Supplementary material

**Sulfate radicals based degradation of the antraquionone textile dye in plug flow photoreactor**

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TABLE I. General characteristic of RB 19 dye

|  |  |
| --- | --- |
| **Properties** | **Dye** |
| Commercial name | Remazol Brilliant Blue R |
| C. I. number | 61200 |
| Apparent color | Blue |
| Purity | ~ 50 % |
| Molecular weight | 626 g mol-1 |
| Molecular formula | C22H16N2Na2O11S3 |
| Chemical structure |  |
| Maximum absorption wavelength | 592 nm |
| Water solubility | 10 g dm-3 |



Figure 1**.** COD changes before and after UV/S2O82- treatment. *c*0(RB 19) = 50 mg∙L-1, *c*0(S2O82-) = 1 mmol∙L-1, flow rate 1.5 mL∙min-1, pH 3 ± 0.1, UV light intensity was 1950 μW∙cm–2, temperature was 25 ± 0.5 ºC.

TABLE II. Removal of RB 19 dye with UV/S2O82- under different experimental conditions

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| ***c*0(RB 19)**  **(mg∙L-1)** | ***c*0(S2O82-)** **(mmol∙L-1)** | **Flow rate**  **(mL∙min-1)** | **pH** | **k (min-1)** | **RE (%)** |
| The effect of initial S2O82- | | | | | |
| 50 | 0.05 | 7 | 4 | 0.022 | 39 |
| 50 | 0.1 | 7 | 4 | 0.038 | 57 |
| 50 | 0.2 | 7 | 4 | 0.083 | 84 |
| 50 | 0.4 | 7 | 4 | 0.204 | 98 |
| The effect of initial pH value | | | | | |
| 50 | 0.1 | 7 | 3 | 0.155 | 99 |
| 50 | 0.1 | 7 | 5 | 0.042 | 62 |
| 50 | 0.1 | 7 | 7 | 0.032 | 51 |
| 50 | 0.1 | 7 | 9 | 0.022 | 40 |
| 50 | 0.1 | 7 | 10 | 0.016 | 30 |
| The effect of flow rate | | | | | |
| 50 | 0.1 | 30 | 4 | 0.006 | 12 |
| 50 | 0.1 | 15 | 4 | 0.013 | 24 |
| 50 | 0.1 | 7 | 4 | 0.036 | 55 |
| 50 | 0.1 | 1.5 | 4 | 0.282 | 99 |
| The effect of initial dye concentration | | | | | |
| 20 | 0.1 | 7 | 4 | 0.113 | 92 |
| 40 | 0.1 | 7 | 4 | 0.044 | 62 |
| 60 | 0.1 | 7 | 4 | 0.027 | 45 |
| 80 | 0.1 | 7 | 4 | 0.0215 | 37 |
| 100 | 0.1 | 7 | 4 | 0.014 | 26 |



Figure 2.Influence of flow rateon RB 19 dye degradation. *c*0(RB 19) = 50 mg∙L-1, *c*0(S2O82-) = 0.1 mmol∙L-1, native pH (3.8 ± 0.1) , UV light intensity was 1950 μW∙cm–2, temperature was 25 ± 0.5 ºC.



Figure 3.Influence of different initial RB 19 concentration on the its degradation. *c*0(S2O82-) = 0.1 mmol∙L-1, flow rate 7 mL∙min-1, pH native (3.8 ± 0.1), UV light intensity was 1950 μW∙cm–2, temperature was 25 ± 0.5 º C



Figure 4.Influence of different carbonate and bicarbonate anions concentrations on the removal efficiency of RB 19. *c*0(RB 19)= 50 mg∙L-1, *c*0(S2O82-) = 0.1 mmol∙L-1, flow rate 7 mL∙min-1, pH 8.0±0.1 (for bicarbonate) 12±0.1 (for carbonate), UV light intensity was 1950 μW∙cm–2



Figure 5. Influence of different chloride anions concentrations on the removal efficiency of RB 19. *c*0(RB 19) = 50 mg∙L-1, *c*0(S2O82-) = 0.1 mmol∙L-1, flow rate 7 mL∙min-1, pH native (3.8 ± 0.1), UV light intensity was 1950 μW∙cm–2

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