freeslate®

APPLICATION NOTE

Eliminate the Bottleneck in Powder Dispensing

Rethinking Powder Dispensing

Weighing and dispensing solids is one of the most tedious and time-consuming tasks faced by laboratory scientists, and it 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 laboratories have been hesitant to adopt these new automated powder-dispensing technologies. Precision and accuracy of powder dispensing and accurate handling of powders with a wide variety of characteristics have been cited as two reason for this hesitation.

Freeslate created the CM Protégé Powder Dispense System 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 powders with very different characteristics.

Precise and Accurate Powder Dispensing

The CM Protégé Powder Dispense System was designed to eliminate powder-dispensing bottlenecks. It dispenses from 0.5 mg to 5 g quantities of a wide range of powders with RSDs between 1% and 5%. It also handles up to 34 different source powders and a variety of destination containers, including vials, jars, and microplates.

Built on the Freeslate CM Protégé robotics platform, the CM Protégé Powder Dispense 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 to compensate for variability in powder properties during the dispensing process. 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—including those with widely varying properties. The CM Protégé Powder Dispense System automatically stores the optimized Powdernium dispense parameters for future use.

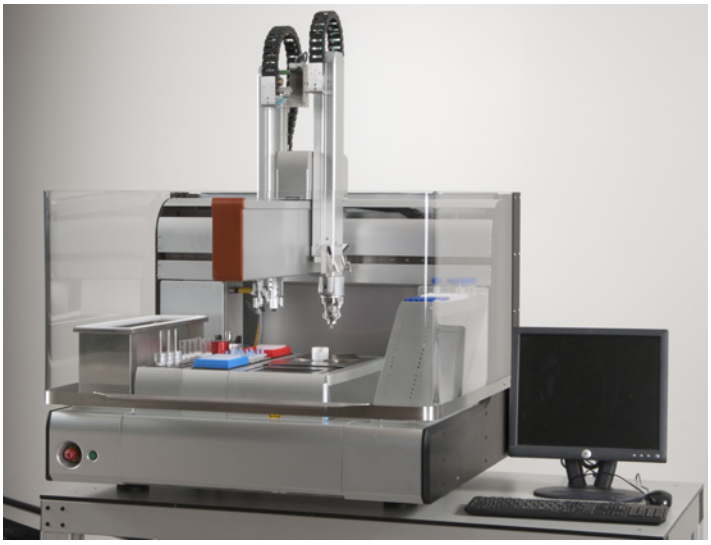
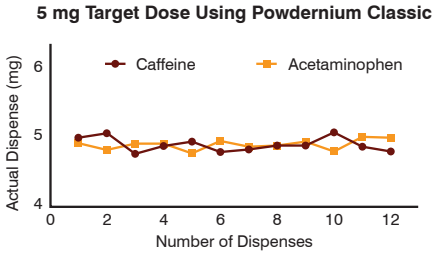
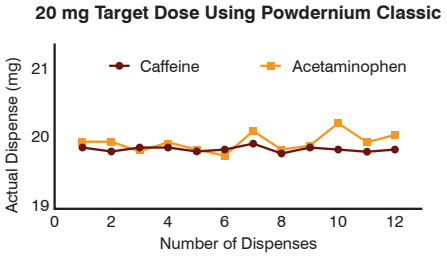


Figure 1: Freeslate CM Protégé Powder Dispense System.

Figure 2: CM Protégé taking a plate from the integrated shoulder hotel to the balance.

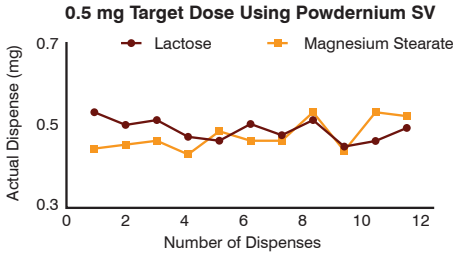


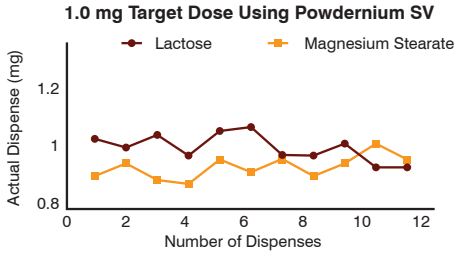


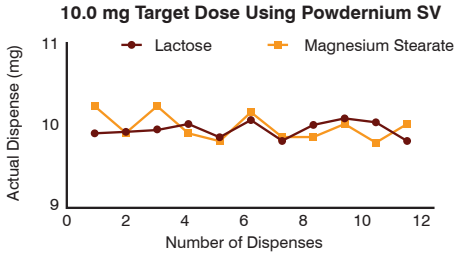
	Caffeine	Acetaminophen
Tolerance (mg)	+/– 0.2	+/– 0.2
Mean (mg)	4.88	4.88
RSD (%)	1.97	1.39
Accuracy (%)	97.53	97.52

	Caffeine	Acetaminophen
Tolerance (mg)	+/– 0.2	+/– 0.2
Mean (mg)	19.84	19.94
RSD (%)	0.18	0.64
Accuracy (%)	99.20	99.68

Figure 3: Powdernium Classic mode data.







