**Table (S1): Tubular reactor dimensions.**

|  |  |
| --- | --- |
| **Parameter** | **Value** |
| Tube diameter (D), mm | 8 |
| Tube height (h), cm | 38 |
| Wall thickness of the tube, mm | 1 |
| Tube volume (V), mL | 19 |

**Table (S2): Helical baffle with central rod dimensions.**

|  |  |
| --- | --- |
| **Parameters** | **Values** |
| Rod length (mm)  | 380  |
| Spacing, mm | 12 |
| The thickness of the baffle (δ), mm | 1.5 |
| Baffle length, mm | 360 |
| The thickness of the rod, mm | 0.5 |

**Table (S3):** The OBR operation conditions in terms of dimensionless.

|  |  |  |
| --- | --- | --- |
| **Group** | **Definition** | **Operation range** |
| Net flow Reynold number, Ren | $$ρuD/µ$$ | 18.89-56.68 |
| Oscillation Reynolds number, Reo | $$2πfX\_{o}ρD/µ$$ | 904.1 |
| Strouhal number, St | D/4πXo | 0.159 |
| Cross-sectional area, α | (Do/D)2 | 25 % |
| Velocity ratio, ψ | Reo / Ren | 15.949-47.848 |
| Space ratio | *l / D* | 1.5 |

**Table (S4):** Specifications of the syringe pumps.

|  |  |
| --- | --- |
| **Item** | **Specification** |
| Syringe Sizes | From 50 µl to 12.5 ml |
| Operating Conditions | Temperature: 15°C to 40°C (59°F to 104°F) |
| Humidity: 20 to 95% RH at 40°C (104°F) |
| Flow rate | 0-112 ml/min |

**Table (S5):** Specifications of the liquid dosing pump.

|  |  |
| --- | --- |
| **Specification** | **Value** |
| Flow rate | 0.1- 40 mL/min for 40 ml/min head |
| Pressure | 0 to 1500 psi for 40 ml/min pump head |
| Flow Precision | 0.2% relative standard deviation (RSD) |
| Liquid road material | 316 L |

**Table (S6):** The experimental runs of the kinetic study.

|  |  |  |
| --- | --- | --- |
| **Run** | **Temperature, oC** | **Space-time, min** |
| 1 | 50 | 0.75 |
| 2 | 50 | 1.5 |
| 3 | 50 | 2.25 |
| 4 | 50 | 3 |
| 5 | 60 | 0.75 |
| 6 | 60 | 1.5 |
| 7 | 60 | 2.25 |
| 8 | 60 | 3 |
| 9 | 70 | 0.75 |
| 10 | 70 | 1.5 |
| 11 | 70 | 2.25 |
| 12 | 70 | 3 |

**Table (S7):** Specifications of the magnetic heating stirrer.

|  |  |
| --- | --- |
| **Item** | **Specification** |
| Stirring speed  | 100 – 1500 rpm |
| Capacity | 100 – 3000 ml |
| Temperature range | Up to 380 oC |

**Table (S8):** The experimental runs of the Fenton process in the batch reactor at phenol initial concentration of 300 ppm and pH=3.

|  |  |  |
| --- | --- | --- |
| **Run** | **Temperature, oC** | **Residence time, min** |
| 1 | 50 | 1 |
| 2 | 50 | 2 |
| 3 | 50 | 3 |
| 4 | 60 | 1 |
| 5 | 60 | 2 |
| 6 | 60 | 3 |
| 7 | 70 | 1 |
| 8 | 70 | 2 |
| 9 | 70 | 3 |