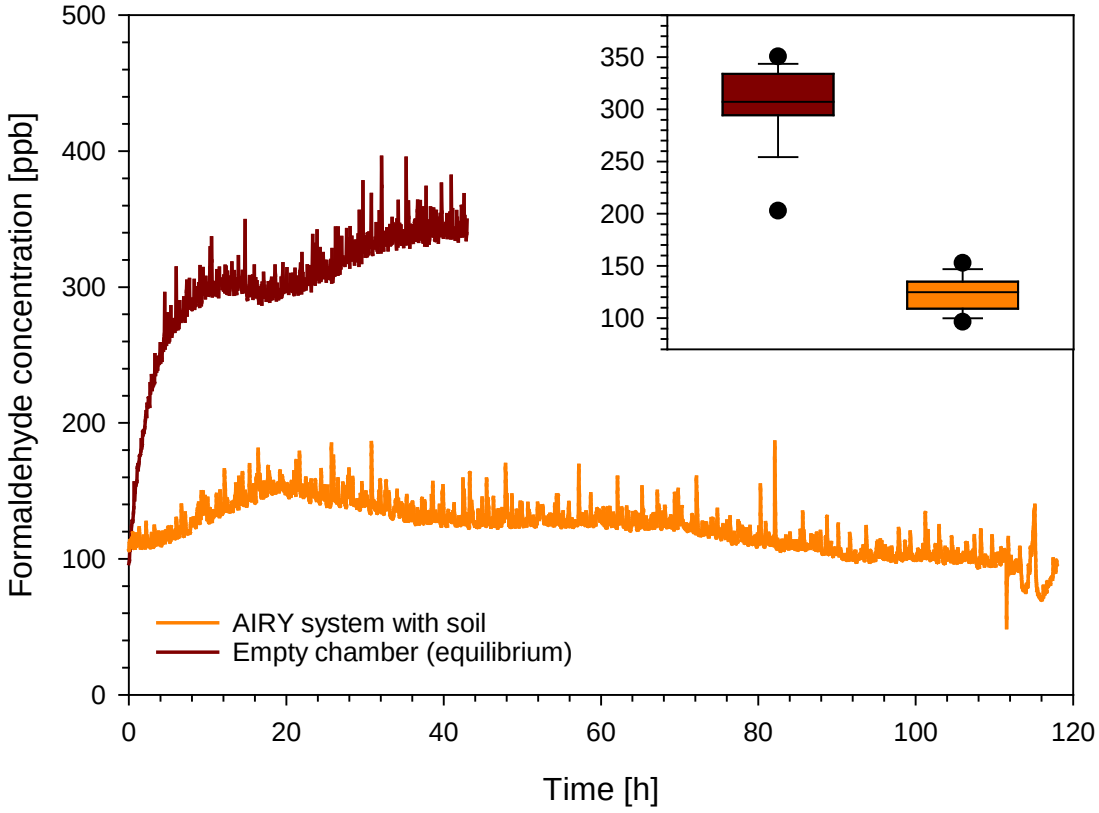


Figure 3: Development of the formaldehyde concentration (sample P51460) in comparison to the empty chamber.

