

# Shining a Light on Sewage Treatment: Building a High-Activity and Long-Lasting Photocatalytic Reactor with the Elegance of a “Kongming Lantern”

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## Texts

### Text S1. Photocatalytic degradation of different colored organic dyes.

In order to adapt to the capacity of the reaction pool and better evaluate the degradation capacity of the reactor, 60mL Rh B or MB solution with a concentration of 10mg/L was added to the reaction pool. After the reactor device and 12W LED light source were placed in the reaction pool, the reactor was darkened for 30min, and then the light source was turned on for 2h. In the whole process, with the time point of turning on the light source as 0h, the appropriate 100  $\mu$ L sample was taken at the given time point (-30min, 0min, 15min, 30min, 45min, 60min, 90min and 120min). At the same time, appropriate amount of solution was taken into a 2mL centrifuge tube to observe its color change.

The degradation rate can be guided by the relevant equation mentioned below.

$$\text{Degradation rate} = \frac{C_t}{C_0} \times 100\% \quad (\text{S1})$$

In equation, where  $C_t$  is the Rh B concentration at given-time intervals, and  $C_0$  is the initial concentration.

### Text S2. Bactericidal activity against conventional Gram-negative and Gram-positive bacteria.

Typical LB medium prepared with sodium chloride, tryptone and yeast powder was used for the culture of *E. coli* and *S. aureus*. The specific procedure is to first culture 2 mL of *E. coli* mother liquor and *S. aureus* mother liquor respectively in a centrifuge tube containing 50 mL of sterile Luria-Bertani (LB), and culture them in a shaking table at 37°C (180 RPM) for 24 h to obtain the re-cultured *E. coli* and *S. aureus*. Harvested *E. coli* and *S. aureus* (about  $8.8 \times 10^8$  and  $9.37 \times 10^8$  CFU/mL) were continuously diluted 10-fold with sterile distilled water to obtain a "standardized cell suspension" with the required concentration ( $10^5$  CFU/mL). Taking the capacity of the reaction tank into account, 60mL of "standardized cell suspension" was added to the reaction tank, and then the constructed reactor and 12W LED light source were also put into it. Then, the appropriate 20  $\mu$ L sample was taken at the given time point (0h, 1h, 2h), immediately spread on a petri dish filled with LB solid AGAR plate, and incubated at 37°C for  $30\text{h} \pm 2\text{h}$ . The bacterial colony count was directly observed using an optical camera (ChemiDoc MP, BIO-RAD, American) to observe the antibacterial activity of the reactor.

The cell density can be guided by the relevant equation mentioned below.

$$C_t \text{ CFU/mL} = \frac{N_t}{V} \quad (\text{S2})$$

$$\text{Cell density} = \log_{10} C_t \text{ CFU/mL} \quad (\text{S3})$$

In equation, where  $N_t$  is the bacterial colony count at given-time intervals,  $C_t$  is the bacterial colony concentration at given-time intervals, and  $V$  is the volume of the taken sample at given-time intervals.

### Text S3. Photocatalytic microbial killing activity in environmental water samples.

Common beef extract peptone AGAR medium is prepared by mixing beef extract, peptone, sodium chloride, AGAR and water in a ratio of 3g:10g:5g:15g:1000mL, and adjusting the pH to 7.4~7.6. After high-pressure steam sterilization at 121°C for 20min, the temperature was lowered to 44~47°C before use. After a simple filtration of the obtained environmental water sample, 60mL of the sample is added to the reaction pool, and the reactor device and 12W LED light source are also put into it. After the light source was turned on, a certain amount of solution

was taken at the given time point and diluted 10 times with sterile distilled water to obtain dilution samples of 10 times, 100 times and 1000 times, respectively. Take 1mL diluted sample of a certain concentration into a disposable petri dish, pour 15-20ml cooled AGAR medium, and immediately shake the petri dish to make the sample and AGAR medium mixed evenly. After the medium was cooled and solidified, the results were observed after  $48\text{h}\pm 2\text{h}$  incubation in a constant temperature incubator at  $37^{\circ}\text{C}$ .