Direct Moisture Determination of Food and Feed Samples Comparing Automated Thermogravimetric and Air Oven Loss-on-drying Techniques

Introduction

An accurate determination of moisture content in food and feed products is important information related to the product’s quality and nutritional value, as well as the need to comply with state and federal food and feed regulations. Moisture determination in food and feed samples can be performed using various methods, such as air oven loss-on-drying and thermogravimetric analysis. Thermogravimetric analysis (TGA) is a technique that uses a controlled-atmosphere balance to analyze the weight change of a sample as a function of temperature. The method is highly accurate and suitable for the determination of moisture content in various food and feed samples.

TGM800 Theory of Operation

The TGM800 is a thermogravimetric analyzer designed to determine moisture content of materials using a controlled-atmosphere environment, allowing for the determination of the weight change of a sample as a function of temperature. The instrument consists of a computer, an integrated four-place balance, and a multiple sample oven that supports the use of either a 1.5 inch diameter aluminum foil crucible or a 2.4 inch diameter aluminum foil crucible.

After a sample analysis has been selected, empty aluminum foil crucibles are loaded into the instrument, and the balance is zeroed. The crucible is then transferred to the sample carousel. The crucible is positioned on the balance, and the instrument records the initial sample mass. The balance is then allowed to reach a set point temperature, such as 100 °C, and the screw is tightened. Once the set point temperature is reached, the balance is allowed to cool and the sample mass is recorded.

Methodology

AOAC Official Method 925.10—Solids (Total) and Moisture in Flour

Three methods were defined based upon AOAC Method 925.10—Moisture in Flour (named Flour-Method 1, Flour-Method 2, and Flour-Method 3). For Flour-Method 1 and feed-Method 1, samples were weighed into a 1.5 inch diameter aluminum foil crucible at the minimum mass of 2 grams and fixed drying time required by the applicable AOAC method. Three methods follow the requirements of both AOAC manual methods.

For Flour-Method 2 and feed-Method 2, samples were weighed into a 1.5 inch diameter aluminum foil crucible at a lower sample mass of 1 gram and smaller diameter aluminum foil crucible.

For Flour-Method 3 and feed-Method 3, samples were weighed into a 2.4 inch diameter aluminum foil crucible at lower sample mass (1 g–1.2 g), with the drying time determined by the sample analysis time method conditions that are compliant to the manual AOAC methods, the total analysis time method conditions that are compliant to the manual AOAC methods, and the total analysis time method conditions that are compliant to the manual AOAC methods, respectively.

Sample Preparation

Four commercial flour samples were used to represent the food materials and corn, hay, and distillers feed samples were used to represent the feed materials. The samples were commercial materials and corn, hay, and distillers feed samples were used to represent the food materials and corn, hay, and distillers feed samples were used to represent the feed materials. The samples were used to demonstrate the operational feasibility and application capabilities of the method developed by the TGM800.

Table 1: Manual Oven Loss-on-Drying Method Parameters

<table>
<thead>
<tr>
<th>Method</th>
<th>Nominal Mass</th>
<th>Start Temperature</th>
<th>Hold Temperature</th>
<th>End Temperature</th>
<th>Hold Time</th>
<th>Total Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flour-Method 1</td>
<td>~2 g</td>
<td>100 °C</td>
<td>110 °C</td>
<td>120 °C</td>
<td>60 min</td>
<td>2:22</td>
</tr>
<tr>
<td>Feed-Method 1</td>
<td>~2 g</td>
<td>100 °C</td>
<td>110 °C</td>
<td>120 °C</td>
<td>60 min</td>
<td>2:22</td>
</tr>
<tr>
<td>Flour-Method 2</td>
<td>~1 g</td>
<td>100 °C</td>
<td>110 °C</td>
<td>120 °C</td>
<td>60 min</td>
<td>1:20</td>
</tr>
<tr>
<td>Feed-Method 2</td>
<td>~1 g</td>
<td>100 °C</td>
<td>110 °C</td>
<td>120 °C</td>
<td>60 min</td>
<td>1:20</td>
</tr>
<tr>
<td>Flour-Method 3</td>
<td>~1 g</td>
<td>100 °C</td>
<td>110 °C</td>
<td>120 °C</td>
<td>60 min</td>
<td>1:08</td>
</tr>
<tr>
<td>Feed-Method 3</td>
<td>~1 g</td>
<td>100 °C</td>
<td>110 °C</td>
<td>120 °C</td>
<td>60 min</td>
<td>1:08</td>
</tr>
</tbody>
</table>

Sample Results

A sample suite for food and feed samples was developed to demonstrate the statistical performance and application capabilities of the method developed by the TGM800. Four commercial flour samples were used to represent the food materials and corn, hay, and distillers feed samples. The results for the TGM800 were compared to AOAC Method 925.10—Solids (Total) and Moisture in Flour (Method 925.10) and the Title 21 Code of Federal Regulations (CFR) method without oven drying. The results for the TGM800 were compared to AOAC Method 925.10—Solids (Total) and Moisture in Flour (Method 925.10) and the Title 21 Code of Federal Regulations (CFR) method without oven drying. The results for the TGM800 were compared to AOAC Method 925.10—Solids (Total) and Moisture in Flour (Method 925.10) and the Title 21 Code of Federal Regulations (CFR) method without oven drying.

Table 2: TGM800 Flow Diagram

Conclusion

The objective of this poster presentation was to demonstrate the novel statistical performance and application capabilities of the method developed by the TGM800. The results for the TGM800 were compared to AOAC Method 925.10—Solids (Total) and Moisture in Flour (Method 925.10) and the Title 21 Code of Federal Regulations (CFR) method without oven drying. The results for the TGM800 were compared to AOAC Method 925.10—Solids (Total) and Moisture in Flour (Method 925.10) and the Title 21 Code of Federal Regulations (CFR) method without oven drying. The results for the TGM800 were compared to AOAC Method 925.10—Solids (Total) and Moisture in Flour (Method 925.10) and the Title 21 Code of Federal Regulations (CFR) method without oven drying.

All of the moisture results obtained using the TGM800 with sample analysis methods from the TGM800 were in agreement with the established methods, such as AOAC Method 925.10 for both the food and feed materials. The precision of the TGM800 for all of the methods was similar or better than the manual AOAC method for both the food and feed materials. The precision of the TGM800 for all of the methods was similar or better than the manual AOAC method for both the food and feed materials. The precision of the TGM800 for all of the methods was similar or better than the manual AOAC method for both the food and feed materials. The precision of the TGM800 for all of the methods was similar or better than the manual AOAC method for both the food and feed materials.