Supplementary Information for

Detailed modeling of particle separation by microsieving in a rotating belt filter: explicit effect of particle size, mesh size, and polymer dose

Furqan Ahmad Khan a,c, Pankaj Chowdhury b,c , Francesca Giaccherini a,c, Anthony Gerald Straatman a and Domenico Santoro b,c\*

a Department of Mechanical & Materials Engineering, Western University, London, Ontario, Canada, N6A 5B9

b Department of Chemical and Biochemical Engineering, Western University, London, Ontario, Canada, N6A 5B9

c Trojan Technologies, London, ON, N5V4T7, Canada



**Fig. SI1. Clean water drainage column tests for 90, 250, and 500 µm mesh sizes with model predictions.**

****

**Fig. SI2. Predicted flow rates and** $TSS$ **removal efficiency as a function of belt speed and polymer.**

**Table SI1**. SF2000 Details

|  |  |
| --- | --- |
| Belt length  | 0.85 m |
| Belt width  | 0.48 m |
| Linear belt velocity  | 0.015 – 0.247 m/s (5 – 80 Hz) |
| Size of the equipment (L x W x H)  | 2 m x 1.7 m x 1.3 m |

**Table SI2**. Experimental Summary Table

|  |  |  |  |
| --- | --- | --- | --- |
| **Dataset Name** | **Objective** | **Validation range** | **Quantity** |
| CWDC | mesh resistance evaluation | mesh size (µm): 54, 90, 158, 250, 350, 500, 840$TSS\_{in}$ (${mg}/{L}$): 0 | 70 total experiments with 10 replicates for each mesh size |
| WWDC-1 | cake resistance evaluation | mesh size (µm): 158, 250, 350$TSS\_{in}$ (${mg}/{L}$): 183, 200, 264, 324, 533 | 29 total experiments with multiple replicates for different mesh size and $TSS\_{in}$ combinations |
| WWDC-2 | mesh size (µm): 54, 158, 350$TSS\_{in}$ (${mg}/{L}$): 152, 221 | 11 total experiments with multiple replicates for different mesh size and $TSS\_{in}$ combinations |
| WWS | TSSout coefficients evaluation | mesh size (µm): 54, 90, 158, 250, 350$TSS\_{in}$ (${mg}/{L}$): 152, 161, 191, 211, 242 | 25 total experiments for different mesh size and $TSS\_{in}$ combinations |
| PC | cake resistance and TSSout coefficients calibration | mesh size (µm): 350$TSS\_{in}$ (${mg}/{L}$): 207-350polymer dose (${mg}/{L}$): 0-6belt speed (Hz): 8-72 | 50 sampling points with SF2000 |
| PV | model validation | mesh size (µm): 350$TSS\_{in}$ (${mg}/{L}$): 169-300belt speed (Hz): 13-80 | 1623 sampling points with SF2000 |
| Korea | cake resistance and TSSout coefficients calibration against pilot data at three international locations | mesh size (µm): 150$TSS\_{in}$ (${mg}/{L}$): 196-445belt speed (Hz): 15-99 | 47 sampling pointswith SF1000 |
| USA | mesh size (µm): 350$TSS\_{in}$ (${mg}/{L}$): 104-1046belt speed (Hz): 40-80 | 183 sampling pointswith SF1000 |
| Australia | mesh size (µm): 250, 350$TSS\_{in}$ (${mg}/{L}$): 132-946belt speed (Hz): 5-80 | 49 sampling pointswith SF1000 |

**Table SI3.** Retrieved model coefficients error for sampling scenario 1 against base value of coefficients given as: ***Bo*** *= 0.728* ${L}/{mg}$*,* ***bt*** *= 0.345,* ***k*** *= 0.01* ${L}/{mg}$*,* ***γ*** *= 0.499* ${m^{2}}/{m^{3}}$*.* The model was simulated by adding a 20% random error to the artificial pilot data (obtained from BSM2 both for flow and influent TSS).

|  |  |
| --- | --- |
| **Sampling duration (h)** | **Retrieved coefficients error (%)** |
| ***Bo*** | ***bt*** | ***k*** | ***γ*** |
| 1 | 232.4 | 5.5 | 10.2 | 33.0 |
| 2 | 260.0 | 31.0 | 29.8 | 84.1 |
| 4 | 185.0 | 21.1 | 23.9 | 61.9 |
| 8 | 20.0 | 3.7 | 6.5 | 14.2 |
| 16 | 17.3 | 6.4 | 3.1 | 7.6 |
| 32 | 16.3 | 6.4 | 4.4 | 11.3 |
| 64 | 12.4 | 4.7 | 3.3 | 10.2 |
| 128 | 10.3 | 4.4 | 3.3 | 9.5 |

**Table SI4.** Retrieved model coefficients error for sampling scenario 2 against base value of coefficients given as: ***Bo*** *= 0.728* ${L}/{mg}$*,* ***bt*** *= 0.345,* ***k*** *= 0.01* ${L}/{mg}$*,* ***γ*** *= 0.499* ${m^{2}}/{m^{3}}$*.* The model was simulated by adding a 20% random error to the artificial pilot data (obtained from BSM2 only for influent TSS. Refer to Table 1 for flow pattern details).

|  |  |  |
| --- | --- | --- |
| **Coefficient** | **Sampling duration (h)** | **Retrieved coefficients error (%)** |
| **Pattern-1** | **Pattern-2** | **Pattern-3** | **Pattern-4** | **Pattern-5** |
| ***Bo*** | 1 | 172.4 | 286.1 | 150.4 | 185.3 | 333.5 |
| 2 | 386.7 | 142.8 | 108.1 | 68.7 | 25.1 |
| 3 | 283.6 | 98.8 | 25.2 | 3.9 | 21.3 |
| 4 | 360.9 | 16.8 | 29.3 | 12.4 | 18.7 |
| 5 | 157.1 | 24.2 | 8.8 | 17.3 | 19.6 |
| ***bt*** | 1 | 6.2 | 17.2 | 9.7 | 6.9 | 46.6 |
| 2 | 59.4 | 10.8 | 3.7 | 18.3 | 5.4 |
| 3 | 30.6 | 7.7 | 5.3 | 0.1 | 7.5 |
| 4 | 53.8 | 0.1 | 10.4 | 3.5 | 6.0 |
| 5 | 21.5 | 4.3 | 2.6 | 6.3 | 7.8 |
| ***k*** | 1 | 27.8 | 3.7 | 30.3 | 32.2 | 36.7 |
| 2 | 24.3 | 33.0 | 34.9 | 18.7 | 8.2 |
| 3 | 21.2 | 37.5 | 14.6 | 3.9 | 2.9 |
| 4 | 29.8 | 23.9 | 3.5 | 1.9 | 4.6 |
| 5 | 15.0 | 13.3 | 2.1 | 3.9 | 6.1 |
| ***γ*** | 1 | 87.2 | 3.4 | 87.2 | 93.4 | 98.0 |
| 2 | 71.2 | 90.5 | 88.0 | 45.7 | 21.3 |
| 3 | 64.7 | 93.0 | 35.6 | 11.5 | 8.5 |
| 4 | 83.1 | 55.1 | 7.2 | 5.4 | 14.8 |
| 5 | 40.9 | 33.1 | 7.9 | 11.5 | 18.1 |