THERMAL APPLICATIONS NOTE

Polymer Heats of Fusion

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The heat of fusion of 100 % crystalline polymer is required to obtain percent crystallinity by differential scanning calorimetry (*1*). Polymer reference materials with 100 % crystallinity are rarely available for comparison purposes. Fortunately, the heats of fusion values for 100 % crystalline polymers may be determined by indirect methods such as extrapolation using the Flory equation (*2*). Wunderlich and co-workers (*3*) have created tables of best estimate values for the heats of fusion for a wide variety of linear polymers with values reported in joules per mole of repeat unit. To be useful for thermal analysis purposes, these enthalpy values need to be normalized to mass. Table 1 includes the mass normalized enthalpy of fusion values commonly used in DSC determinations.

REFERENCES

1. TA123, "Determination of Polymer Crystallinity by DSC", TA Instruments, New Castle, DE.
2. TA276, "Determination of Polymer Crystal Molecular Weight Distribution by DSC", TA Instruments, New Castle, DE.
3. B. Wunderlich, *Thermal Analysis*, Academic Press, **1990**, pp. 417-431.
4. D1600, "Abbreviated Terms Relating to Plastics", American Society for Testing and Materials, West Conshohocken, PA.

KEYWORDS

differential scanning calorimetry, melting, thermoplastic polymers

Table 1 – Polymer Heats of Fusion

Acronym (*4*)	Name	Enthalpy (kJ/mol) (*3*)	Repeat Unit	Molecular Weight (g/mol)	Enthalpy (J/g)
PE	Polyethylene	4.11	$-CH_2-$	14.03	293
PP	Polypropylene	8.70	$-CH_2CH(CH_3)-$	42.08	207
PB	Polybutene-1	7.00	$-CH_2CH(C_2H_5)$	56.1	125
POM	Polymethylenoxide	9.79	$-CH_2O-$	30.03	326
PEOX	Polyethyleneoxide	8.66	$-CH_2CH_2O-$	44.05	197
PA6	Polycaprolactam	26.0	$-NH(CH_2)_5CO-$	113.2	230
PA11	Polyundecanolactam	44.7	$-NH(CH_2)_{10}CO-$	183.3	244
PA12	Polylauryllactam	48.4	$-NH(CH_2)_{11}CO-$	197.3	245
PA66	Poly(hexamethylene adipamide)	57.8	$-NH(CH_2)_6NHCO(CH_2)_4CO-$	256.3	226
PA69	Poly(hexamethylene nonanediamide)	69	$-NH(CH_2)_6NHCO(CH_2)_7CO-$	268.4	257
PA610	Poly(hexamethylene sebacamide)	71.7	$-NH(CH_2)_6NHCO(CH_2)_8CO-$	282.4	254
PA612	Poly(hexamethylene dodecanediamide)	80.1	$-NH(CH_2)_6NHCO(CH_2)_{10}CO-$	310.5	258
PVOH	Polyvinyl alcohol	7.11	$-CH_2CH(OH)-$	44.05	161
PET	Polyethylene terephathalate	26.9	$-O(CH_2)_2O_2CC_6H_4CO-$	192.2	140
PBT	Polybutylene terephathalate	32.0	$-O(CH_2)_4O_2CC_6H_4CO-$	220.2	145
PVF	Polyvinyl fluoride	7.54	$-CH_2CH(F)-$	46.04	164
PVDF	Polyvinylidene fluoride	6.70	$-CH_2CF_2-$	64.03	105
	Polytrifluoroethylene	5.44	$-CH(F)CF_2-$	82.0	66.3
PTFE	Polytetrafluoroethylene	4.10	$-CF_2-$	50.0	82.0
PVC	Polyvinyl chloride	11.0	$-CH_2CH(Cl)-$	62.50	176
PCTFE	Polychlorotrifluoroethylene	5.02	$-CF_2CF(Cl)-$	116.5	43.1
PEEK	Polyetheretherketone	37.4	$-C_6H_4COC_6H_4OC_6H_4O-$	288.3	130