

# Effect of outdoor exposure on the mechanical and structural properties of Nylon 6

Material recycling of polymers involves handling samples that have been exposed to the outdoors. Short-term outdoor exposure in real environments was examined by mechanical and thermal analysis. Change in higher-order structure was predominant in the present case.

## Condition of outdoor exposure

Nylon 6 dumbbell specimen

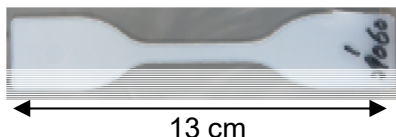
Place: Otsu, Shiga, JAPAN

Time: 7/7/2022 - 18/8/2022 (1000 h)

Temperature:  $27.7^{\circ}\text{C} \pm 3.0^{\circ}\text{C}$

(Min.  $20^{\circ}\text{C}$ , Max  $37^{\circ}\text{C}$ )

Dew point:  $16\text{-}25^{\circ}\text{C}$



Thickness  
1 mm

Molecular weight

Mn 140,000

Mw 430,000

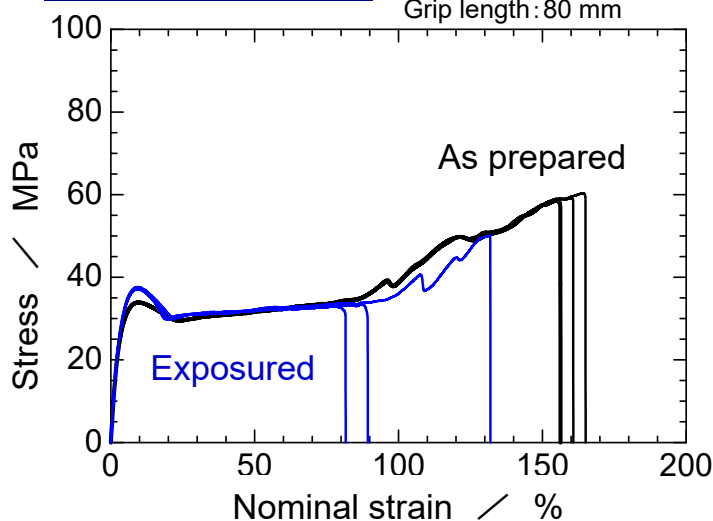
Mz/Mw 1.6

## Tensile property

Temperature: R.T.

Rate: 50 mm/min

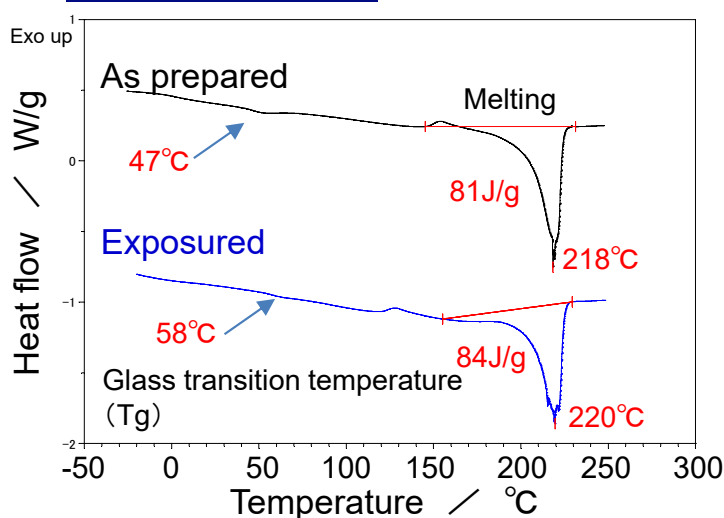
Grip length: 80 mm



## Thermal property (DSC heating)

The center of the dumbbell specimen was cut out for DSC

Heating rate:  $10^{\circ}\text{C}/\text{min}$



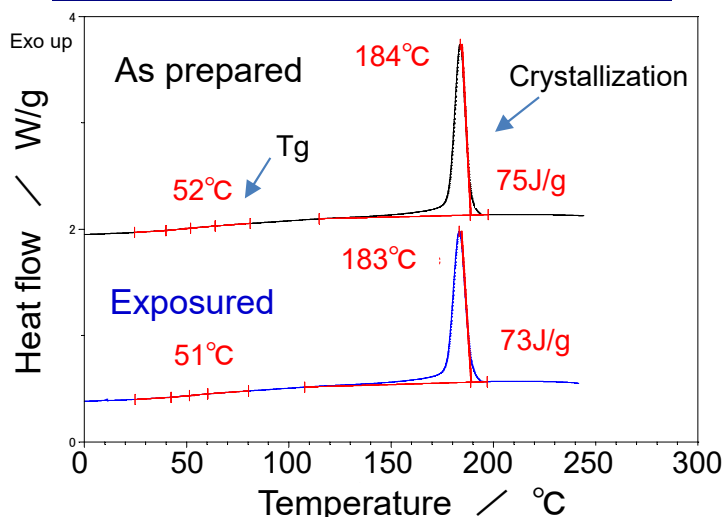
Sample	Breaking strength / MPa	Elongation at break / %	Yield stress / MPa	Yield strain / %	Elastic modulus / GPa
As prepared	59.3	160	34.0	9.66	1.0
Exposed	38.6	99.3	37.3	9.30	1.1

Sample	Tg / °C	Crystallinity / %
As prepared	47	35
Exposed	58	37

Increasing yield stress and elastic modulus after exposure

Confirming the changing in high-order structure

## Compositional evaluation (DSC cooling)



A simple evaluation of compositional difference was carried out by using DSC cooling curves under the assumption that the same materials should be shown the same crystallization behavior.

Glass transition temperature and crystallization temperature/enthalpy are consistent within the error

→ Compositions are presumed to be equivalent

The result of tensile test and DSC suggests that short-term outdoor exposure of Nylon 6 may be feasible to recycle by re-melting process.