Documentation of the photocatalytic reduction in acetaldehyde on tiles with HT coating

Task set

Two different tiles of **production dates 05.07.2011 (Sample 5810) and 15.07.2011 (Sample 5811)** were to be tested in a sealed system for their characteristics of photocatalytic reduction of acetaldehyde.

The experiment and its implementation

Tiles 5810 and 5811 in their dimensions, 12 x 3 cm were each exposed to a gaseous atmosphere consisting of air and acetaldehyde and irradiated for 3 hours with UV light both without a cut-off filter and with a 455 nm cut-off filter respectively. The reduction in the acetaldehyde concentration was determined at hourly intervals by gas chromatography (GC FID). Acetaldehyde concentrations in the regions of approx. 5 ppm (vol.) and 4,000 mg/m^3 respectively were selected as the initial concentrations.

Gas samples were taken by means of a septum seal (see Fig. 1)

Fig.1: Photoreactor with water filter for the removal of infrared rays (centre).
The lamp - not illustrated - is located to its left.

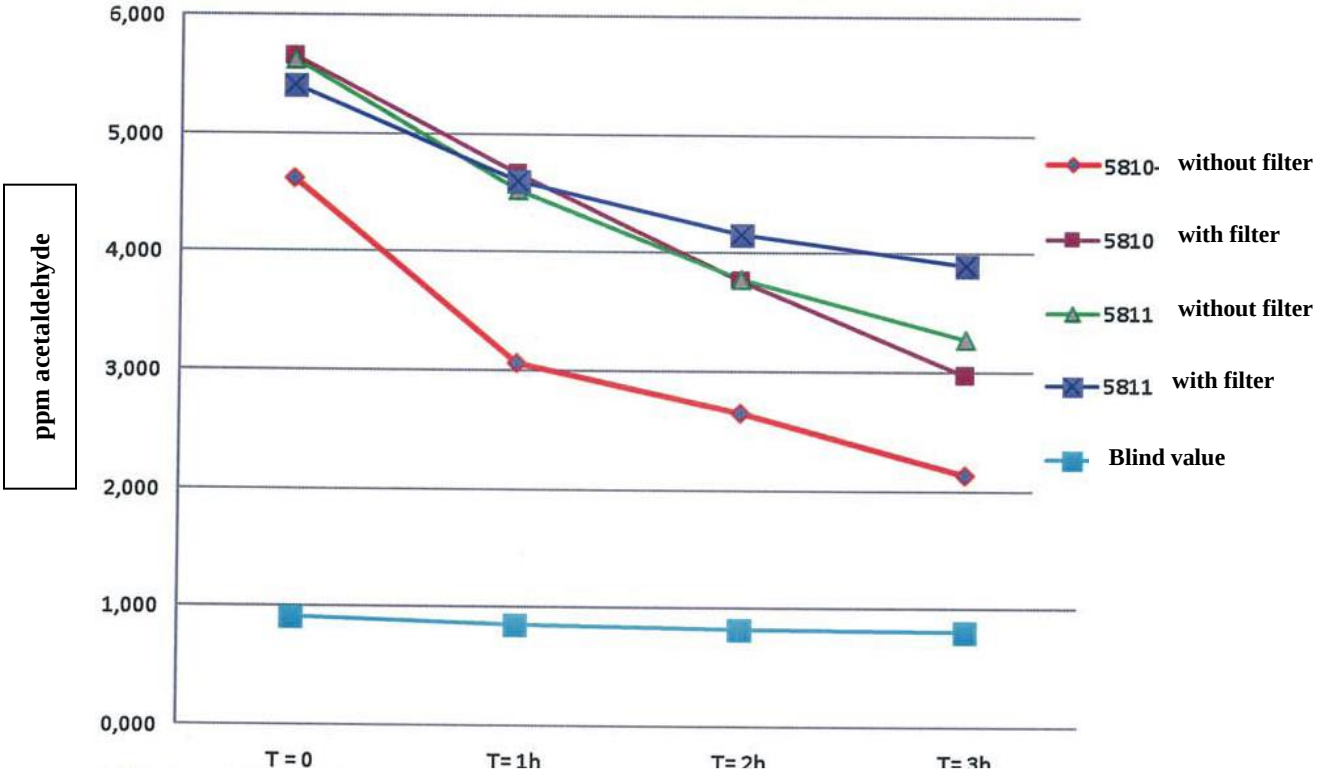
Exposure to acetaldehyde gas was effected by injecting the appropriate volume.
After an equilibration time of 15 minutes in darkened conditions, the samples were exposed for 3 hours to a 150w Xe lamp without and with an upstream 455 nm cut-off filter. A gas-tight septum was used to take samples for analysis at the beginning, after 1 hour, after 2 hours and after 3 hours.

