Photocatalytic degradation of microcystins by TiO_2 using UV-LED controlled periodic illumination

Supplementary Information

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Pulsed Width Modulation Setup

Pulse width modulation (PWM) was used to control the UV-LED. Digital control is used to create a square wave, a signal switched between on and off states. This on-off pattern can simulate voltages in between full on (5 volts) and off (0 volts) by changing the portion of the time the signal spends on versus the time it spends off. The duration of the "on time" is called the pulse width. An Arduino Uno connected to a LED Current Driver (LEDSEEDUINO) and a high power UV-LED (LED Engin, 1 A, λ = 365 nm) was used. A PWM program was coded into the Arduino microcontroller using the following script:

```
int ledPin = 9;            // LED connected to digital pin 9
int  timeON = x             // initializes x value of time that LED  is ON
int timeOFF = y            // initializes y value of time that LED is OFF

void setup()
{
  pinMode(ledPin, OUTPUT);      // sets the digital pin as output
}
```

```
void loop()
{
  digitalWrite(ledPin, HIGH);   // sets the LED on
  delay(timeON);                // waits for x milliseconds
  digitalWrite(ledPin, LOW);    // sets the LED off
  delay(timeOFF);               // waits for x milliseconds
}
```

Table S1. Calculated Degradation Rates. Poor fit with the linear regression model due to insignificant degradation is seen in membrane only and UV only conditions, as well as 50 Hz MC-LR.

		MC-LA	*MC-LR*	*MC-RR*	*total*
50 Hz	K_{app} (min^{-1})	-1.24×10^{-3}	1.88×10^{-5}	-1.04×10^{-3}	-7.83×10^{-4}
	R^2	0.88	0.29	0.50	0.80
5 Hz	K_{app} (min^{-1})	-2.07×10^{-3}	-6.26×10^{-4}	-2.60×10^{-3}	-1.82×10^{-3}
	R^2	0.86	0.74	0.76	0.90
0.5 Hz	K_{app} (min^{-1})	-2.10×10^{-3}	-8.86×10^{-4}	-3.98×10^{-3}	-2.61×10^{-3}
	R^2	0.96	0.79	0.92	0.97
dual frequency	K_{app} (min^{-1})	-3.12×10^{-3}	-2.08×10^{-3}	-6.72×10^{-4}	-2.08×10^{-3}
	R^2	0.81	0.93	0.29	0.89
membrane, no UV	K_{app} (min^{-1})	-6.44×10^{-4}	-5.86×10^{-4}	-6.20×10^{-4}	-6.11×10^{-4}
	R^2	0.23	0.25	0.44	0.37
UV, no membrane	K_{app} (min^{-1})	1.03×10^{-4}	-5.28×10^{-4}	1.29×10^{-4}	-1.55×10^{-4}
	R^2	-0.10	0.57	0.44	0.20

