Solar-activated persulfate degradation of bisphenol-S: Kinetics in laboratory and pilot scale, transformation products and phytotoxicity

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- Endocrine disruptors (EDCs) are chemicals that block natural hormones, leading to health problems such as reproductive disorders and cancer. They are found in pharmaceuticals, personal care products, and industrial chemicals, and enter water systems through sewage treatment plants and industrial waste.
- Detecting and regulating EDCs in water bodies is difficult due to their low concentrations (μg/L – ng/L) and complex structures, while conventional waste treatment technologies are inadequate.
- Advancedoxidation processes (AOPs), such as the activation of persulfate (PS) with solar radiation, are the focus of interest for the effective degradation of persistent organic compounds into harmless molecules.

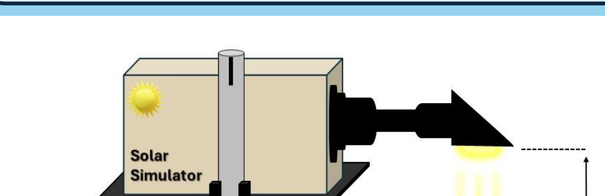
The **GOAL** of the research is to examine the degradation of bisphenol S (BPS) using solar radiation to activate SPS in:

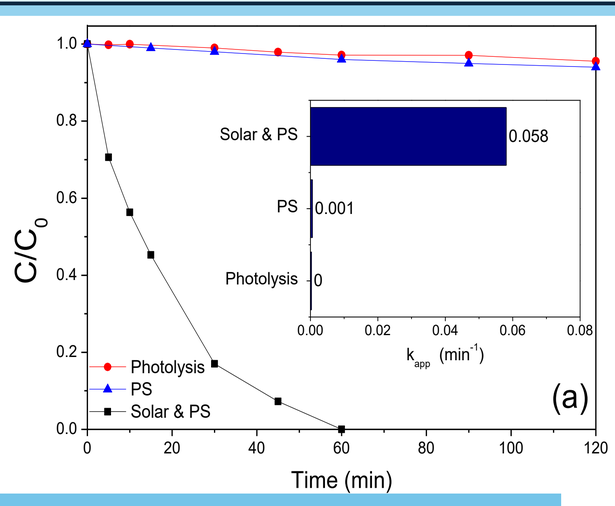
1. Laboratory scale

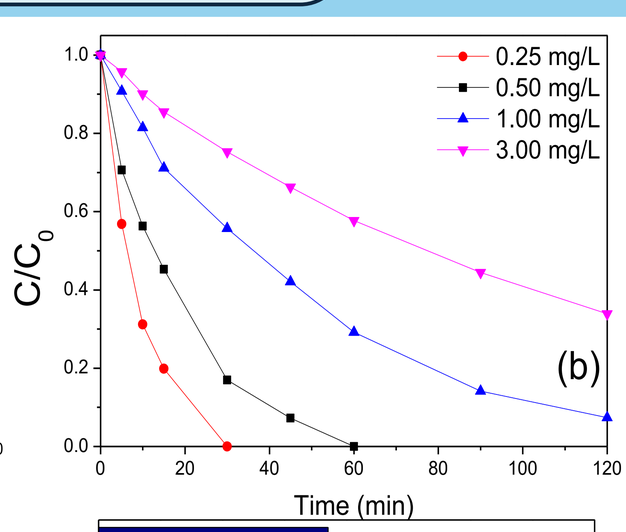
$[PS]_0$=250 mg/L, $[BPS]_0$=0.5 mg/L, Ultrapure water, inherent pH

