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UV/H_2O_2 treatment: an essential process in a multi barrier approach against trace chemical contaminants

SUPPLEMENTARY MATERIAL

UV/H_2O_2 research in collimated beam equipment

In addition to pesticides, the focus was extended to endocrine disruptors, pharmaceuticals, algae toxins and solvents. For a large set of target compounds, collimated beam experiments have been carried out for a set of selected process conditions:

- the standard UV dose of 600 mJ/cm^2 only;
- the standard UV dose of 600 mJ/cm^2 and the standard H_2O_2 dosage of 6 mg/L;
- the standard UV dose of 600 mJ/cm^2 and the highest possible H_2O_2 dosage of 15 mg/L;
- the highest possible UV dose of 1200 mJ/cm^2 and the standard H_2O_2 dosage of 6 mg/L;
- the highest possible UV dose of 1200 mJ/cm^2 and the highest H_2O_2 dosage of 15 mg/L.

Examples for the degradation of an endocrine disruptor, bisphenol A, a pharmaceutical carbamazepine, an algae toxin microcystine and a solvent diglyme are presented in Figure S1–S4.

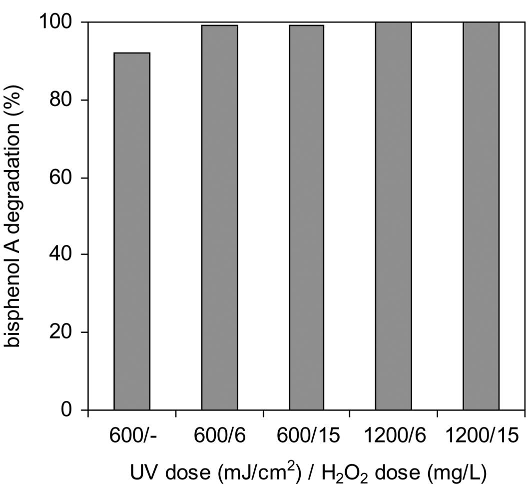

Figure S1 | Bisphenol A degradation by UV/H_2O_2 treatment for selected process conditions.

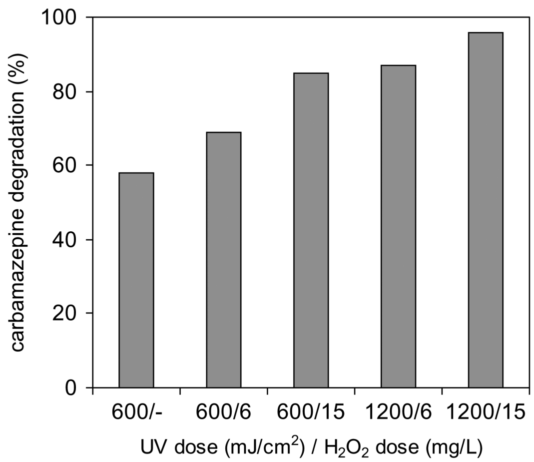

Figure S2 | Carbamazepine degradation by UV/H_2O_2 treatment for selected process conditions.

For bisphenol A, using photolysis with 600 mJ/cm^2, a degradation of more than 90% is achieved. For the other process conditions, the conversion is close to 100% (Figure S1).

For carbamazepine with a conversion of 58%, the target degradation of 80% is not achieved by photolysis with 600 mJ/cm^2 only.

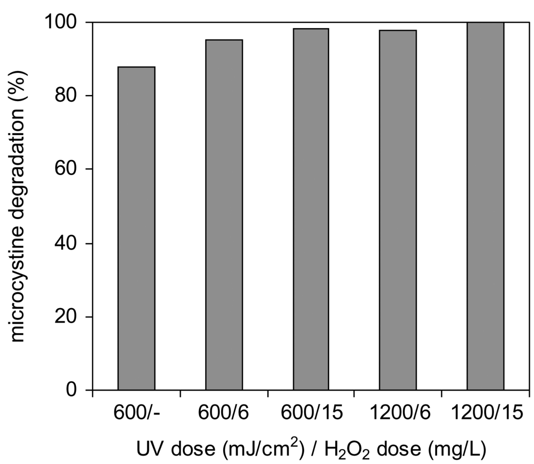

Figure S3 | Microcystine degradation by UV/H_2O_2 treatment for selected process conditions.

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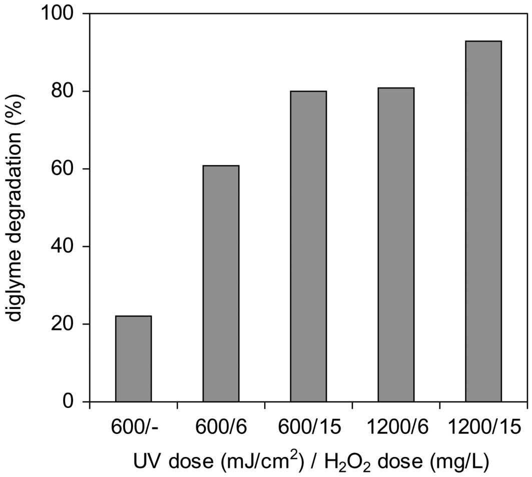

Figure S4 | Diglyme degradation by UV/H_2O_2 treatment for selected process conditions.

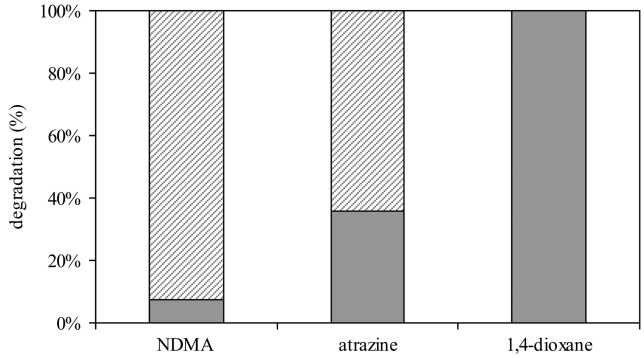

Figure S5 | Ratio of degradation by photolysis and OH radical oxidation for NDMA, atrazine and 1,4-dioxane (▨ = photolysis, ■ = OH radical oxidation).

Even for standard UV and H_2O_2 dosages, the target degradation is not realized. The target degradation is exceeded for both 600 mJ/cm^2 with 15 mg/L H_2O_2 and 1200 mJ/cm^2 with 6 mg/L H_2O_2 (Figure S2).

Microcystine showed the same behaviour as bisphenol A. Using photolysis with 600 mJ/cm^2, the degradation target of 80% is realized. For the other conditions the conversion is close to 100% (Figure S3).

Of the selected compounds, diglyme proved to be most resistant against photolysis. A UV dose of 600 mJ/cm^2 achieved a degradation of about 20% only. For standard UV and H_2O_2 dosages the degradation increased to 60% while 80% conversion could be achieved by both 600 mJ/cm^2 with 15 mg/L H_2O_2 or 1200 mJ/cm^2 with 6 mg/L H_2O_2 (Figure S4).

So depending on the chemical structure of the pollutant either photolysis or OH radical oxidation plays a predominant part. This is once again illustrated in Figure S5 applying the kinetic model provided by Trojan Technologies Inc.

NDMA, like bisphenol A and microcystine, is primarily degraded by photolysis; 1,4-dioxane, like diglyme, is primarily converted by OH radical oxidation. Atrazine, like carbamazepine and most other compounds is degraded by a combination of both.