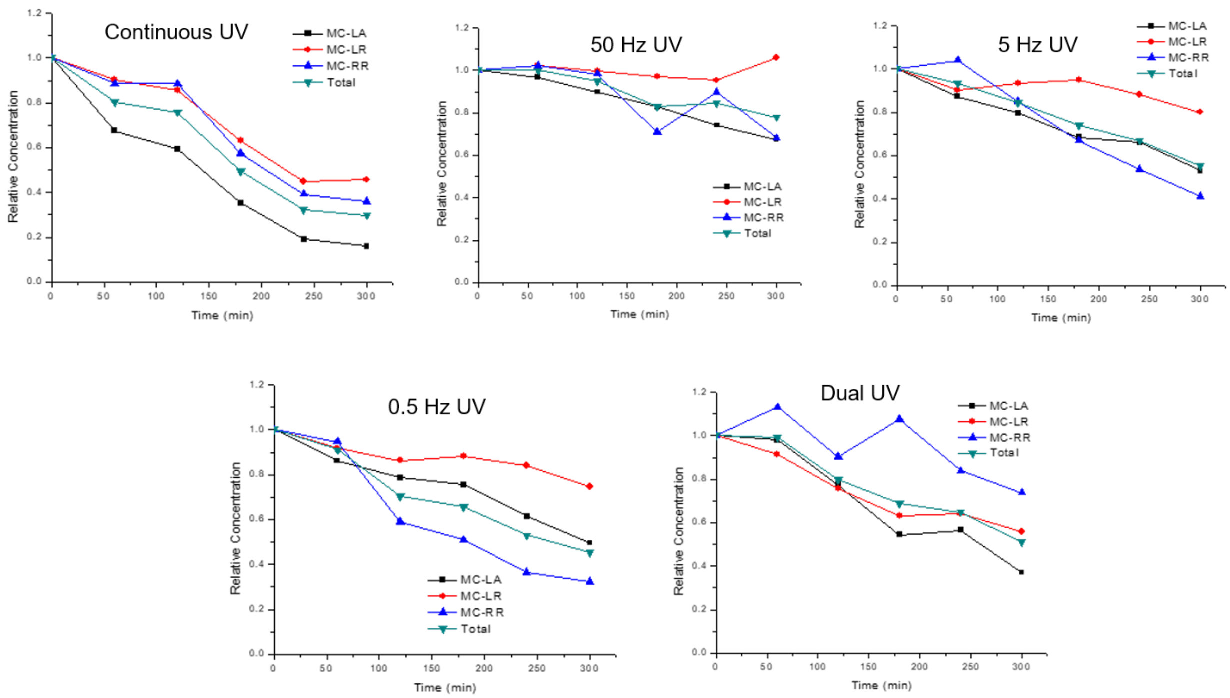

Figure S1. Change in microcystin concentration over the course of various UV/TiO_2 treatments.

