Volume Dispensing with SONOFLOW® CO.55 and FCS Controller

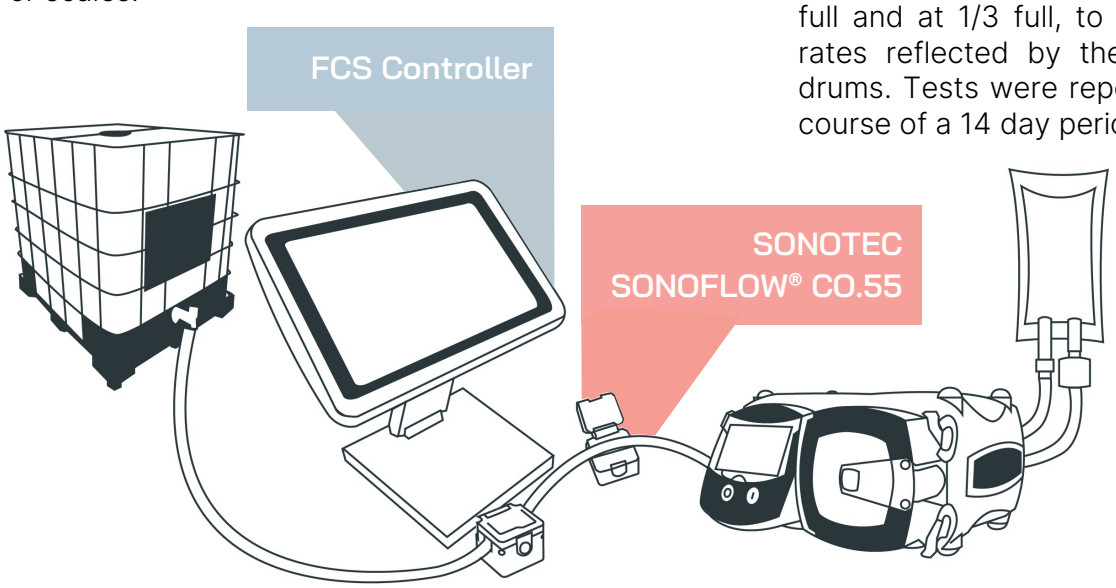
Fill & Finish Application with Ultrasonic Flow Meter

Application Note V1.1 10.08.2021

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 Flow Controller Systems single channel closed loop controller and SONOFLOW CO.55 sensor, accurate and reliable dispensing was achieved and maintained throughout 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 FCS Controller and Sonotec SONOFLOW CO.55/120 flow sensor clamped around 1/2" OD platinum cured silicone tubing. The FCS 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 FCS 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. 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 testing.

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SONOTEC

Comparison of Sonotec/FCS Control Loop vs. Peristaltic Pump

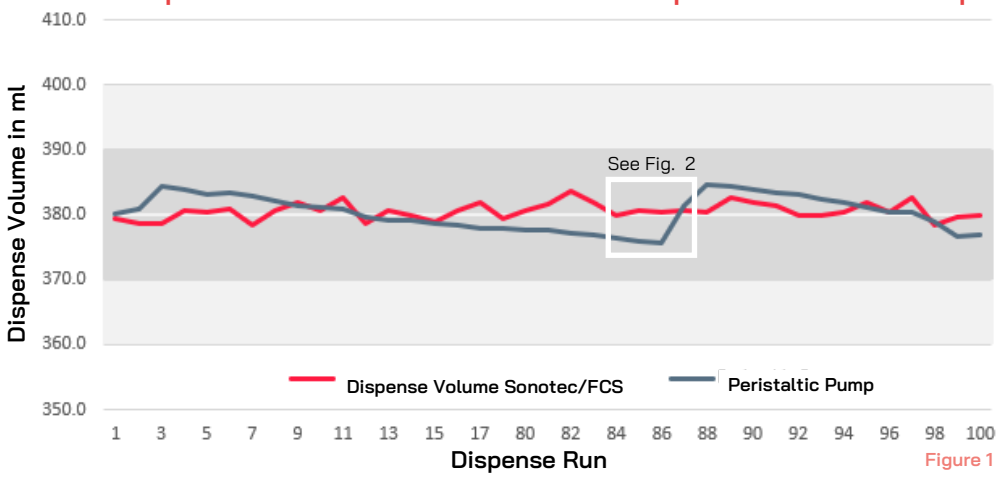

Figure 1

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 FCS Controller and SONOFLOW CO.55 flow sensor. Repeatability of the Sonotec/FCS 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 FCS Controller and SONOFLOW sensor can be effectively used to create an accurate and repeatable dispensing system with less than 0.5% variation/repeatability irrespective of the change in mechanical action to the tubing as well as changes in the suction condition. The FCS 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/FCS Control Loop vs. Peristaltic Pump

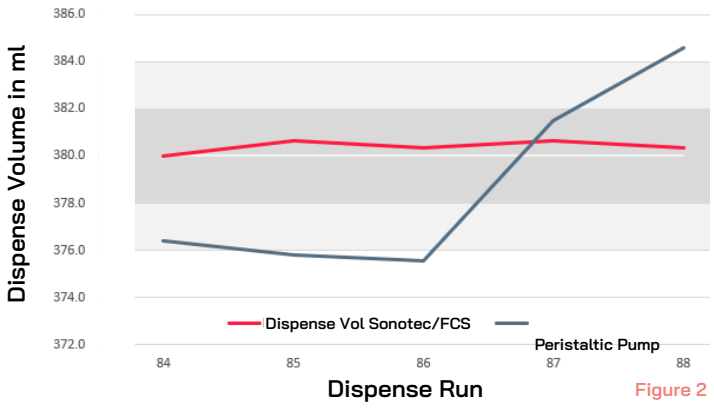

Figure 2

Summary of Sonotec/FCS Control Loop Test Runs

Test 1: Full Drumset Point 380ml		Test 2: 1/2 Full Drumset Point 380ml		Test 3: 2/3 Empty 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	**0.71%**	**Accuracy**	**0.39%**	**Accuracy**	**0.35%**

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