

## Volume Dispensing with SONOFLOW® CO.55 and Flotek Controller Fill & Finish Application with Ultrasonic Flow Meter

Application Note V1.0 11.18.2020

### Application

Historically, a peristaltic pump has been used to dispense a set volume into a vial, bag, or bottle. Dispensing pumps calculate volume based on displacement per revolution or counting internal pulses to determine when the desired volume has been reached. Due to the mechanical action of occlusion, the tubing wears over time. Variation of the suction conditions as liquid level decreases in the filling source, as well as tubing degradation, lead to a drop off in volume dispensed until a re-calibration must be implemented to maintain the required accuracy of volume dispense. Depending on the filling application, every 50-100 dispenses are quality control checked and an “on the fly” pump re-calibration may be implemented to maintain compliance to application requirements.

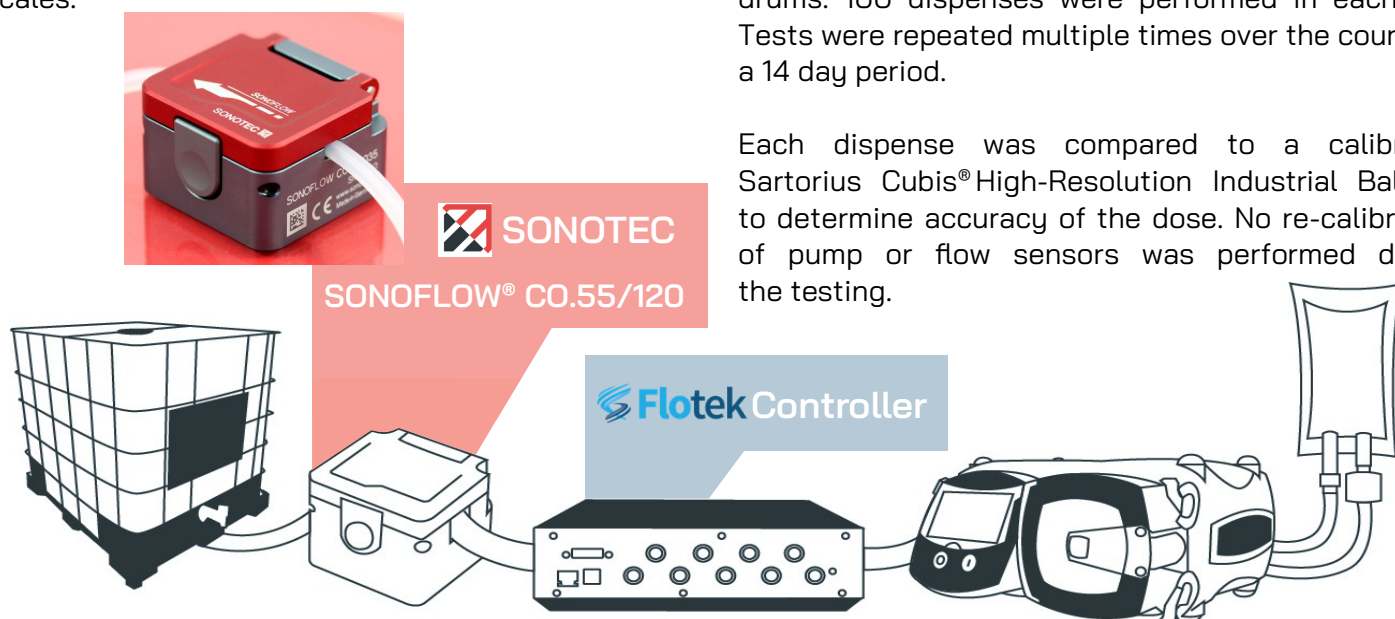
A west coast biotechnology company was looking to minimize quality control issues related to dispensing, eliminate the use of scales, and automate their process. With the use of the Flotek Controller and SONOFLOW® CO.55 sensor, accurate and reliable dispensing was achieved and maintained through the process without the need to re-calibrate pumps or scales.