	Lactose	Magnesium Stearate
Tolerance (mg)	+/– 0.1	+/– 0.1
Mean (mg)	0.49	0.47
RSD (%)	5.16	7.43
Accuracy (%)	97.27	94.55

	Lactose	Magnesium Stearate
Tolerance (mg)	+/– 0.2	+/– 0.2
Mean (mg)	1.01	0.96
RSD (%)	3.42	2.89
Accuracy (%)	99.09	96.18

	Lactose	Magnesium Stearate
Tolerance (mg)	+/– 0.2	+/– 0.2
Mean (mg)	9.96	9.99
RSD (%)	1.04	1.62
Accuracy (%)	99.6	99.9

Figure 4: Powdernium SV mode data.

Flexible Powder Dispensing

To enable users to meet the broadest range of dispensing challenges with the most productive results, the CM Protégé Powder Dispense System offers two dispense modes: Powdernium Classic and Powdernium Storage Vial (SV).

- **Powdernium Classic mode** (Figure 3) 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.
- **Powdernium SV mode** (Figure 4) 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.

Proven Powder Dispensing

To demonstrate the precision, accuracy, and flexibility of the CM Protégé Powder Dispense System, an experiment was conducted using samples of six powders with different characteristics:

- Microcrystalline cellulose (Avicel PH101), a freely flowing powder
- Potassium phosphate, a sticky and fine powder
- Magnesium stearate, a very fine powder
- Tetrabutylammonium bromide, a coarse and crystalline powder
- Zirconyl chloride, a sticky and crystalline powder
- Each powder was dispensed 10 times with Powdernium Classic and/or SV modes at target dispense amounts of 5 mg, 10 mg, 25 mg, 100 mg, and 200 mg, using an absolute tolerance of +/- 0.2–0.5 mg.

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.

Easy to Use Powder Dispensing

The CM Protégé Powder Dispense System has a simple drag-and-drop interface for fast experiment set up and editing. Dispensing status is displayed in real time, and you can quickly import and export methods to standardize powder dispensing across your organization.

Remove the Bottleneck in Powder Dispensing

Advance your powder dispensing productivity and free up more time to focus on your research priorities with the CM Protégé Powder Dispense System.

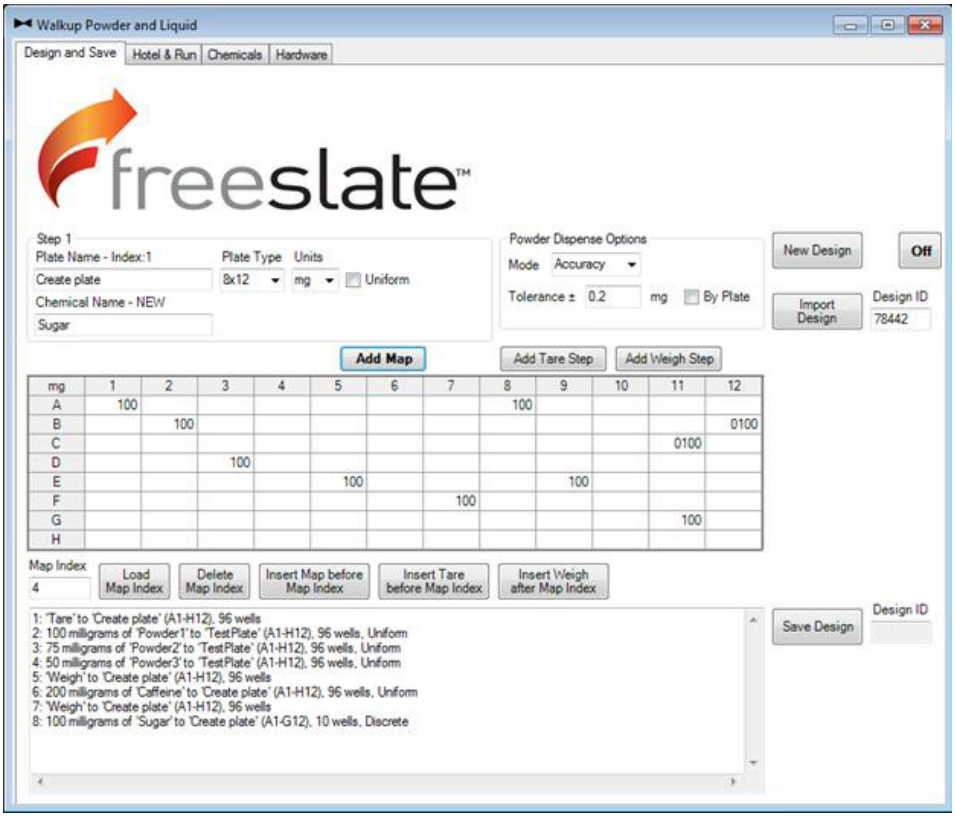


Figure 5: CM Protégé User Interface.

freeslate®
www.freeslate.com

Headquarters
415 Oakmead Parkway
Sunnyvale, CA 94085
United States
T 408.773.4000
F 408.773.4002
E customercontact@freeslate.com