Correlation between Evolved Gas Analysis (EGA) and Thermogravimetry (TG)

- Correlation in apex temperatures between EGA and TG -

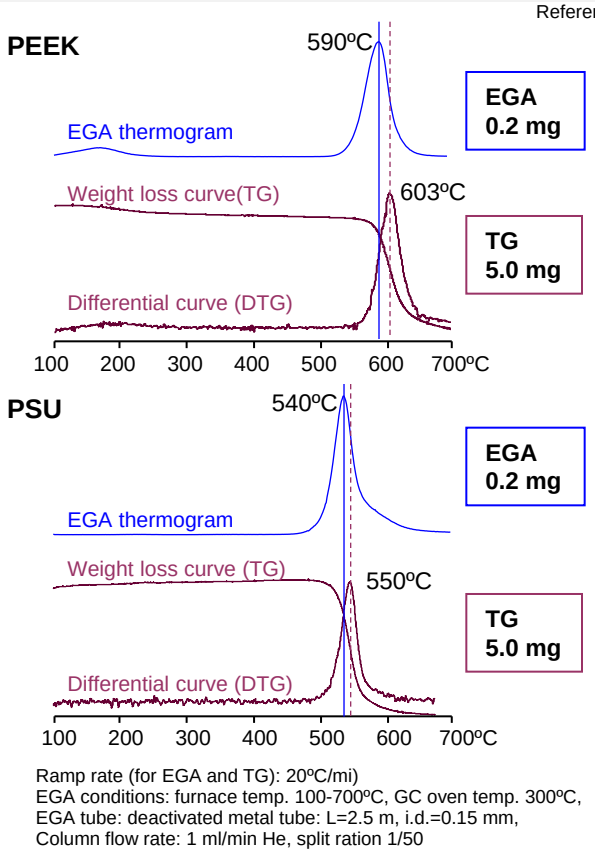
[Background]: Thermogravimetry (TG) has been used for the investigation of thermal properties of polymeric materials. On the other hand, Evolved Gas Analysis (EGA) using the Multi-Shot Pyrolyzer is a simple thermal analysis method in which a polymeric material is continuously heated in a program mode and the evolved gases released are directly detected by a detector. This report describes the correlation between the TG differential curves and EGA thermograms obtained from major polymers.[1)] Also, the relative standard deviations (RSD) obtained for some polymers are compared.

[Experimental]: In EGA-MS analysis, 0.2 mg of a sample was placed in a sample cup and was analyzed using the Multi-Shot Pyrolyzer (EGA/PY-3030D). In TG measurement, 5.0 mg of a sample was placed in a platinum sample pan and was analyzed using TG instrument (Rigaku ThermoPlus TG8110, or Shimadzu DTG-50).

[Results]: Apex temperatures were obtained from EGA thermograms and TG differential curves (DTG). The EGA thermograms and the weight loss curves along with its DTG for PEEK and PSU are shown in Fig. 1. Table 1 summarizes apex temperatures obtained by EGA and TG together with percent relative standard deviations (% RSD). The RSDs for EGA and TG are found to be comparable. The plots of apex temperatures obtained from the DTG against those obtained from EGA thermograms are shown in Fig. 2. The graph indicates there is a linear correlation between EGA and TG as seen by the slope of the regression line and r^2 (residual) value.

1) Styrene-butadiene rubber (SBR), polyethylene (PE), carboxymethylcellulose (CMC), polyvinyl chloride (PVC), polyether etherketone (PEEK), polyurethane (PU), melamine-formaldehyde (MF), polytetrafluoroethylene (PTFE), polystyrene (PS), polyaminobismaleimide (PABM), polydimethylsiloxane (PDMS), nylon 6,6, *iso*-polypropylene (*iso*-PP), epoxy (EP), polycarbonate (PC), polysulfone (PSU)

References: LCGC 4, 374-378,2002, Amer. Lab., Jan.,32-36,2003, Amer. Lab., Mar,1-3, 2003



Ramp rate (for EGA and TG): 20ºC/mi)
EGA conditions: furnace temp. 100-700ºC, GC oven temp. 300ºC,
EGA tube: deactivated metal tube: L=2.5 m, i.d.=0.15 mm,
Column flow rate: 1 ml/min He, split ration 1/50

Fig. 1 Weight loss curve and EGA thermograms

Table 1 Apex temp. and RSD (n=3) by EGA and TG

	EGA		TG	
	Temp [ºC]	RSD [%]	Temp [ºC]	RSD [%]
SBR	463	0.25	473	0.73
PE	490	0.24	488	0.35
CMC	300	0.00	301	0.19
PVC1	320	0.63	308	0.99
PVC2	463	0.25	479	0.67
PEEK	590	0.99	603	0.44

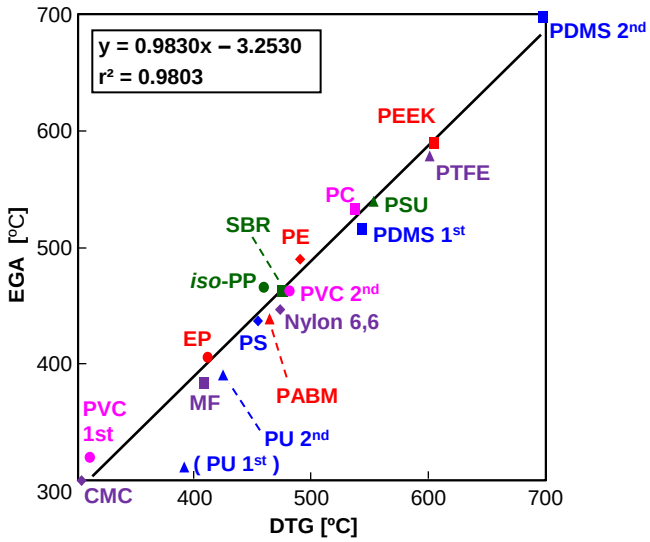


Fig. 2 Correlation between EGA and TG in apex temp.

Keywords : EGA-MS, thermogravimety (TG), comparison between EGA and TG

Products used : Multi-functional pyrolyzer, Vent-free GC/MS adapter, Deactivated metal capillary tube

Applications : General polymer analysis

Related technical notes : PYT-007E, PYT-031E

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