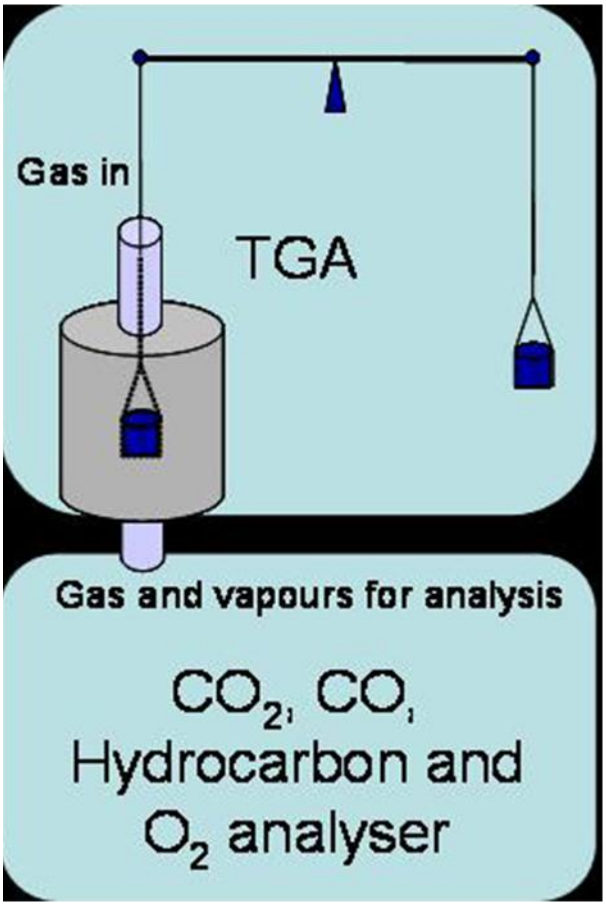
EVOLVED GAS ANALYSIS (EGA)

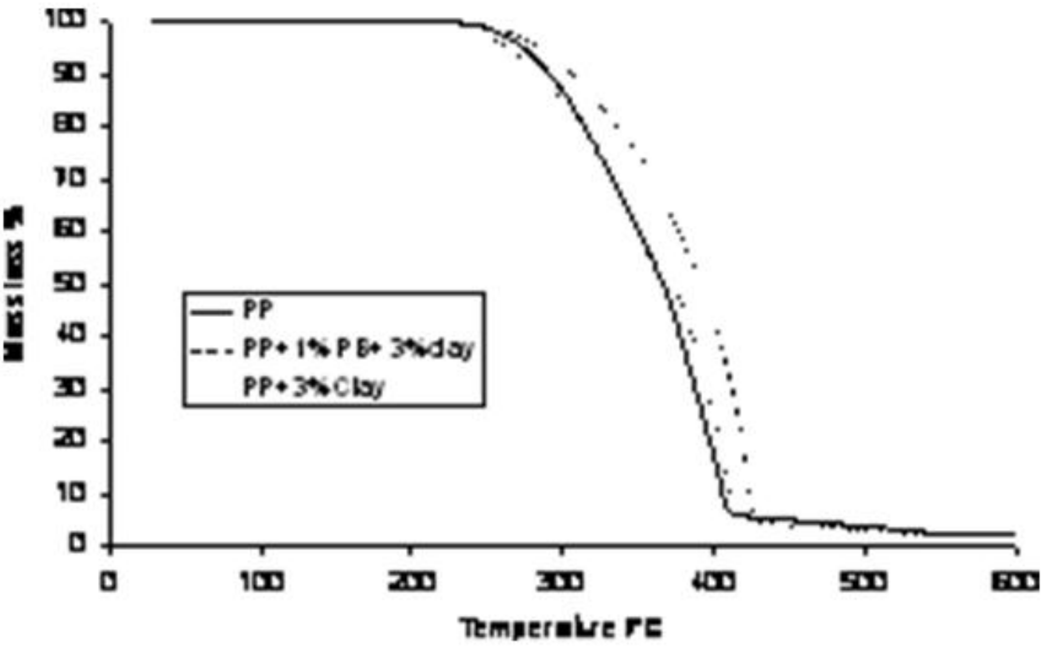
Thermogravimetric Analysis (TGA) provides the crucial material property data with which to interpret the complexities of burning behaviour. For example, ignition can only occur when there is sufficient fuel present in the gas phase. The temperature at which the first sharp mass loss occurs normally corresponds to the critical surface temperature for ignition, and if the addition of fire retardants delays this onset, they may also delay ignition.

