Rapid Solids Analysis in Coatings, Paints, & Resins

Introduction

Process control of solids and volatiles is critical in the manufacturing of coatings, paints, and resins. Tight control of these parameters ensures proper formulations and improves overall yields. Raw materials and finished products in these industries are sold and purchased according to their respective COA's (Certificate of Analysis), thereby necessitating the need for strict process control parameters.

The SMART 6™ Moisture & Solids Analyzer is uniquely designed to fit the needs of the large variety of sample types in these markets, from water or solvent-based products, to powder coatings. The system utilizes dual-frequency energy, specifically microwave and infrared, to rapidly analyze solids and volatiles. The low frequency microwaves penetrate the entire sample and rapidly remove volatiles through dipole rotation, while high frequency infrared energy evenly heats the surface and removes non-polar components through molecular vibration. The two energy sources work in unison, providing benefits over microwave-only and infrared-only analyzers.

To demonstrate the ability of the SMART 6 Moisture and Solids Analyzer for rapid solids analysis, an assortment of 12 polar and non-polar coatings, paints, and resins samples were analyzed. The samples spanned a range of ca. 0.40 – 55.50 % solids.

Key System Benefits

- Rapid, ≤ 3 minute analysis
- Direct solids and volatiles determination through loss on drying
- Analyze water-based, solvent-based, and dry powders on a single system
- Accuracy and precision comparable to ASTM oven methods
- Adjustable airflow to quickly remove hazardous volatiles
- Flame detection with extinguishing option

Sample Preparation and Analysis

Various polar and non-polar coatings, paints, and resins were analyzed using the SMART 6 Moisture & Solids Analyzer. Each sample was mixed using a pipette prior to analysis.

Note: For best results, samples should be stored in an airtight container with minimal exposure to air to prevent any volatilization of the sample. If the sample is volatile and an accurate/stable initial weight is difficult to achieve, "syringe mode" should be used to contain the sample during weighing.

Figure 1. SMART 6 Moisture and Solids Analyzer

Figure 2. Multiple technological advancements are built into the SMART 6. Its honeycomb lattice, for example, provides collimated infrared radiation for sample heating, therefore avoiding stray light. This allows for highly accurate temperature control.

Results and Discussion

The accuracy and precision of the SMART 6 Moisture & Solids Analyzer for various polar and non-polar coatings, paints and resins are demonstrated in **Table 1** and **Table 2**, where the average of three SMART 6 replicates are compared with solids values obtained following official air oven methods (e.g. ASTM or equivalent).

As shown in **Table 1**, the difference between the SMART 6 and air oven results ranged from 0.01 – 0.16 % solids, with an average difference of 0.06 % solids. As shown in **Table 2**, the standard deviation ranged from 0.01 – 0.33 % solids.

Table 1: Accuracy of SMART 6 for Solids in Polar and Non-polar Coatings, Paints, and Resins.

	% Solids		
Sample	**SMART 6**	**Air Oven**[a]	**Difference**
Coating, SEBS Rubber	52.84	52.76	0.08
Emulsion, Oil/Amine	40.89	40.90	0.01
Emulsion, Silicone	52.52	52.50	0.02
Emulsion, Silicone with Wax	31.53	31.60	0.07
Ink, Silver Gravure	25.62	25.56	0.06
Latex 1	40.21	40.23	0.02
Latex 2	50.03	49.96	0.07
Paint 1	20.99	20.94	0.05
Paint 2	37.76	37.92	0.16
Resin, Methyl Methacrylate	0.41	0.41	0.00
Resin, Phenolic 1	55.54	55.41	0.13
Resin, Phenolic 2	46.12	46.11	0.01
		Average	0.06

a. ASTM D2369 ("Standard Test Method for Volatile Content of Coatings") used as primary oven method, however, oven temperature and drying times were varied based on specific customer recommendations per matrix.

Table 2: Precision of SMART 6 for Solids in Polar and Non-polar Coatings, Paints and Resins.

Sample	Replicates (% Solids)			Average	Range	StDev
	1	2	3			
Coating, SEBS Rubber	52.72	52.92	52.87	52.84	0.20	0.10
Emulsion, Oil/Amine	40.73	41.09	40.86	40.89	0.36	0.18
Emulsion, Silicone	52.37	52.51	52.67	52.52	0.30	0.15
Emulsion, Silicone with Wax	31.46	31.51	31.62	31.53	0.16	0.08
Ink, Silver Gravure	25.36	25.52	25.99	25.62	0.63	0.33
Latex 1	40.18	40.21	40.24	40.21	0.06	0.03
Latex 2	50.05	50.08	49.96	50.03	0.12	0.06
Paint 1	20.81	21.12	21.04	20.99	0.31	0.16
Paint 2	37.73	37.70	37.84	37.76	0.14	0.07
Resin, Methyl Methacrylate	0.41	0.42	0.41	0.41	0.01	0.01
Resin, Phenolic 1	55.47	55.43	55.73	55.54	0.30	0.16
Resin, Phenolic 2	46.10	46.22	46.03	46.12	0.19	0.10

Conclusion

These results indicate the SMART 6 is able to reliably match existing reference methods for solids analysis of polar and non-polar coatings, paints, and resins. The combination of dual-frequency energy sources allows manufacturers to use the SMART 6 to rapidly and reliably confirm solids and volatiles of raw materials, in-process products, and finished products for COA verification.

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