1. Measurement results

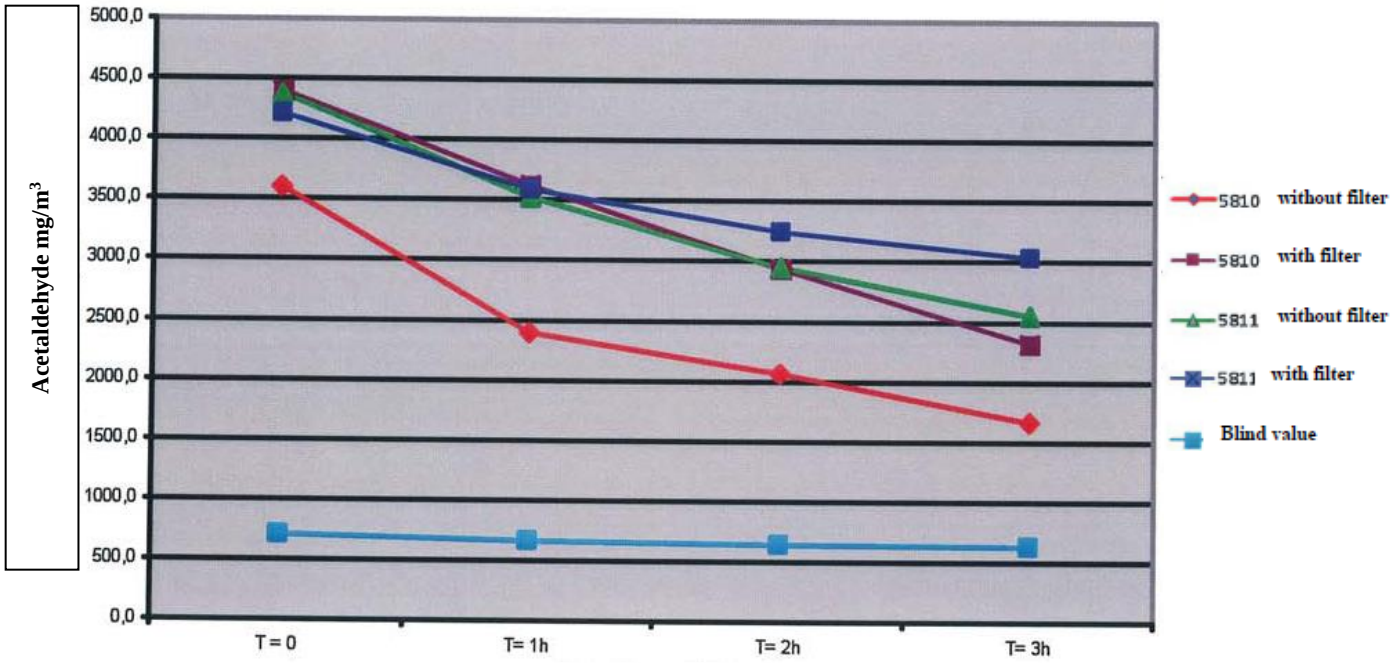
Exposure for 3 h without and with 455 nm cut-off filter