### Materials and Methods

An alcohol based aqueous solution was dispensed from 1000 L plastic carboy to 425 ml single use bags using a Verderflex® Vantage 5000 pump with a feedback control loop consisting of the Flotek Controller and Sonotec SONOFLOW® CO.55/120 flow sensor clamped around 1/2” OD platinum cured silicone tubing. The Flotek Controller uses an embedded digital PLC to create a PID control loop where the Verderflex pump becomes slave to the SONOFLOW® Sensor. Volume measurements determined by the CO.55 flow sensor are reported to the Flotek Controller, which in turn sends a signal to stop the pump when the accurate volume has been reached. Because the volume is being determined in real time, changes due to tubing degradation or fluid suction are accounted for by the SONOFLOW® sensor reading.

More than ten tests were performed with the dispense volume set at 380 ml/min and 100 dispenses were in each run. Tests were performed with the feed reservoir drum at full capacity, at 1/2 full and at 1/3 full, to account for different suction rates reflected by the varying fluid levels of the drums. 100 dispenses were performed in each run. Tests were repeated multiple times over the course of a 14 day period.

Each dispense was compared to a calibrated Sartorius Cubis® High-Resolution Industrial Balance to determine accuracy of the dose. No re-calibration of pump or flow sensors was performed during the testing.



## Comparison of Sonotec/Flotek Control Loop vs. Peristaltic Pump

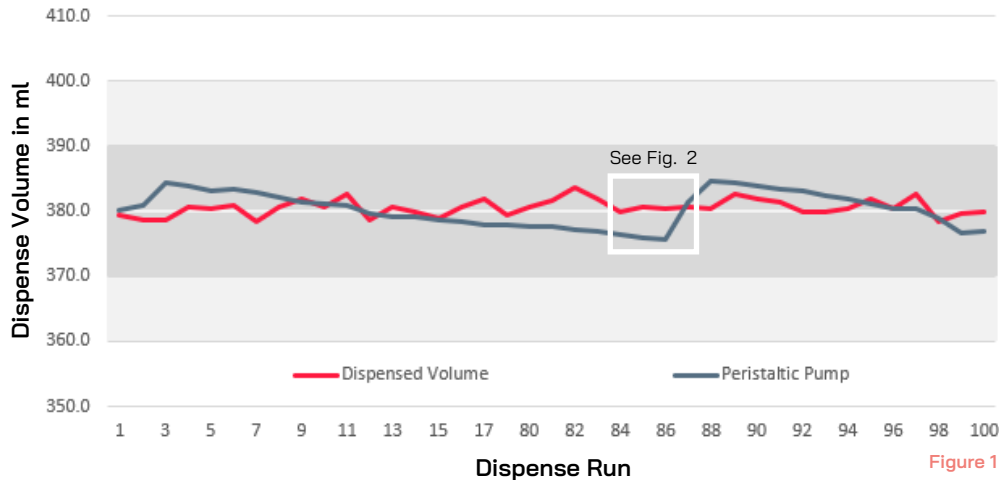


Figure 1

**Volume Dispensing with Accuracy better than 1%**

### Conclusion

Average accuracy of better than 1% was achieved over multiple tests of 100 doses each from full, 1/2 full, and 1/3 full drums using the Flotek Controller and SONOFLOW® CO.55 flow sensor. Repeatability of the Sonotec/Flotek Control Loop resulted in filled bags that were consistently more accurate to the required target volume than the peristaltic pump alone (see Fig. 1 and 2).

The combination of the Flotek Controller and SONOFLOW® sensor can be effectively used to create an accurate and repeatable dispensing system with less than 0.5% variation/accuracy irrespective of the change in mechanical action to the tubing as well as changes in the suction condition. The Flotek Controller used in conjunction with the SONOFLOW® sensor maintains a robust industrial control loop resulting in a stable filling system, without the need for re-calibration due to external variations.

