

Process Control for Plastic Manufacturers



Abstract

Nearly all manufactured plastic parts come from compounded plastics, which consist of many ingredients such as the polymer itself, plus fillers, slip agents, and antioxidants. Ensuring proper formulation is critical for product performance, least-cost formulation and regulatory compliance. Ash analysis is a fundamental test that is used to provide insight into the formulation of the plastic compound. Traditionally, ash analysis has taken countless hours to perform, creating unnecessary bottle necks in the production process. In this application note, we demonstrate the time savings of the Phoenix BLACK™ microwave muffle furnace, which provides up to 97% time savings without sacrificing the high levels of precision expected by analysts.

Introduction

Plastic compounders are the first step to creating the world of plastic that we currently live in. The millions of molded and extruded plastics products that we interact with on a daily basis all start with compounders and masterbatchers. Regardless if you are a producer of masterbatch raw materials, recycled material provider, or focus on extrusion of various pellets, determining and carefully monitoring the ash content of your products is a critical stage of ensuring proper formulation and material performance.

In this application note, we focus on the technology behind the Phoenix BLACK microwave muffle furnace, which allows users to reduce their ash analysis time from hours down to minutes, while maintaining compliance with all standard test methods that specify an electrically heated muffle furnace, such as ASTM D5630-94, ASTM D1506-94B, as well as various ISO and DIN methods.

Experimental Details

To evaluate the time savings and repeatability of ash analysis in the Phoenix BLACK, a wide variety of polymer samples, compounds, and compound ingredients were analyzed. Each sample was ashed at industry-standard temperatures until constant weight was achieved. For samples analyzed with the Phoenix BLACK, quartz-fiber crucibles were used. Quartz-fiber crucibles maximize air-to-sample contact, aiding in a faster, more efficient ashing process. For comparison, samples were also ashed in a traditional electrically heated muffle furnace in ceramic, quartz, or platinum crucibles, depending on the sample type. For the time savings study, all samples were measured in triplicate.

Results

For the time savings study, typical ashing times required for ash analysis in a traditional muffle furnace were compared to the time required to completely ash the sample to constant weight using the Phoenix BLACK. Time savings varied from 77-97% compared to the traditional muffle furnace (**Table 1**).

To highlight the repeatability of ash analysis carried out in the Phoenix BLACK using quartz-fiber crucibles, nine different sample types were analyzed in triplicate. Sample to sample variation is very low, as shown in **Table 2**.

Conclusion

For compounders and masterbatchers, ash analysis is a fundamental test that is used to check proper formulation. Ash analysis has traditionally taken hours to perform and in many cases is a bottleneck in the batch release process. By reducing test times down to as little as five minutes, the Phoenix BLACK provides faster results that allows users to quickly make changes to formulations or release batches sooner.

Table 1. Time Savings of the Phoenix BLACK

Material	Conventional (min)	Phoenix BLACK (min)	Time Savings (%)
Butyl Rubber	90	20	78
Carbon Black	960	90	91
Polyester (Filled)	480	15	97
Polyethylene (Unfilled)	30	5	83
Polyethylene (% Carbon Black)	30	7	77
Polypropylene	30	5	83
Silicon Carbide Mixture	120	10	92
Stearates	90	5	94

Table 2. Repeatability of the Phoenix BLACK

Material	Sample 1 (%)	Sample 2 (%)	Sample 3 (%)	Average (%)
PET Masterbatch	4.88	4.85	4.89	4.87
HDPE	2.35	2.38	2.28	2.34
Carbon Black 1	0.524	0.539	0.564	0.542
Carbon Black 2	0.235	0.255	0.255	0.248
Butyl Rubber	9.32	9.47	9.43	9.41
Filled Plastic	65.54	65.4	65.67	65.54
Phenolic Resins	2.4	2.38	2.39	2.39
PE Black	2.7	2.77	2.76	2.76
Pellet Resin	22.26	22.56	22.66	22.49

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