Time Degradation of Rubber Bands

2015. 3

Long-term use and storage of rubber are accompanied by gradual changes in the material, such as hardening, cracking, and loss of luster. Such changes are due to deterioration by ultraviolet light, oxidation, ozone, moisture, additives, etc. Understanding these changes provides important information to help maintain the appearance and performance of rubber bands over long periods of time.

This report introduces a case study that compares changes in the decomposition and glass transition of new and degraded rubber bands using TG and DSC measurements carried out with a STA7200RV sample observation system.

Measurements and Results

■TG measurement conditions
Sample weight: 3 mg
Heating rate: 10 ºC /min
Purge gas: Air 200 mL/min
Pan: Al open pan

STA7200RV+RV-2TG

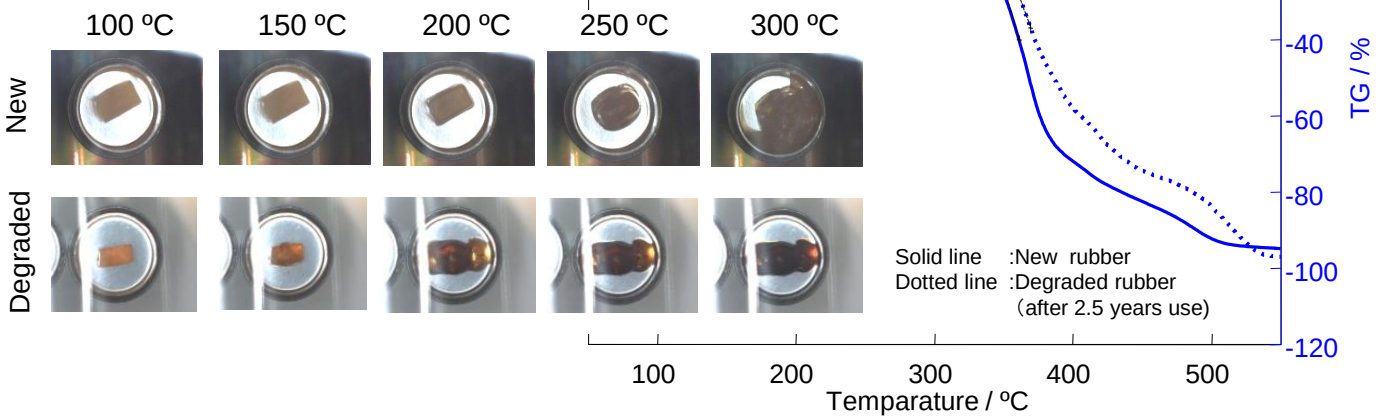

Fig. 1 TG comparison of new and degraded rubber bands

A clear change in the TG signal was not observed for the new rubber band up to 300 ºC. However, our imaging data shows that rubber undergoes fluidization behavior after ~250 ºC. Degraded rubber starts to exhibit weight loss and changes in its shape at 160 ºC, and turns black after ~200 ºC.

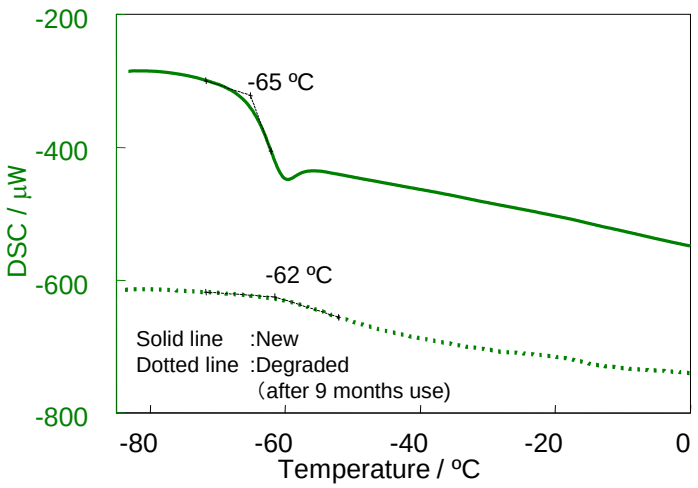

Fig.2 DSC comparison of new and degraded rubber bands

The shift in the DSC curve for the new rubber band around -65 ºC is attributed to its glass transition. The glass transition temperature of the degraded rubber band was 3 ºC higher than that of the new rubber band. Additionally, the DSC curve of the degraded rubber band changes gradually and smoothly in comparison with the new rubber band.

It is known that the molecular chain length of rubber decreases upon degradation (i.e., molecular weight is decreased). Thermal analysis is highly effective in evaluating such changes.

■ DSC measurement conditions
Sample weight: 3 mg
Heating rate: 10 ºC /min
Pan: Al open pan

DSC7000X