Rapid and Precise Loss-on-Drying Analysis for Chemical Manufacturers

Introduction

Chemical manufacturing is one of the most diverse markets in the world, with each site custom tailored to the product being manufactured. Despite the wide diversity, one of the most common factors in all processes is the need to control total solids or volatile component levels. For some manufacturing processes, high moisture levels can degrade reactivity or lead to agglomeration. For other processes, such as slurries, total solids must be accurately maintained for best performance and cost. Whether manufacturers are testing for total solids or percent volatiles, loss-on-drying is the only simple and direct method of analysis. Long total solids test times can lead to unnecessary and costly time waiting for batch release or reformulation. Infrared loss-on-drying balances are a relatively rapid approach to measuring total solids, but can take 20 minutes or more to complete. Dedicated optical sensors can be fitted to certain continuous processes, but are expensive, highly specialized, and require regular calibration.

The SMART Q™ is uniquely designed to rapidly measure loss-on-drying in both manufacturing and in laboratory settings. With a highly accurate 4-place analytical balance, the SMART Q provides reliable, repeatable results in approximately 5 minutes. The SMART Q uses direct sample temperature feedback and active cavity ventilation to dry samples faster than any other infrared moisture analyzer and requires no cavity pre-heat.

This study demonstrates that the SMART Q can rapidly analyze a wide range of manufactured chemicals for loss-on-drying with an average difference of less than 0.04%, compared to air oven reference results.

Experimental

To evaluate the performance of the SMART Q, five chemical samples were obtained: Kaolinite, carbon nanotubes, an acrylic emulsion, a water-based resin, and an iron oxide slurry. For loss-on-drying determination, a 15 g sample of each product was analyzed in the SMART Q. Reference testing was performed in an air oven in triplicate to establish a basis of comparison. The air oven method was set for 8 h at 100 °C, followed by a cooling period under desiccation to ensure complete drying.

Results

Table 1 highlights the precision of the SMART Q. The SMART Q outperformed the air oven reference method for precision, exhibiting an average standard deviation of 0.05%. Results for average percent moisture using the SMART Q compared closely to air oven results, as illustrated in **Table 2**. The average absolute difference between the SMART Q results and air oven results is 0.04%. The average dry time for the SMART Q was approximately 5 minutes, requiring no cavity pre-heat, a necessary feature common among other infrared loss-on-drying analyzers.

Table 1: Precision of SMART Q Compared to Air Oven for Moisture Analysis

Sample	Kaolinite	Carbon Nanotubes	Acrylic Emulsion	Water-Based Resin	Iron Oxide Slurry
SMART Q	0.77	4.49	40.88	45.39	52.20
Air Oven	0.76	4.40	40.90	45.42	52.15
Difference	0.01	0.09	-0.02	-0.03	0.05

Table 2: Accuracy of SMART Q Compared to Air Oven for Average Percent Moisture

Sample	Kaolinite	Carbon Nanotubes	Acrylic Emulsion	Water-Based Resin	Iron Oxide Slurry
1	0.70	4.45	40.86	45.37	52.10
2	0.79	4.48	40.94	45.49	52.20
3	0.80	4.41	40.88	45.36	52.26
4	0.79	4.54	40.80	45.38	52.22
5	0.77	4.55	40.90	45.34	52.23
Average	0.77	4.49	40.88	45.39	52.20
STDEV	0.01	0.06	0.05	0.06	0.02

Conclusion

For manufactured chemical applications where accuracy and precision are critical, the SMART Q offers reliable results that match air oven results, in only a few minutes. The combination of CEM proprietary and patented technology translates into one of the fastest primary loss-on-drying tests on the market. With short test times and accurate results, the SMART Q allows chemical suppliers to maintain better control over the manufacturing process and improve profitability.

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