

Macro Thermogravimetric Analysis of Tire (SBR) Rubber

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Abstract

The limiting factor on most thermogravimetric analyzers (TGA) today is the amount of sample you can analyze. In most of TGAs being produced today, the maximum sample weight is one (1) gram. In most cases this is sufficient, but not always. The new Shimadzu TGA-51 Macro Thermogravimetric Analyzer is the answer to that problem. The TGA-51 has the ability to measure weight changes on samples of up to ten (10) grams. This is accomplished by the use of a large capacity taut-beam balance, a larger furnace, and large sample crucibles. All of this allows for increased sensitivity and sample resolution while providing a more representative sample to be analyzed. To facilitate current users, the TGA-51 is designed to interface with operating Shimadzu thermal analysis hardware and software.

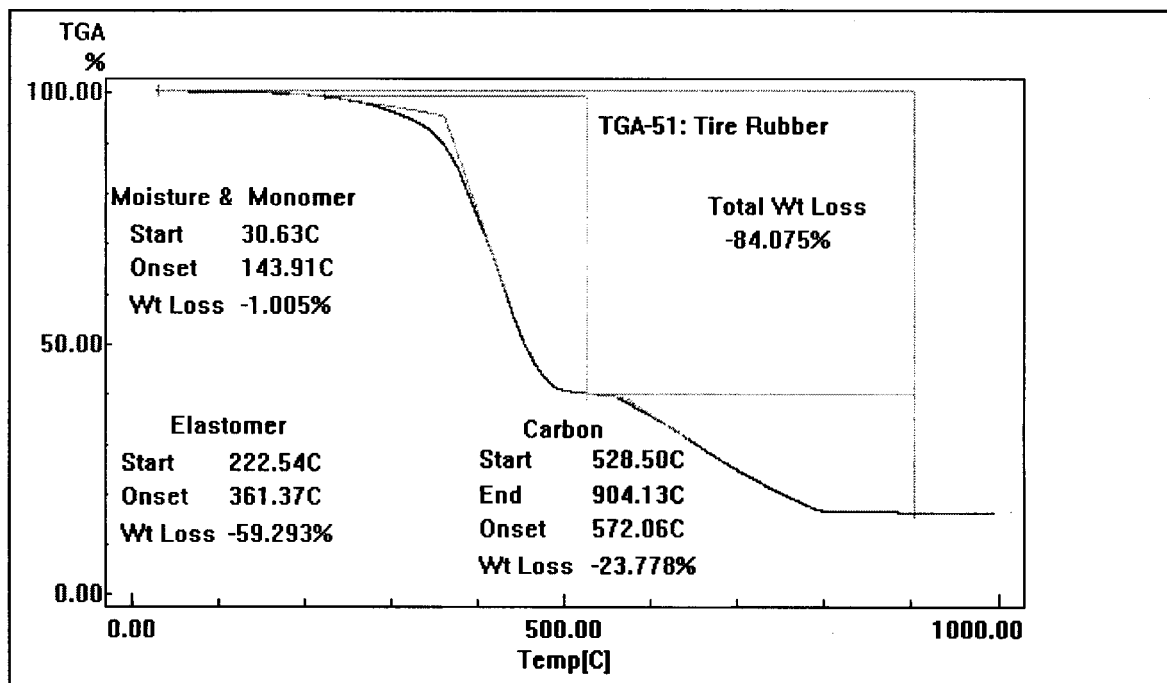
Introduction

The TGA-51 Macro Thermogravimetric Analyzer is another example of Kaizen. The addition of the TGA-51 to the 50 series of modules currently in existence, [DSC-50(Q), TGA-50(H), DTA-50, TMA-50(H), and TAC-50 T/D] improve Shimadzu's placement and resourcefulness in the thermal analysis industry.

Theoretically, Thermogravimetric Analysis (TGA) measures changes in weight that occur to a sample as a function of temperature ($^{\circ}\text{C}$) over time. These changes usually occur as a loss in weight, but a gain in weight can be seen if the sample goes through an adsorption (i.e. oxidation). The ability to measure these changes in a larger sample size (i.e. > 1 gram) is very vital in manufacturing processes. The larger sample size simply gives the user a more representative sample to analyze.

The TGA-51 is easily interfaced to the TA-50WS multi-tasking system controller, eliminating the need for additional cables, software, and interfaces. The TGA extended software packages of PARTIAL AREA and KINETICS is included with all TA-50WS's purchased. The multi-tasking, temperature profile, and basic analysis windows software are also included in the package

Experimental



This is a typical tire rubber curve. Tire rubber is composed of Styrene Butadiene Rubber (SBR), additives, and carbon. The first weight loss of 1.005% between 30.63°C and 222.54°C is caused by the evolution of free and bound H₂O and any unresolved monomers. The next event seen is the degradation of the SBR rubber. In this case a weight loss of 59.293% between 222.54°C and 528.50°C is observed. At 600°C the atmosphere is switched from N₂ to air using the FC-40. As the remaining sample is exposed to the air, the carbon content oxidizes and a weight loss of 23.778% between 528.50°C and 904.13°C is seen. The remaining material is ash. The sample was analyzed in an open Pt cell at a gradient heating rate of 20°C/min. This method is commonly used in the determination of carbon content in polymer and elastomer samples that completely decompose in an inert atmosphere

Conclusion

The TGA-51, as detailed, can be a useful and versatile instrument in a variety of fields. Its ability to accurately measure large samples, both in weight and volume, provide the analyst with another tool to determine the sample's chemical makeup. The stable baseline and minimal drift make this instrument a reliable and precise tool to be used in the evaluation of samples. Its ease of use and compact design will make the TGA-51 a valuable addition to any thermal laboratory.