### Sonotec/Flotek Control Loop vs. Peristaltic Pump

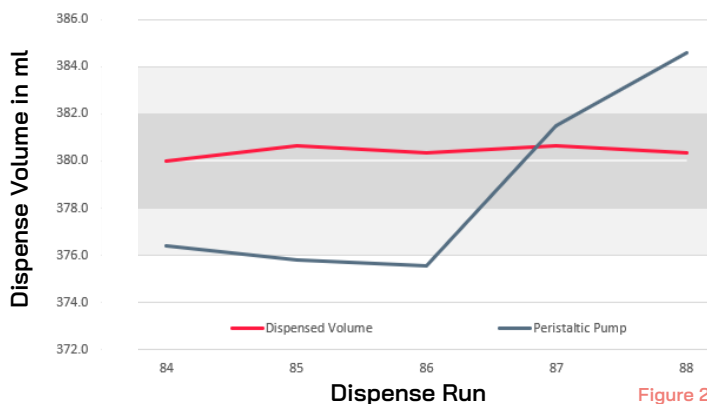


Figure 2

| Test 1 Full<br>Drumset point 380ml |     | Test 2 1/2 Full<br>Drumset point 380ml |     | Test 3 2/3 Empty<br>Drumset point 380ml |     |
|------------------------------------|-----|--|-----|---|-----|
| 1                                  | 381 | 1                                      | 380 | 1                                       | 377 |
| 2                                  | 382 | 2                                      | 376 | 2                                       | 378 |
| 3                                  | 380 | 3                                      | 378 | 3                                       | 378 |
| 4                                  | 382 | 4                                      | 379 | 4                                       | 381 |
| 5                                  | 385 | 5                                      | 377 | 5                                       | 379 |
| 6                                  | 384 | 6                                      | 379 | 6                                       | 380 |
| 7                                  | 380 | 7                                      | 376 | 7                                       | 379 |
| 8                                  | 382 | 8                                      | 379 | 8                                       | 381 |
| 9                                  | 386 | 9                                      | 380 | 9                                       | 380 |
| 10                                 | 384 | 10                                     | 378 | 10                                      | 380 |
| 11                                 | 386 | 11                                     | 383 | 11                                      | 379 |
| 12                                 | 384 | 12                                     | 376 | 12                                      | 376 |
| 13                                 | 384 | 13                                     | 379 | 13                                      | 379 |
| 14                                 | 382 | 14                                     | 380 | 14                                      | 378 |
| 15                                 | 380 | 15                                     | 377 | 15                                      | 380 |
| 16                                 | 384 | 16                                     | 378 | 16                                      | 380 |
| 17                                 | 384 | 17                                     | 383 | 17                                      | 379 |
| 18                                 | 383 | 18                                     | 377 | 18                                      | 378 |
| 80                                 | 382 | 80                                     | 381 | 80                                      | 379 |
| 81                                 | 382 | 81                                     | 381 | 81                                      | 382 |
| 82                                 | 380 | 82                                     | 382 | 82                                      | 389 |
| 83                                 | 378 | 83                                     | 381 | 83                                      | 387 |
| 84                                 | 383 | 84                                     | 378 | 84                                      | 379 |
| 85                                 | 383 | 85                                     | 380 | 85                                      | 379 |
| 86                                 | 384 | 86                                     | 379 | 86                                      | 378 |
| 87                                 | 382 | 87                                     | 380 | 87                                      | 380 |
| 88                                 | 381 | 88                                     | 381 | 88                                      | 379 |
| 89                                 | 385 | 89                                     | 380 | 89                                      | 383 |
| 90                                 | 385 | 90                                     | 382 | 90                                      | 379 |
| 91                                 | 383 | 91                                     | 380 | 91                                      | 381 |
| 92                                 | 382 | 92                                     | 380 | 92                                      | 378 |
| 93                                 | 381 | 93                                     | 381 | 93                                      | 378 |
| 94                                 | 384 | 94                                     | 377 | 94                                      | 380 |
| 95                                 | 384 | 95                                     | 379 | 95                                      | 383 |
| 96                                 | 385 | 96                                     | 378 | 96                                      | 378 |
| 97                                 | 385 | 97                                     | 383 | 97                                      | 380 |
| 98                                 | 379 | 98                                     | 378 | 98                                      | 378 |
| 99                                 | 380 | 99                                     | 378 | 99                                      | 381 |
| 100                                | 382 | 100                                    | 379 | 100                                     | 379 |

|          |       |          |        |          |        |
|----------|-------|----------|--------|----------|--------|
| Average  | 382.6 | Average  | 379.56 | Average  | 379.85 |
| Accuracy | 0.68% | Accuracy | 0.11%  | Accuracy | 0.03%  |