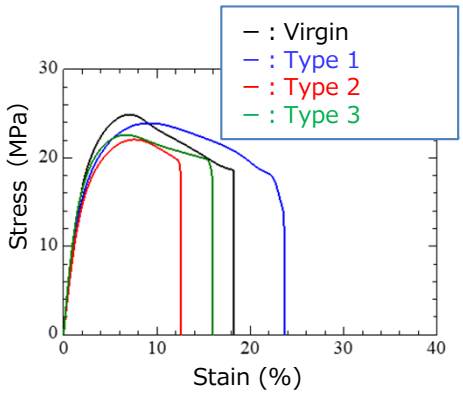
Analysis of Recycled Polypropylene
～ What factors affect the breaking elongation ? ～

Recycled polypropylenes (PP) with different quality have different tensile strength and elongation. Several kind of analyses (GPC, ^{13}C NMR, DSC measurements) were carried out to find out the factors that affected the breaking elongation in the tensile testing.

Samples

*1: Results from TG　*2: Results from tensile testing

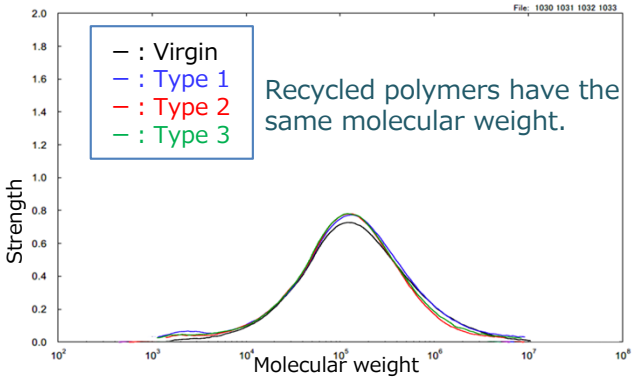
Name	Detail	Tensile strength*2 (MPa)	Elongation*2 (%)
Virgin PP	Target	24.9	18.2
Recycled PP Type 1	High-quality type *Pre consumer recycled PP *Amount of inorganic matter:2.9%*1	23.9	23.7
Recycled PP Type 2	Middle-quality type *Pre and post consumer recycled PP *Amount of inorganic matter:3.0%*1	22	12.4
Recycled PP Type 3	Low-quality type *Post consumer recycled PP *Amount of inorganic matter:8.7%*1	22.6	16



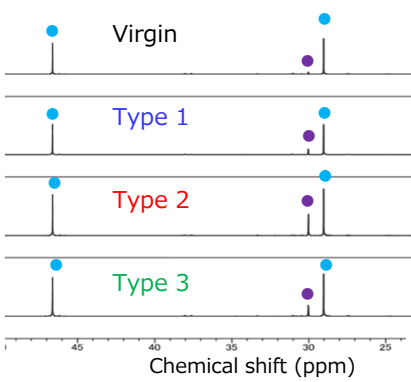
✓Tensile strength: Virgin PP > Type 1 > Type 3 > Type 2　→ Almost the same order as quality
✓Breaking elongation: Type 1 > Virgin PP > Type 3 > Type 2　→ Different order from quality

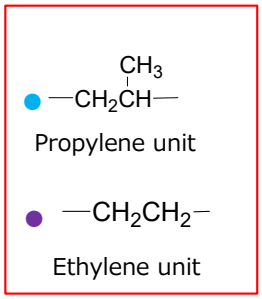
What are the factors?

GPC



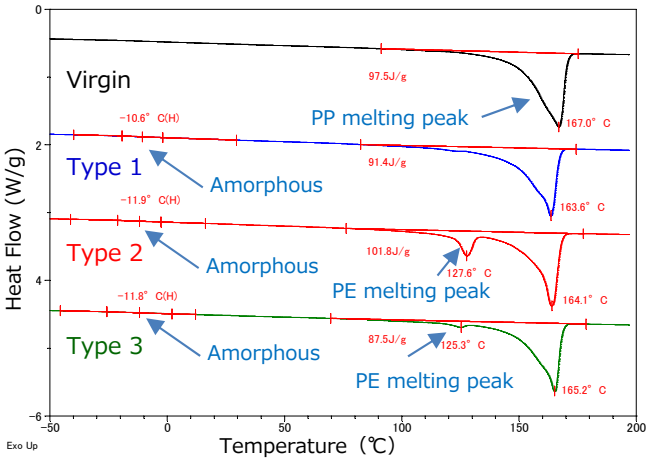
^{13}C NMR





All samples have the ethylene unit with different amount.

DSC



Type 2, 3: Homo PE melting peaks were detected.
Type 1: Homo PE melting peak was not detected.
→ Ethylene-propylene copolymer is suggested to be included in Type 1.

Summary

*3: Detected　*4: Not detected

	Tensile testing	NMR mol ratio (%)		DSC	
	Elongation (%)	Propylene	Ethylene	Amorphous	Homo PE
Virgin	18.2	93	7	–*4	–*4
Type 1	23.7	83	17	○*3	–*4
Type 2	12.4	67	33	○*3	○*3 (many)
Type 3	16	78	22	○*3	○*3(Few)

■ Factor behind the low breaking elongation of Types 2 and 3
→Presence of homo PE that is incompatible with PP.

■ Factors behind the high breaking elongation of Type 1
→Presence of ethylene-propylene copolymer with rubber property.

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