No.	5810	5810	5811	5811	
Description	HT tiles	HT tiles	HT tiles	HT tiles	Blind test
					without tile
PN date	22.09.2011	22.09.211	22.09.2011	22.09.2011	
Dimensions	10 x3 cm	10 x 3 cm	10 x 3 cm	10 x 3cm	
Colour	white	white	white	white	
Gassing	Acetaldehyde	Acetaldehyde	Acetaldehyde	Acetaldehyde	Acetaldehyde
Cut-off-filter	without	455 nm	without	455 nm	without
Lamp	Xe 166 w	Xe 166 w	Xe 166 w	Xe 166 w	Xe 166 w
Equilib.time	15 min.	15 min.	15 min.	15 min.	15 min.
Gas collection tube vol. in ml	211	211	211	211	211
Acetaldehyde in mg/cm^3					
t = 0	3597.9	4406.7	4377.4	4213.3	714.1
t = 1h	2390.8	3628.8	3530.9	3588.5	661.6
t = 2h	2061.2	2936.7	2951.3	3243.2	643.7
t = 3h	1659.0	2313.9	2551.2	3036.8	628.4
Acetaldehyde in ppm (vol.)					
t = 0	4.61	5.65	5.61	5.40	0.92
t = 1h	3.07	4.65	4.53	4.60	0.85
t = 2h	2.64	3.76	3.78	4.16	0.83
t = 3h	2.13	2.97	3.27	3.89	0.81
Relative acetaldehyde reduction in %					
t = 0	100.0	100.0	100.0	100.0	100.0
t = 1h	66.4	82.3	80.7	85.2	92.6
t = 2h	57.3	66.6	67.4	77.0	90.1
t = 3h	46.1	52.5	58.3	72.1	88.0

Acetaldehyde reduction with and without filter

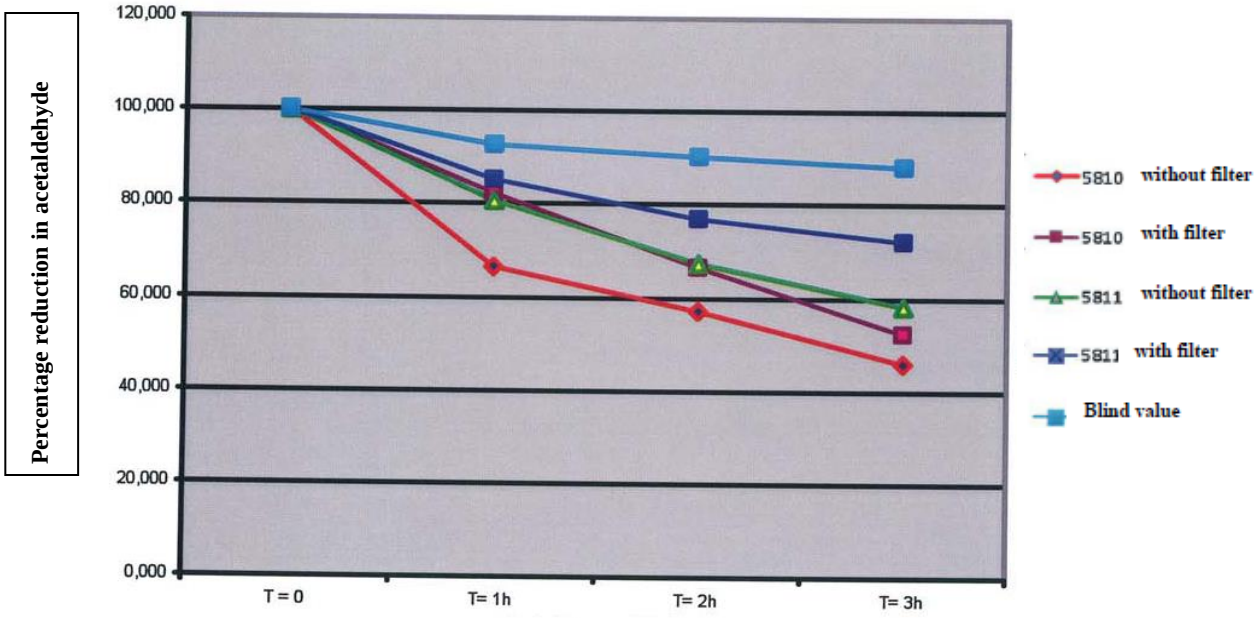


Acetaldehyde reduction with and without cut-off filter



Exposure time in h

Acetaldehyde reduction with and without filter



Test conclusions

The two tile types (5310 and 5311) significantly catalyse the reduction of acetaldehyde under the influence of light. In both tile samples, the reduction progresses rather "more quickly" with UV + vis. light as is illustrated in the example of 5810 with filter (- - - - - -) (vis. only, i.e. visible light) and 5810 without filter (———) (UV + vis. light).

In contrast, acetaldehyde alone shows no reduction or only a very weak reduction under the influence of light - which is however, caused by the oxidation of the acetaldehyde due to the oxygen content of the air in the gas collection tube.

Erlangen, 28.11.2011

H. Kisch

Prof. Dr. Horst Kisch