Rapid and Precise Moisture Analysis for Powdered Dairy and Food Ingredients

Introduction

The production of spray-dried powders is a relatively simple process, where liquid product is heated under low pressure to drive off moisture, creating a dry product that flows freely and will not spoil. As straightforward as the process is, the moisture content in the finished product is critical to control. Too much moisture will cause the final product to agglomerate and spoil. On the other hand, manufacturers must balance the removal of moisture with energy usage. Spray drying is an energy-intensive process; over-drying powdered products increases energy usage and reduces overall profitability. Moisture levels can be monitored by in-line detectors located within the drying equipment. However, these sensors must be calibrated and final product must still be qualified by a direct method before release. Traditional infrared moisture balances are a relatively rapid approach to verifying moisture content, but can take 20 minutes or more to complete. Extended testing times, along with the inability to directly measure sample temperature, can result in scorched samples and inaccurate results.

The SMART Q™ moisture analyzer is uniquely designed to accurately and rapidly measure low moisture levels, common in powdered ingredients. By combining active cavity ventilation with direct sample temperature feedback, the SMART Q analyzes samples up to 3-times faster than traditional infrared moisture balances with no risk of burning. With a highly accurate 4-place analytical balance and 3-digit moisture readout, the SMART Q provides reliable, repeatable results in approximately 5 minutes. For even faster test times, the SMART Q can be upgraded to the SMART 6, which incorporates microwave and infrared technology for the fastest direct moisture analysis on the market.

This study demonstrates that the SMART Q can rapidly analyze a wide range of powdered ingredients for moisture with an average difference of 0.007% compared to vacuum oven reference results.

Key System Benefits of SMART Q

- **Rapid at-line testing** - Results in minutes
- **Easy to use** - Not sensitive to color, density, or consistency changes
- **Rugged** - Designed to withstand the toughest manufacturing environments
- **Direct Loss-on-drying** - a direct, primary method with no calibration required

Experimental

To evaluate the performance of the SMART Q, five powdered samples were obtained: whey protein concentrate (WPC), egg powder, milk powder, non-fat dry milk (NFDM), and isolate milk powder (Isolate MP). For moisture determination, a 5 g sample of each product was analyzed in the SMART Q using a constant-weight end parameter. Testing took approximately 5 minutes for all samples. Reference testing was performed in a vacuum oven in triplicate to establish a basis of comparison. The oven method was set for 5 hours at 100 °C, followed by a cooling period under desiccation to ensure complete drying.

Results

Results for average percent moisture using the SMART Q compared closely to vacuum oven results, as illustrated in **Table 1**. The average absolute difference between the SMART Q results and vacuum oven results are less than 0.003%. **Table 2** highlights the precision of the SMART Q. The SMART Q precision outperformed the vacuum oven reference method, exhibiting average standard deviations of 0.011% and 0.013% respectively. The average dry time for the SMART Q was approximately 5 minutes with no cavity pre-heat, a necessary feature common among other leading brands of infrared moisture analyzers.

Table 1. Accuracy of SMART Q for Moisture Analysis of Powdered Products

	Percent Moisture		
Sample	**SMART Q**	**Vacuum Oven**	**Difference**
WPC	8.065	8.075	-0.010
Egg Powder	3.457	3.465	-0.008
Milk Powder	3.905	3.900	0.005
NFDM	5.814	5.795	0.019
Isolate MP	9.185	9.193	-0.008

Table 2: Precision of SMART Q for Moisture Analysis of Powdered Products

	Percent Moisture Replicates						
Sample	**1**	**2**	**3**	**4**	**5**	**Average**	**Std. Dev.**
WPC	8.051	8.067	8.064	8.072	8.069	8.065	0.008
Egg Powder	3.454	3.446	3.460	3.465	3.460	3.457	0.007
Milk Powder	3.923	3.891	3.915	3.904	3.892	3.905	0.014
NFDM	5.802	5.837	5.808	5.824	5.801	5.814	0.016
Isolate MP	9.180	9.178	9.189	9.188	9.191	9.185	0.006

Conclusion

For powdered dairy and food applications where accuracy and precision are critical, the SMART Q offers reliable results that match vacuum oven reference methods in only a few minutes. CEM's combination of proprietary and patented technology translates into one of the lowest primary moisture tests on the market. With short test times and accurate results, the SMART Q is rapid enough and rugged enough to work at-line, or in the laboratory.

United States (Headquarters)
800-726-3331
704-821-7015
Fax: 704-821-7894
info@cem.com

France
33 (01) 69 35 57 80
Fax: 33 (01) 60 19 64 91
info.fr@cem.com

Germany, Austria, Switzerland
(49) 2842-9644-0
Fax: (49) 2842-9644-11
info@cem.de

Ireland
+353 (0) 1 885 1752
Fax: +353 (0) 1 885 1601
info.ireland@cem.com

Italy
(39) 35-896224
Fax: (39) 35-891661
info.srl@cem.com

Japan
+81-3-5793-8542
Fax: +81-3-5793-8543
info@cemjapan.co.jp

United Kingdom
(44) 1280-822873
Fax: (44) 1280-822873
info.uk@cem.com

www.cem.com