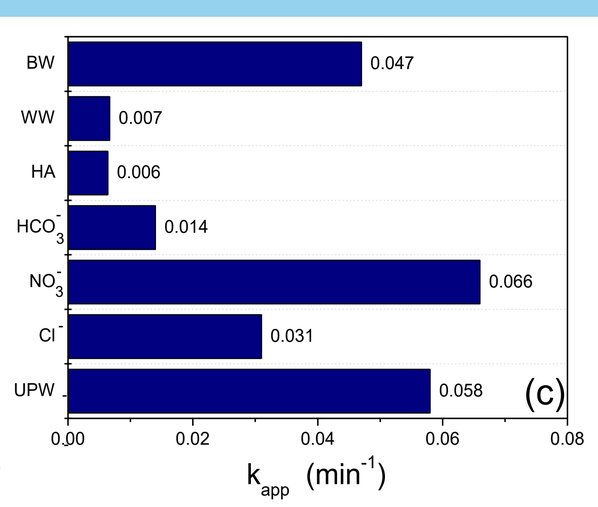
2. Pilot scale

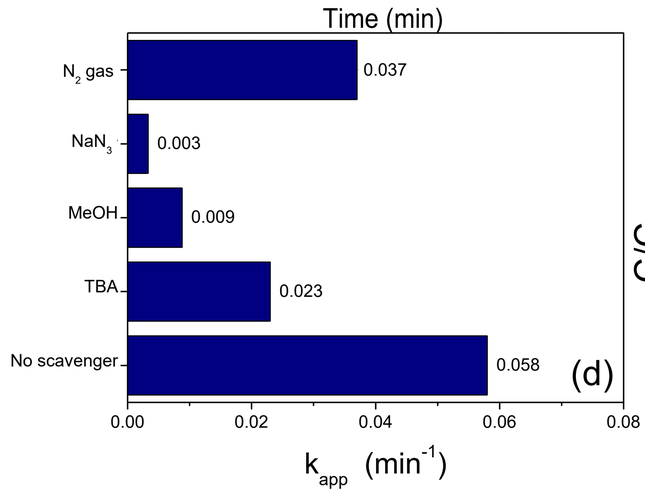
$[PS]_0$=250 mg/L, $[BPS]_0$=0.5 mg/L, Distilled water, inherent pH

