Eliminate the bottleneck in powder dispensing

Rethinking powder dispensing

Dispensing and weighing solids is one of the most tedious and time-consuming tasks faced by lab scientists, and is considered by many to be an unavoidable bottleneck. Fortunately, that is changing. Advances in solid dispensing automation have been shown to free up time for scientists while also increasing the reproducibility and traceability of the data generated. Even so, many labs have been hesitant to adopt these new automated powder-dispensing technologies. The concern stems from the precision and accuracy of dispensing and accurate handling of powders with a wide variety of characteristics.

Unchained Labs created the Junior for powder dispense to put an end to powder-dispensing bottlenecks. In order to demonstrate the precision, accuracy and flexibility of the system, this application note describes the accurate dispensing of a variety powders with very different characteristics.

Precise and accurate powder dispensing

The Junior for powder dispense can dispense from 0.1 mg–10 g quantities of a wide range of powders with RSDs between 1–5%. It also handles up to 34 different source powders and a variety of destination containers, including vials, jars and microplates.

Built on Unchained Labs' Junior platform, the system weighs each powder as it is dispensed, then reports the results and stores them for future use. Add the optional positive displacement tip pipette, and the system will accurately dispense µL to mL volume quantities of liquids.

Intelligent powder dispensing

This exceptional performance is based on the proprietary Powdernium™ dispense algorithm—a technology that monitors and optimizes dosing parameters in real time. Using input from the system balance, the Powdernium algorithm dynamically controls the dispensing head to adjust for powders with different densities, particle sizes, particle shapes and static charges. The result is accurate and precise dispensing of powders—even of those with widely varying properties.

Figure 1: Junior for powder dispense.

Figure 2: Junior for powder dispense taking a plate from the integrated shoulder hotel to the balance.

Flexible powder dispensing

To enable users to meet the broadest range of dispensing challenges with the most productive results, the Junior for powder dispense offers two

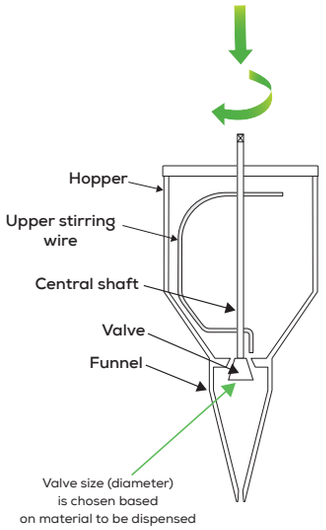

Figure 3: Powdernium™ classic powder dispensing.

separate dispense technologies: Powdernium classic and Powdernium storage vial (SV).

- **Powdernium classic mode** uses an autoclavable hopper with an internal stirring wire to fluidize the powder. A range of hopper sizes are provided for holding different powder volumes (Figure 3).
- **Powdernium SV mode** dispenses solids directly from a standard storage vial using a vibratory dispense head. With a low dead volume, SV mode is ideal for quickly dispensing small amounts of precious materials from compound libraries with maximal accuracy and minimal loss (Figure 4).

Proven powder dispensing

To demonstrate the precision, accuracy and flexibility of the Junior for powder dispense, an

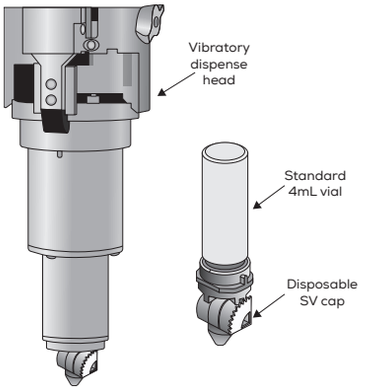

Figure 4: Powdernium SV (storage vial) dispensing.

experiment was conducted using samples of five powders with different characteristics:

