



# Thermal Analysis Market in India

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Material characterization has become a very challenging task in our present day to day life. Newer and newer materials are being developed to meet the demanding needs of wide range of applications. Hence characterizing the material in terms of quality, suitability and safety aspects are very important. All materials starting from foods, pharmaceuticals, polymers, biomaterials, petrochemicals, minerals need characterization to check their suitability for certain specific application. Advanced instrumentation techniques based on spectroscopy, thermal analysis, chromatography etc are available now to fulfill this challenging task. The demand for such instrumentation is increasing especially in the developing countries due to industrial development.

Thermal analysis and Rheology is a very important characterization technique for a broad range of materials. This is a useful tool in basic research, quality control, product development etc. This has become so popular because it is an accurate, fast, reliable and reproducible technique requiring few milligram of sample to test. Thermal analysis and Rheology are synergetic and complementary to each other.

Thermal Analysis is a series of complementary technique to measure the various physical & chemical properties of the materials when it is subjected to a variable temperature controlled environment in a inert or reactive atmosphere. Since the temperature range is very wide from -180 to even up to 2000 deg C, this technique is suitable for different materials like organic, inorganic, polymers, ceramics, metals etc. Only very few milligram of sample is enough for one experiment. The various modular technique and applications are as follows.

## A. Differential Scanning Calorimetry (DSC)

In this the various phase transitions measurements such as solid-solid, solid to liquid, solid to gas are measured. Also various exothermic, endothermic reactions are quantified in terms of heat flow; We can also measure the heat capacity of

## Market Dynamics in India

- ⇒ Last five years there is a growth of about 10% in the thermal analysis market.
- ⇒ The total market for 2006 was about \$ 8 Million.
- ⇒ The market is expected to grow at about 10%.
- ⇒ Quantum jump in demand from Pharmaceutical, CRO, Automobile, Aerospace, Polymers and Chemicals.

the materials which is a very important property of the material from the processing point of view. Based on the quantity of heat involved DSC is classified into two Microcalorimetry and Normal DSC. Microcalorimetry has wide applications in Bio pharmaceuticals, biotechnology, and pharmaceuticals & material science. Normal DSC has applications in polymer science, composites, pharmaceuticals, petrochemicals etc. In pharmaceuticals, Polymorphism, Compatibility of drugs with various recipients, Characterization of amorphous & crystalline phase are some of the applications.

## B. Thermogravimetric Analyser (TGA)

In TGA measure the weight change during heating. This technique is used for thermal stability, percentage composition in a multi component system. TGA is also coupled with FT-IR or Mass spectrometer for simultaneous measurement of both qualitative & quantitative. Widely used in Polymers, Pharmaceuticals, foods

## C. Thermomechanical Analyser (TMA)

TMA measure the dimensional change and thereby coefficient of expansion or shrinkage. This technique is much more sensitive than DSC. Various types of probes are available to accommodate sample like films, fibres, solids, granules, powders etc. Application areas include Electronic Industry, Polymers, Automobiles, Packaging,

## D. Dynamic Mechanical Analyser (DMA)

DMA is a very powerful tool to check the suitability of the materials for a specific end use application. Sample is subjected to dynamic oscillatory experiments under a static force and thereby measure the modulus of the

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### Thermal Analysis Techniques

Modules	Measured Property	Application Area	End Use Applications
Micro calorimetry	Heat Flow, Heat Capacity, Delta H in Nano watts or micro joules	Biopharmaceuticals, Biotechnology, Material Science, Basic Research	Proteins Bindings, Ligand binding, Isothermal Titration, Heat of Dissolution, Amorphicity.
DSC	Heat Flow, Heat Capacity, Delta H in Micro watts to milliwatts	Polymers, Pharmaceuticals, Composites, Basic Research, Petroleum Products	Phase Transition Temp., Heat of fusion, OIT, Polymorphism, Excipient compatibility, Cure profile, Reaction Kinetics
TGA	Weight Change	Pharmaceuticals, Polymers	Percent Composition, Free & Bound water content, Decomposition Kinetics, Shelf life, Stability
TMA	Dimensional Change	Polymers, Composites, Aer	Coeficient of Expansion, Softening point, Gelation point, Tg,
DMA	Modulus, Tan Delta	Composites, Elastomers, Polymers,	Mechanical properties of materials for specific end use applications
Rheology	Visoelastic properties, Viscosity measurements	Polymers, Pharmaceuticals, food	Polymer Melt viscosity for Injection moulding, Cure Profile,

sample. DMA is also known as Solid Rheometer as it gives both visco elastic properties of the materials.. Wide variety of clamps are available to accommodate different types of samples like Single/Dual cantilever, 3 point Bend, Tension, Film/fibre, etc. Submersion clamps are also available to do the experiments in liquid medium. Application area include Polymers, Elastomers, Aerospace materials, Composites,

#### E. Rheometers

Rheology, relatively a new technique is very useful to predict the flow behavior of the materials. As everybody knows, anything will flow with respect to time. Different types of rheometers are available in the market for wide variety of applications. This has applications in pharmaceuticals, paints, polymers, food etc.

Out of these TA technique, DSC & TGA are the most common tool. TMA, DMA & Rheometers are used for specialised or advanced studies depending on the applications.

In early nineties, TA & Rheology techniques were mainly used in government research labs, defence labs, Education Research etc. The demand for such instruments was minimal and the manufacturers of such instruments believed that it is a stable business.

In the last few years we can observe a quantum jump in the industrial investments in India. Pharmaceutical, Contract Research Organization (CRO), Automobile, Aerospace,

Polymers & Chemicals, Food etc all are equally growing sectors. All these sectors are setting up state-of-the art analytical laboratory in their facility for quality control or research. This is very much reflected in the demands for thermal analysis & Rheology instruments. Both MNC's and Indian MNC's are investing a lot due to competition in improving quality and for market capitalization. Last five years there is a growth of about 10% in these market segments.

Four manufacturers dominate the thermal analysis market worldwide as well as in India, viz, TA Instruments – Waters (TA), Perkin Elmer (PE), Mettler Toledo (MT) and Netzsch. Amongst the thermal analysis instruments DSC (Differential Scanning Calorimetry) leads the way. There are two techniques available, one is Power Compensation Principle DSC – supplied by PE only. Another is Heat-flux design, manufactured by all other companies in the field. Modulated DSC, a patented technique by TA are the leaders in thermal analysis. Mettler has got variable, interchangeable sensors for DSC, Netzsch is concentrating both on the low and high temperature thermal analysis markets.

When contacted all these companies for their revenues and future market potential in India, we could not get a clear number. However, we could identify that the total market for 2006 was about \$8Million and the market is expected to grow at about 10% with investments happening in Pharmaceuticals, Polymers, Petrochemicals and Automobile industries. ■