

Differential Thermal Analysis

Differential Thermal Analysis (DTA) is a "fingerprinting" technique that provides information on the chemical reactions, phase transformations, and structural changes that occur in a sample during a heat-up or a cool-down cycle. The DTA measures the differences in energies released or absorbed, and the changes in heat capacity of materials as a function of temperature.

All materials behave in certain, predictable ways when exposed to certain temperatures, so the resulting DTA curve is an indication of the materials and phases present in the sample. For example, the DTA is used to indicate the relative magnitude of reactions and phase transitions of ceramic materials or batches that can be destructive so that safe drying and firing schedules can be determined. The DTA identifies the temperature regions and the magnitude of critical events during a drying or firing process such as

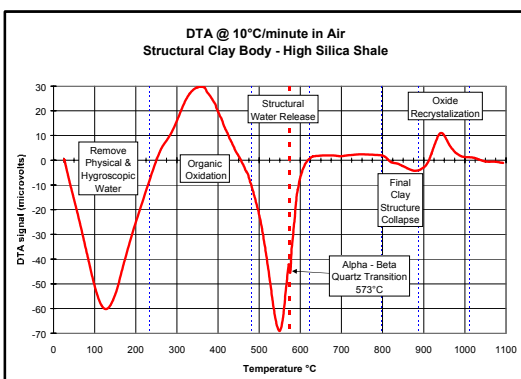
drying, binder burnout, carbon oxidation, sulfur oxidation, structural clay collapse, Alpha to Beta quartz transition, carbonate decompositions, recrystallizations, melting and cristobalite transitions, melting, solidification or solidus temperature, glass transition temperature (T_g), curie point, energy of reaction, heat capacity, and others.



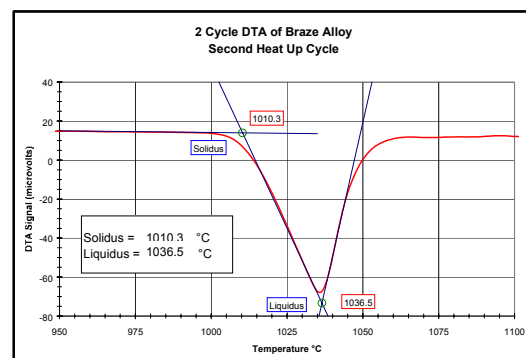
The photo at the top-right is the Model DT-730 Series DTA Module which houses the furnace, differential thermocouple, and electronic components. The photo immediately below the DTA module is the Universal Temperature Control (UTC) console with a user-programmable PID controller which is used to control the thermal cycle of the furnace. Although not shown, the system includes a Windows 98/2000 (English version) compatible data acquisition/analysis software and an analog to digital interface card for the user supplied personal computer system. The included software displays the test progress on the monitor, stores the data and enables the user to perform the standard DTA analyses on the data after the test is completed.

The test results are a graph of the DTA signal (microvolts) on the Y-axis plotted versus the sample temperature in °C on the X-axis. Sample graphs of enhanced output are shown below.

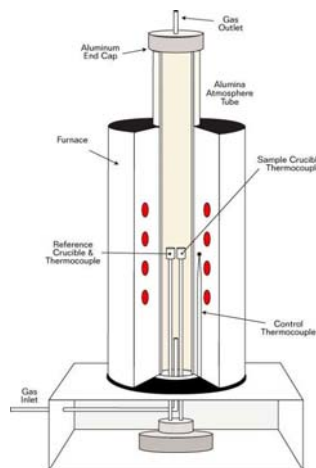
Ceramics - Structural Clay Analysis



Metals – Braze Alloy Solidus / Liquidus



Principal of Operation



The Orton DTA uses a pair of ceramic cups that are supported by a pair of vertical thermocouples (differential thermocouple) positioned on the module base. (concept sketch to the left). After both cups are placed on top of the differential thermocouple stalks (photo to the right), the furnace is lowered over the cups, and the furnace is heated and cooled according to the programmed thermal cycle. The differential thermocouple output (DTA signal in micro-volts) is displayed on a PC monitor, and stored on the PC hard drive as a function of time and temperature for post testing analysis.



Standard DTA Instruments

Orton uses one of two standard module designs for two temperature ranges as specified below. Orton can modify these systems to suit individual requirements. For example, type "K" differential thermocouples for low temperature units, and alternate cup designs for specific application are available upon discussion with Orton.



| Specifications | DT-730 Series | DT-720 Series |
|---|---|---|
| Ambient to 1,200°C (Kanthal Heating Element) | DT-732 | DT-722 |
| Ambient to 1,600°C (Platinum Heating Element) | DT-736 | DT-726 |
| Sample Volume (cubic millimeters) | 150 – 250 mm ³ | 150 – 250 mm ³ |
| Sample Cup Material | High Alumina | High Alumina |
| Sample Cup Design | Boersma | Boersma |
| Differential Thermocouple | Type "S" | Type "S" |
| DTA Sensitivity (micro-volts) | < 0.0005 | < 0.0005 |
| Atmospheres | Static Air or flowing gas (system NOT sealed) | Sealed System Air, Inert, Reactive, Vacuum |
| Power Requirement | 120 VAC, 15 amp, 50/60 Hz (240 VAC available) | 120 VAC, 15 amp, 50/60 Hz (240 VAC available) |
| Module Dimensions | 24" x 18" x 30" high (440 x 280 x 660 mm) | 8.5" x 13.5" x 32" high (228 x 340 x 810 mm) |
| UTC Console Dimensions | 18" x 12" x 5" high (460 x 305 x 130 mm) | 18" x 12" x 5" high (460 x 305 x 130 mm) |
| A/D Card and Software | Included | Included |
| Personal Computer with Windows 2000 (English Version) | Not-included | Not-included |

(Descriptions and specifications are subject to change without notice - 9 July 2003)