- Microcrystalline cellulose (Avicel PH101), a freely flowing powder (Tables 1 and 2)
- Potassium phosphate, a sticky and fine powder (Tables 3 and 4)
- Magnesium stearate, a very fine powder (Tables 5 and 6)
- Tetrabutylammonium bromide, a coarse and crystalline powder (Tables 7 and 8)
- Zirconyl chloride, a sticky and crystalline powder (Table 9)

Powders microcrystalline cellulose (Avicel PH101), potassium phosphate, magnesium stearate and tetrabutylammonium bromide were each dispensed 10 times with Powdernium classic and SV modes at target dispense amount of 5 mg, 10 mg, 25 mg, 100 mg and 200 mg, using an absolute tolerance of +/- 0.2-0.5 mg. Zirconyl chloride was tested with the previous conditions above along with being dispensed 10 times, however, only using Powdernium SV mode.

Easy-to-use powder dispensing

The Junior for powder dispense has a simple drag-and-drop interface for fast experimental set up and editing. Dispensing status is displayed in real time, and allows for quick import and export of methods to standardize powder dispensing across your organization.

Target (mg)	200	100	50	25	10	5
Tolerance (mg)	+/– 0.5	+/– 0.5	+/– 0.2	+/– 0.2	+/– 0.2	+/– 0.2
Mean (mg)	201.93	99.75	49.75	24.91	9.85	4.95
Standard deviation (mg)	1.58	0.33	0.07	0.15	0.07	0.07
RSD (%)	0.78	0.33	0.14	0.60	0.72	1.43
Accuracy (%)	99.04	99.75	99.50	99.65	98.50	99.00

Table 1: Microcrystalline cellulose (Avicel PH101) using Powdernium classic.

Target (mg)	200	100	50	25	10	5
Tolerance (mg)	+/– 0.5	+/– 0.5	+/– 0.2	+/– 0.2	+/– 0.2	+/– 0.2
Mean (mg)	199.87	99.80	49.85	24.88	9.88	4.85
Standard deviation (mg)	0.58	0.28	0.17	0.05	0.05	0.08
RSD (%)	0.29	0.28	0.35	0.20	0.51	1.73
Accuracy (%)	99.93	99.80	99.70	99.50	98.75	97.00

Table 2: Microcrystalline cellulose (Avicel PH101) using Powdernium SV.

Target (mg)	200	100	50	25	10	5
Tolerance (mg)	+/– 0.5	+/– 0.5	+/– 0.2	+/– 0.2	+/– 0.2	+/– 0.2
Mean (mg)	199.55	99.58	49.80	24.85	9.85	4.90
Standard deviation (mg)	0.10	0.10	0.14	0.21	0.06	0.13
RSD (%)	0.05	0.10	0.28	0.85	0.59	2.69
Accuracy (%)	99.78	99.58	99.60	99.40	98.50	97.96

Table 3: Potassium phosphate using Powdernium classic.

Target (mg)	200	100	50	25	10	5
Tolerance (mg)	+/– 0.5	+/– 0.5	+/– 0.2	+/– 0.2	+/– 0.2	+/– 0.2
Mean (mg)	201.80	100.30	49.85	24.98	9.88	4.87
Standard deviation (mg)	3.14	1.25	0.24	0.05	0.05	0.09
RSD (%)	1.56	1.25	0.48	0.20	0.51	1.77
Accuracy (%)	99.10	99.65	99.70	99.90	98.75	97.30

Table 4: Potassium phosphate using Powdernium SV.

Target (mg)	200	100	50	25	10	5
Tolerance (mg)	+/– 0.5	+/– 0.5	+/– 0.2	+/– 0.2	+/– 0.2	+/– 0.2
Mean (mg)	199.75	99.48	50.22	24.80	9.94	4.88
Standard deviation (mg)	0.42	0.13	0.88	0.14	0.12	0.14
RSD (%)	0.21	0.13	1.76	0.57	1.17	2.91
Accuracy (%)	99.87	99.48	99.56	99.20	99.38	97.55

Table 5: Magnesium stearate using Powdernium classic.