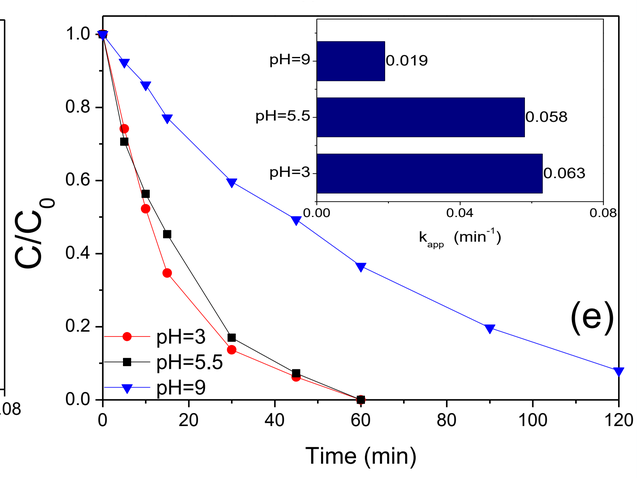




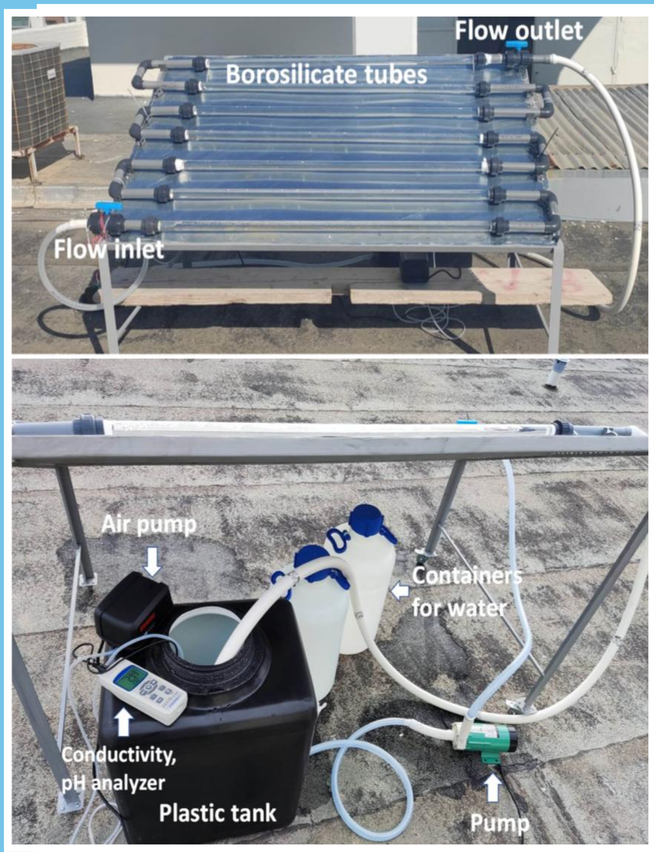




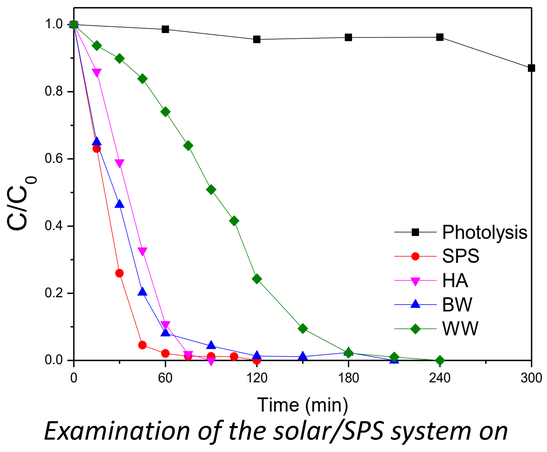




Effect of main parameters on BPS degradation on laboratory scale.
Effect of (a) solar, PS, and combined treatment, (b) $[BPS]_0$, (c) water matrices, (d) scavengers, (e) initial pH



- Reactor: Flat plate reflector (FPR) (SS)
- Irradiated surface: 1.1 m2
- Irradiated volume: 7.9 L
- Flow rate: 12 L/min
- Solution volume: 35 L distilled water (DW)

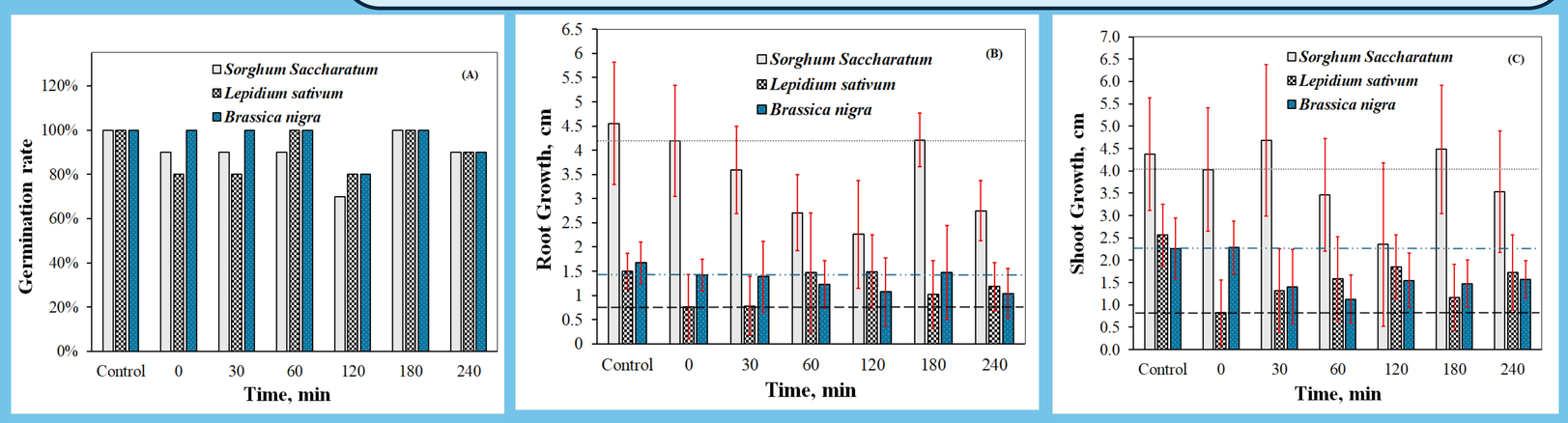


Examination of the solar/SPS system on a pilot scale

Five BPS transformation products (TPs) were identified by UHPLC/TOF-MS system.

Phytotoxicity Evaluation

- Tested on seeds of *Sorghum saccharatum*, *Lepidium sativum*, and *Brassica nigra*.
- BPS exhibited inhibitory effects on root and shoot growth across all species.
- Transformation products generally caused greater growth inhibition in *S. saccharatum* and *B. nigra*.
- Conversely, all TPs were less phytotoxic than the parent BPS compound for *L. sativum*.



Phytotoxicty results of BPS and its TPs

Conclusions

- On a laboratory scale, the system achieved complete degradation of 500 μg/L BPS in just 60 mins with the addition of 500 mg/L PS, in UPW and unadjusted pH (k_{app} = 0.19 min^{-1}).
- The degradation rate decreases at higher initial BPS concentrations.
- Water chemistry impacts degradation as alkaline conditions slow BPS removal.
- The complexity of the aqueous matrix and the presence of 250 mg/L chloride ions, 250 mg/L bicarbonate ions, or 10 mg/L humic acid led to a decrease in the degradation rate.
- On a pilot scale, complete degradation of BPS was achieved in 120 minutes with the addition of 250 mg/L SPS.
- Toxicity generally decreases with irradiation time, but some transformation products can be more hazardous than BPS

ACKNOWLEDGEMENTS

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