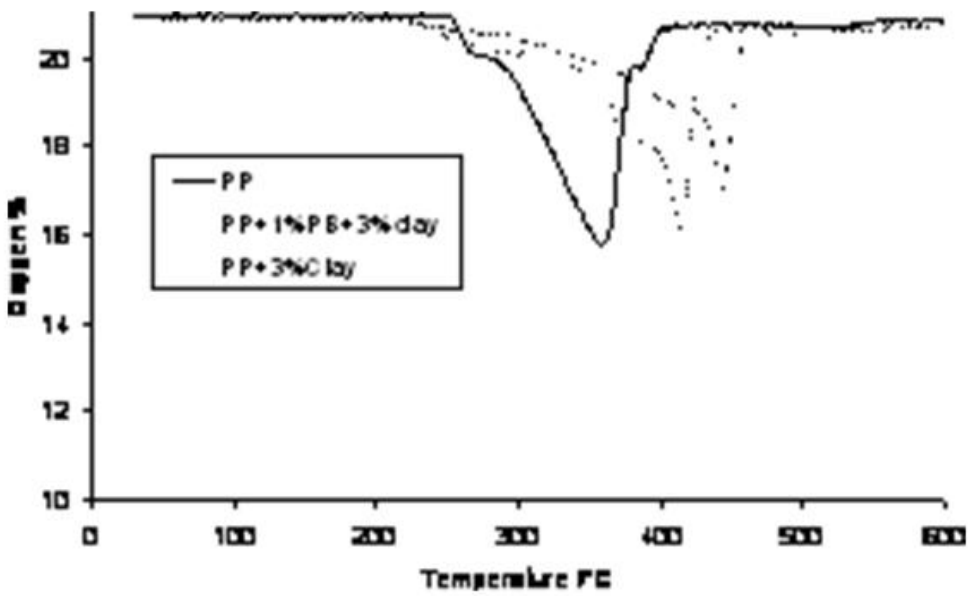
TGA can be refined through knowledge of the gases evolved. Hydrated fillers release water vapour as they decompose; surface oxidation can result in carbon dioxide (CO2) formation, which tends to delay ignition; evolution of hydrocarbons is indicative of the fuel release step leading to ignition.

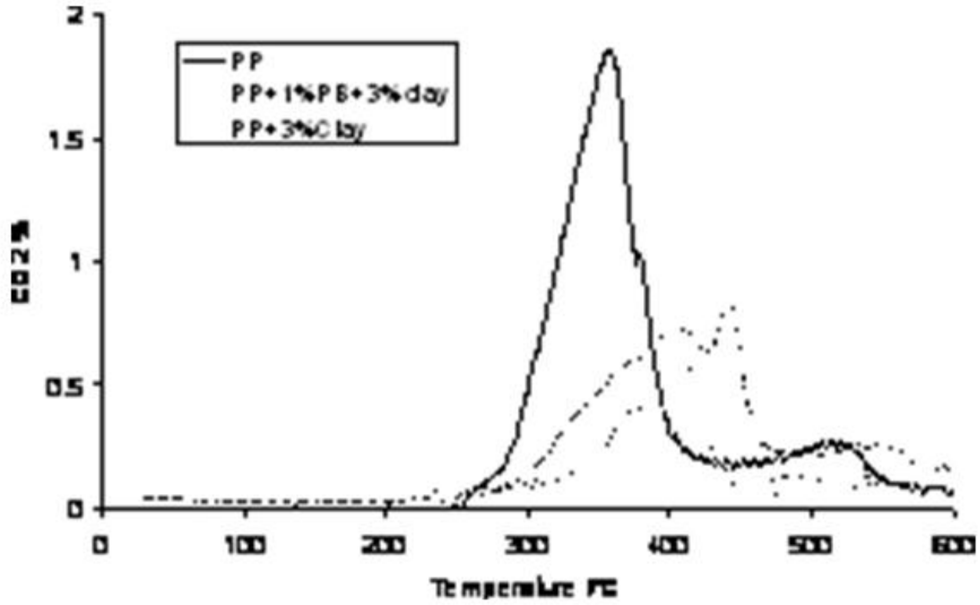
Attachment of a non-dispersive infrared analyser (NDIR) on the TGA exhaust provides a time resolved profile of CO2, CO, hydrocarbons and oxygen concentrations as a function of time, during the TGA run.

