

# LOI in Combustion Residues

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## Instrument: TGA701

### Introduction

Thermogravimetric analysis (TGA) is an analytical technique in which changes in physical and chemical properties of materials are measured as a function of temperature and/or time. TGA is commonly used to determine selected characteristics of materials that exhibit either mass loss, or gain, due to decomposition, oxidation, or loss of volatile materials such as moisture. Macro TGA systems using gram-size samples allow more accurate mass measurements for characterization of heterogeneous materials.

Loss on Ignition (LOI) refers to the mass loss of a combustion residue when it is heated in an air or oxygen atmosphere to a high temperature. In the cement industry the term LOI refers to a mass loss in a sample heated to 950°C. LOI values in combustion residue values are used by industries that utilize combustion residues in various processes and products, such as the production of cement, providing a quality parameter estimating the amount of unburned carbon and other possible constituents in the combustion residues.

### Sample Preparation

Sample should be a fine powder (-60 mesh)

### Accessories

621-331 Ceramic Crucibles (Large)

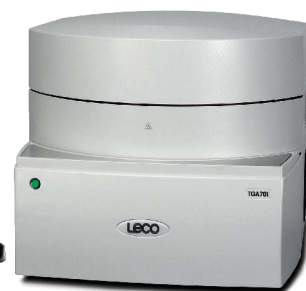
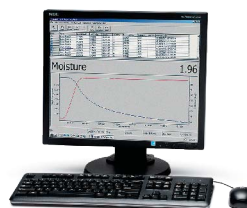
**Sample Mass** ~1.0 g

**Method Reference** ASTM D7348

**Analysis Time** ~3 hours

### Method General Parameters

|                        |                                  |
|------------------------|----------------------------------|
| Crucible Type          | Ceramic                          |
| Crucible Density       | 3.00                             |
| Cover Density          | 3.00                             |
| Sample Type            | Fly ash or<br>combustion residue |
| Sample Density         | 1.50                             |
| Significant Digits     | F6                               |
| Barometric Pressure    | 760                              |
| Cover Open Half        | 800                              |
| Cover Open Full        | 450                              |
| Furnace Over Temp.     | 1200                             |
| Increment Sample Names | Disable                          |
| Crucible Locations     | Auto Find                        |
| Temperature Check      | False                            |
| Alarm On Errors        | True                             |
| Cover Option           | Half Open                        |
| Carousel Option        | Weigh Position                   |
| Batch Mode             | False                            |
| Enable Lid Dispenser   | False                            |
| Readability            | 4                                |



Balance Environment  
Balance Constancy

Minimum Weight  
Maximum Weight  
Zero Deviation  
Retake Initial Weights

Stable  
Absolute Weight  
(grams)  
0.8 g  
1.2 g  
0.0005  
False

### Method Step Parameters

| Parameter        | Moisture     | Step-1         | LOI          |
|------------------|--------------|----------------|--------------|
| Covers           | No           | No             | No           |
| Start Temp. °C   | 25           | 110            | 500          |
| End Temp. °C     | 110          | 500            | 950          |
| Ramp Rate        | 6            | 6              | 8            |
| Ramp Time (h:m)  | 0:14         | 1:05           | 0:56         |
| Hold Time (h:m)  | 0:05         | 0:05           | 0:00         |
| Total Time (h:m) | 0:19         | 1:10           | 0:56         |
| Max Time (h:m)   | 0:00         | 0:00           | 0:00         |
| Atmosphere       | Nitrogen     | Oxygen         | Oxygen       |
| Flow Rate        | High         | High           | High         |
| Window           | 3            | 0              | 3            |
| Comparator       | 0.0003 g     | 100.0000 g     | 0.0003 g     |
| Final Weight     | At Constancy | At End of Step | At Constancy |

### Method Equation Parameters

Moisture  
$$(((\text{Initial Mass}) - [\text{Moisture Mass}]) / [\text{Initial Mass}]) * 100$$

Step-1  
$$(((\text{Moisture Mass}) - [\text{Step-1 Mass}]) / [\text{Initial Mass}]) * 100$$

LOI  
$$(((\text{Initial Mass}) - [\text{LOI Mass}]) / [\text{Initial Mass}]) * 100$$

LOI Dry  
$$(((\text{Moisture Mass}) - [\text{LOI Mass}]) / [\text{Initial Mass}]) * 100$$

### Procedure

1. Create and/or select a method using the parameters described above following the procedure in the TGA701 Instruction Manual.
2. Login and load samples following the procedure outlined in the TGA701 Instruction Manual.



## Typical Results

| Sample          | Mass (g)    | % Moisture  | % LOI       |
|-----------------|-------------|-------------|-------------|
| LECO 502-813    | 1.1226      | 0.10        | 1.48        |
| Fly Ash         | 1.1112      | 0.09        | 1.47        |
|                 | 1.1375      | 0.08        | 1.48        |
|                 | $\bar{x} =$ | <b>0.09</b> | <b>1.48</b> |
|                 | $s =$       | <b>0.01</b> | <b>0.01</b> |
| Coal Fly Ash #1 | 1.0915      | 0.04        | 0.53        |
|                 | 1.0901      | 0.10        | 0.61        |
|                 | 1.0901      | 0.07        | 0.54        |
|                 | $\bar{x} =$ | <b>0.07</b> | <b>0.56</b> |
|                 | $s =$       | <b>0.03</b> | <b>0.04</b> |
| Coal Fly Ash #2 | 1.0949      | 0.02        | 0.38        |
|                 | 1.0442      | 0.02        | 0.33        |
|                 | 1.0604      | 0.07        | 0.38        |
|                 | $\bar{x} =$ | <b>0.04</b> | <b>0.36</b> |
|                 | $s =$       | <b>0.03</b> | <b>0.03</b> |
| Portland Cement | 1.0394      | 0.41        | 1.75        |
|                 | 1.0931      | 0.48        | 1.76        |
|                 | 1.1096      | 0.48        | 1.77        |
|                 | $\bar{x} =$ | <b>0.46</b> | <b>1.76</b> |
|                 | $s =$       | <b>0.04</b> | <b>0.01</b> |