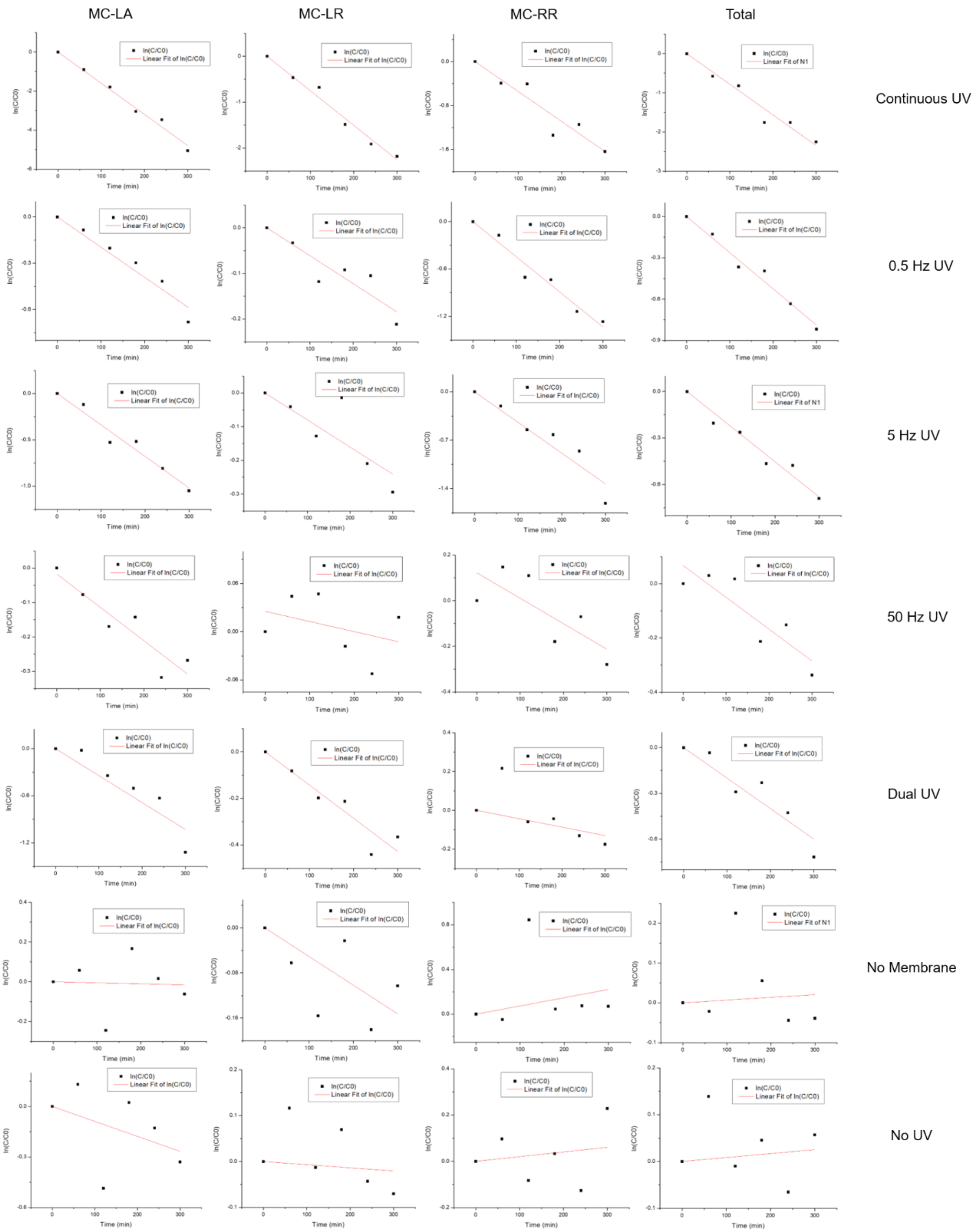

Figure S2. Linear regression plots for the calculation of degradation rate.

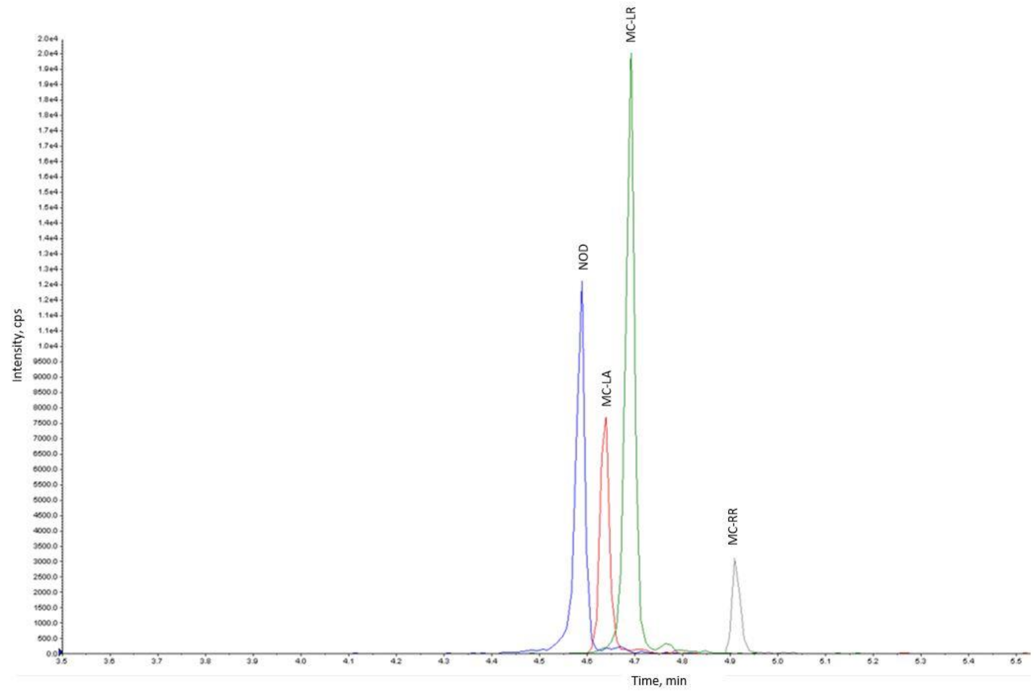

Figure S3. Chromatogram demonstrating the separation of MC-LA, MC-LR, MC-RR, and NOD.