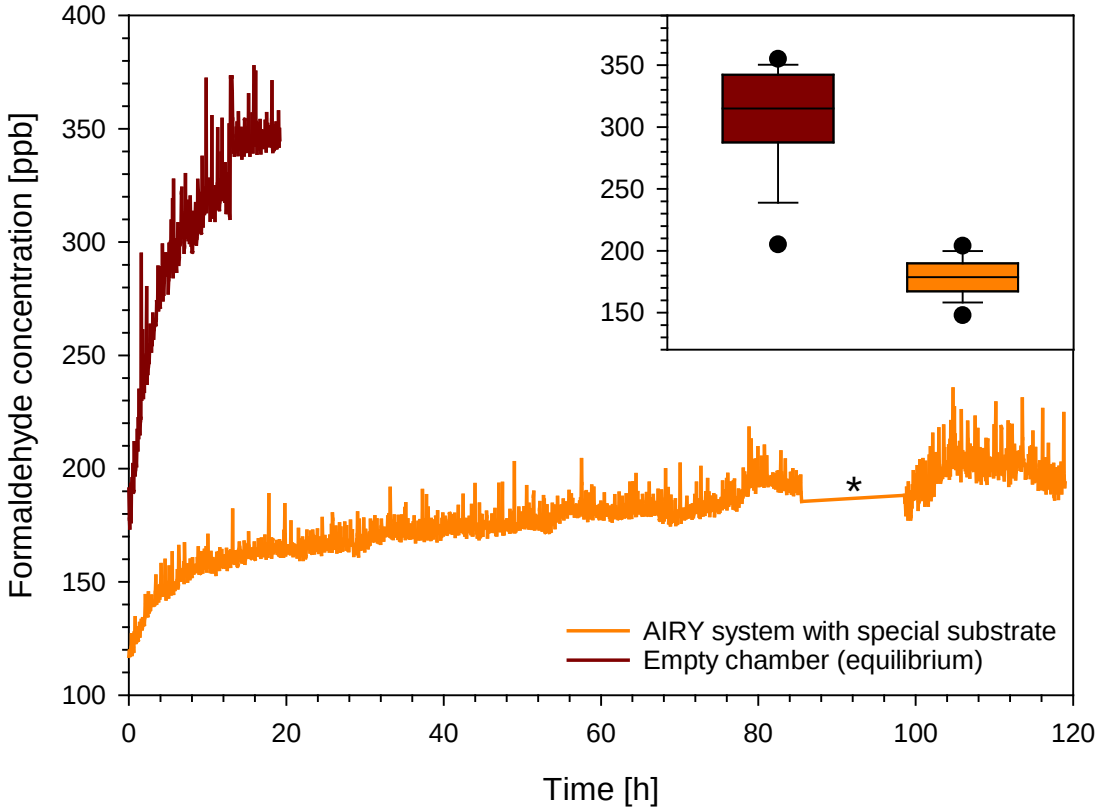


Figure 4: Development of the formaldehyde concentration (sample P51461) in comparison to the empty chamber. The area marked with * is missing due to an instrument error.

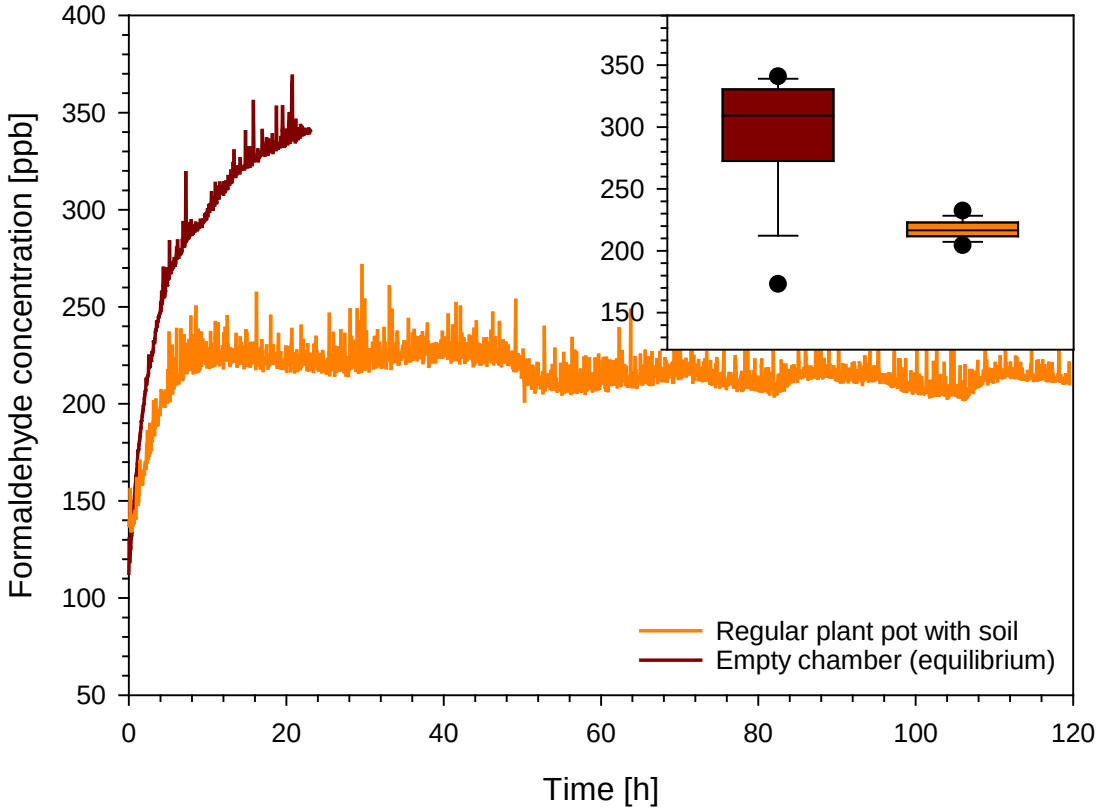


Figure 5: Development of the formaldehyde concentration (sample P51462) in comparison to the empty chamber.

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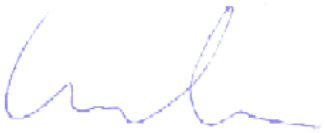
Conclusion

Three plant pot systems with dragon trees were exposed against an elevated formaldehyde concentration in a chamber. All three systems caused a reduction of the formaldehyde concentration in the chamber air. The highest reduction was observed for one AIRY system which reduced the air concentration by 63%.

Officer in charge

C. Fauck

For the department



Dr. E. Uhde