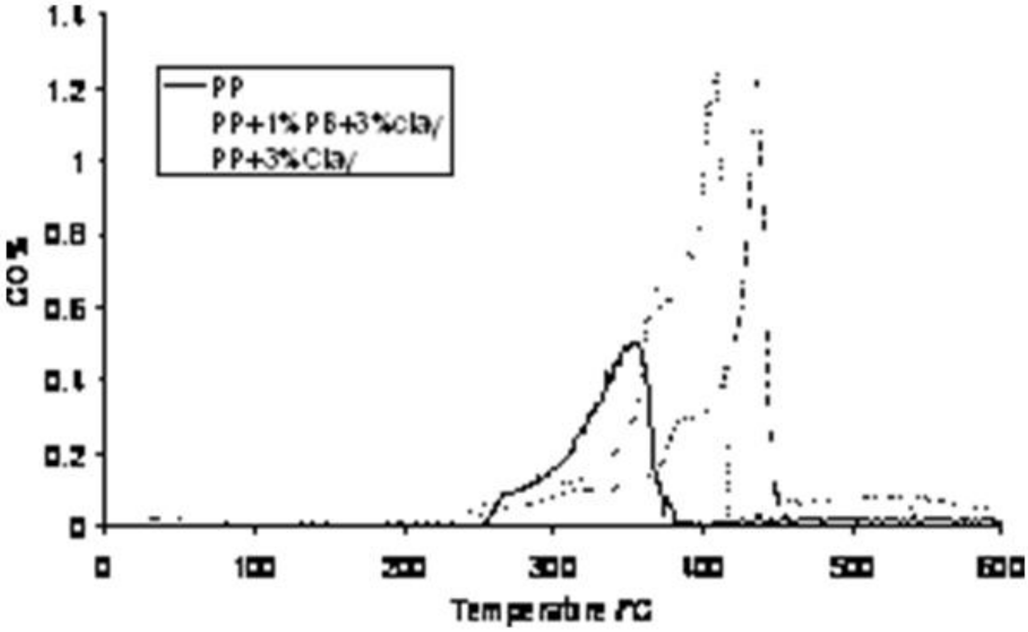


The results below show the decomposition of polypropylene (PP), and PP nanocomposites (Cloisite 20A, with and without maleic anhydride grafts (PB) for improved dispersion), as a TG trace with the corresponding evolution of O2, CO2, and CO. There is evidence of a passivating effect of nanoclay on the surface oxidation of PP, and also the enhanced CO yield, probably a result of catalytic activity on the clay surface.


Mass loss %
Temperature /°C
PP
PP+ 1% PB+ 3% clay
PP+3% Clay


Oxygen %
Temperature /°C
PP
PP+1%PB+3% clay
PP+3%Clay





This technique allows the major decomposition products to be distinguished during thermal decomposition, particularly in relation to fuel gases and inert gases. The evolution of CO2 formed on the surface of the decomposing polymer is indicative of the consumption of oxygen and fuel, but accompanied by self-heating. CO2 is not formed in the gas phase below 500°C.