Moisture Analysis for Plastic Pellets

Abstract

Manufactured plastic parts are ubiquitous in everyday life, from household goods to industrial applications. One thing all plastic parts share in common is the need for precise moisture control during manufacturing. Unfortunately, traditional moisture analysis requires eight hours or more to perform, causing a significant bottleneck in the production process. In this application note, we show how the SMART Q™ infrared moisture analyzer can reduce test times to approximately 10 minutes, while maintaining the same levels of accuracy and precision as the traditional air oven method.

Introduction

Plastic pellets are used in countless production processes, including but not limited to extrusion, injection molding, blow molding, and thermoforming. Moisture content has a direct impact on nearly all molding processes and must be tightly controlled. If moisture levels in pellets are too high, the final product can have visual or structural flaws, depending on the polymer type. Plastic part producers typically dry pellets before a manufacturing run, checking moisture content periodically until acceptable levels are reached. Long moisture test times can lead to unnecessary and costly time in the pellet dryer. Infrared moisture balances are a relatively rapid approach to measuring moisture, but can take 20 minutes or more to complete. Dedicated optical sensors can be fitted to pellet dryers, but are expensive, highly specialized, and require regular calibration.

The SMART Q™ moisture analyzer is uniquely designed to accurately measure low moisture levels common in plastic pellets. With a highly accurate 4-place analytical balance and 3-digit moisture readout, the SMART Q provides reliable, repeatable results in approximately five minutes. The SMART Q uses direct sample temperature feedback and active cavity ventilation to dry samples faster than any other infrared moisture analyzer with no cavity pre-heat.

This study demonstrates that the SMART Q can rapidly analyze a wide range of plastics for moisture with an average difference of less than 0.003% when compared to air oven reference results.

Materials and Methods

To evaluate the performance of the SMART Q, five types of plastic pellet samples were obtained: nylon, acrylonitrile-butadiene-styrene (ABS), polycarbonate, polypropylene and a rubber thermoplastic elastomer (TPE). The ABS, polypropylene and rubber TPE were compounded pellets filled with carbon black, whereas the nylon and polycarbonate were neat pellets. All pellets were subjected to ambient laboratory temperature and humidity for 24 hours prior to analysis. For moisture determination, a 15 g sample of each product was analyzed in the SMART Q. SMART Q parameters were set to 100 °C maximum temperature with set-time end point of five to eight minutes depending on sample type. Reference testing was performed in an air oven in triplicate to establish a basis of comparison. The air oven method was set for 8 hours at 100 °C, followed by a cooling period under desiccation to ensure complete drying.

Results and Discussion

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

Conclusion

For plastics applications where accuracy and precision are critical, the SMART Q offers reliable results that match air oven reference methods in approximately five to eight 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 series is rapid enough and rugged enough to work at-line or in the laboratory.

Table 1. Accuracy of SMART Q for Moisture Analysis of Plastic Pellets

Sample	Reference Moisture (%)	Reference STDEV	SMART Q Moisture (%)	SMART Q STDEV	Difference
Nylon - Unfilled	1.090	0.015	1.087	0.015	-0.003
ABS - Black Filled	0.323	0.022	0.328	0.010	0.005
Polycarbonate - Unfilled	0.173	0.008	0.175	0.013	0.002
Polypropylene - Black Filled	0.094	0.009	0.096	0.006	0.002
Rubber TPE - Black Filled	0.062	0.010	0.061	0.012	-0.001

Table 2. Precision of SMART Q for Moisture Analysis of Plastic Pellets

	Replicate						
Sample	1	2	3	4	5	Average	STDEV
Nylon - Unfilled	1.089	1.066	1.100	1.101	1.079	1.087	0.015
ABS - Black Filled	0.333	0.337	0.325	0.334	0.313	0.328	0.010
Polycarbonate - Unfilled	0.172	0.176	0.189	0.155	0.183	0.175	0.013
Polypropylene - Black Filled	0.095	0.102	0.087	0.101	0.093	0.096	0.006
Rubber TPE - Black Filled	0.044	0.070	0.067	0.051	0.071	0.061	0.012

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