Target (mg)	200	100	50	25	10	5
Tolerance (mg)	+/– 0.5	+/– 0.5	+/– 0.2	+/– 0.2	+/– 0.2	+/– 0.2
Mean (mg)	199.78	100.38	50.22	25.01	9.77	4.93
Standard deviation (mg)	0.22	0.81	0.78	0.27	0.14	2.95
RSD (%)	0.11	0.80	1.55	1.07	1.40	2.95
Accuracy (%)	99.89	99.63	99.57	99.96	97.67	98.55

Table 6: Magnesium stearate using Powdernium SV.

Target (mg)	200	100	50	25	10	5
Tolerance (mg)	+/– 0.5	+/– 0.5	+/– 0.2	+/– 0.2	+/– 0.2	+/– 0.2
Mean (mg)	200.95	99.71	50.15	24.88	9.98	4.92
Standard deviation (mg)	1.85	0.15	0.35	0.16	0.08	0.22
RSD (%)	0.92	0.15	0.70	0.65	0.78	4.56
Accuracy (%)	99.53	99.71	99.70	99.51	99.76	98.32

Table 7: Tetrabutylammonium bromide using Powdernium classic.

Target (mg)	200	100	50	25	10	5
Tolerance (mg)	+/– 0.5	+/– 0.5	+/– 0.2	+/– 0.2	+/– 0.2	+/– 0.2
Mean (mg)	199.87	100.23	49.81	24.82	9.90	4.85
Standard deviation (mg)	0.31	0.69	0.22	0.25	0.67	0.13
RSD (%)	0.16	0.69	0.44	0.99	6.75	2.66
Accuracy (%)	99.93	99.78	99.62	99.26	99.00	97.00

Table 8: Tetrabutylammonium bromide using Powdernium SV.

Target (mg)	200	100	50	25	10	5
Tolerance (mg)	+/– 0.5	+/– 0.5	+/– 0.2	+/– 0.2	+/– 0.2	+/– 0.2
Mean (mg)	199.58	99.58	49.87	24.88	9.80	4.83
Standard deviation (mg)	0.10	0.05	0.10	0.08	0.09	0.05
RSD (%)	0.05	0.05	0.21	0.30	0.91	1.07
Accuracy (%)	99.79	99.58	99.73	98.53	98.00	96.67

Table 9: Zirconyl chloride using Powdernium SV.

Remove the bottleneck in powder dispensing

Through two separate dispensing methods, and utilizing the power of walk-up, ease-of-use software, the Junior for powder dispense is a powerful tool to combat powder dispensing bottlenecks and free up more of your time to focus on research priorities.

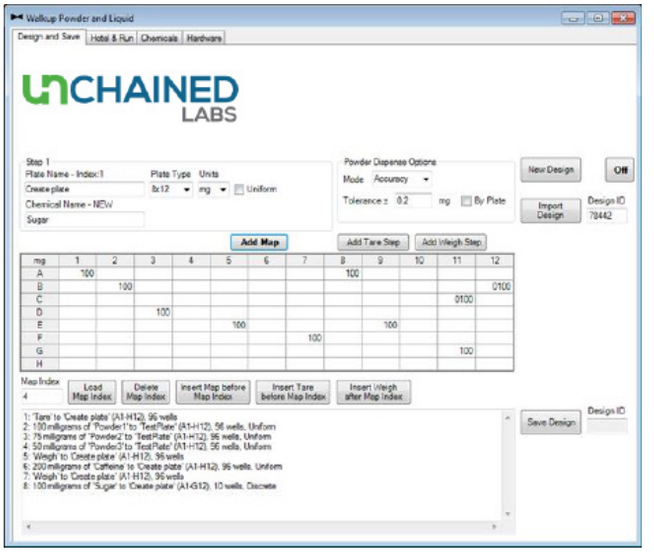

Figure 5: Junior for powder dispense user interface.

Unchained Labs
6870 Koll Center Pkwy
Pleasanton, CA 94566
Phone: 1.925.587.9800
Toll-free: 1.800.815.6384
Email: info@unchainedlabs.com

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