Application Brief

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# Oxidation Induction Time Measurements by DSC

## 1. Introduction

Polymer is oxidized in the atmosphere including Oxygen which deteriorates mechanical strength and electrical property. This decomposition by the oxidation starts from the low temperature than thermal decomposition in the inert gas. For example of Polyethylene, the oxidation decomposition starts below than 200°C in the air to the contrary of the thermal decomposition from the vicinity of 400°C in the Nitrogen gas. For this reason, antioxidizing agent protecting from oxidization deterioration is added into the polymer such as Polyethylene as the industrial material.

DSC is one of the evaluation methods of oxidative stability; Oxidation Induction Time (OIT). The measurement procedure is the followings:

1) Sample is heated in the Nitrogen atmosphere. And temperature is kept at the specified temperature.
2) Change the atmosphere to the Oxygen.
3) After changing to the Oxygen, the time from the gas change to the observed exothermic peak is measured.

In this brief, the oxidation induction time (OIT) of Polyethylene (PE) is measured.

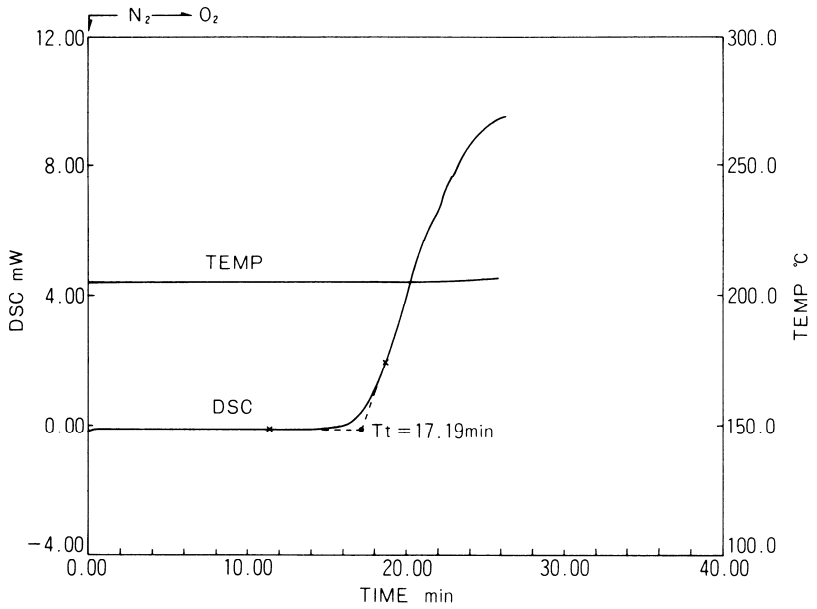


Figure 1 Oxidation induction time measurement result for PE at 205°C

## 2. Measurements

DSC200 is used. Measurement condition is 5mg of sample, isothermal temperature is 200°C, 205°C, 210°C, and 215°C. In the Nitrogen and Oxygen atmosphere, the flow rate is 40mℓ/min. Change from Nitrogen to Oxygen is automatically performed by the programming using gas controller unit.

## 3. Results

Figure 1 show the measurement result of the oxidation induction time at 205°C for PE. This is the DSC curve after changing the gas from Nitrogen to Oxygen. During 17 minutes after gas change, DSC curve does not show any change due to the effect of antioxidizing agent; however, the exothermic peak appears due to the oxidization after 17 minutes. From this result, the oxidation induction time of PE at 205°C is measured as 17.2 minutes.

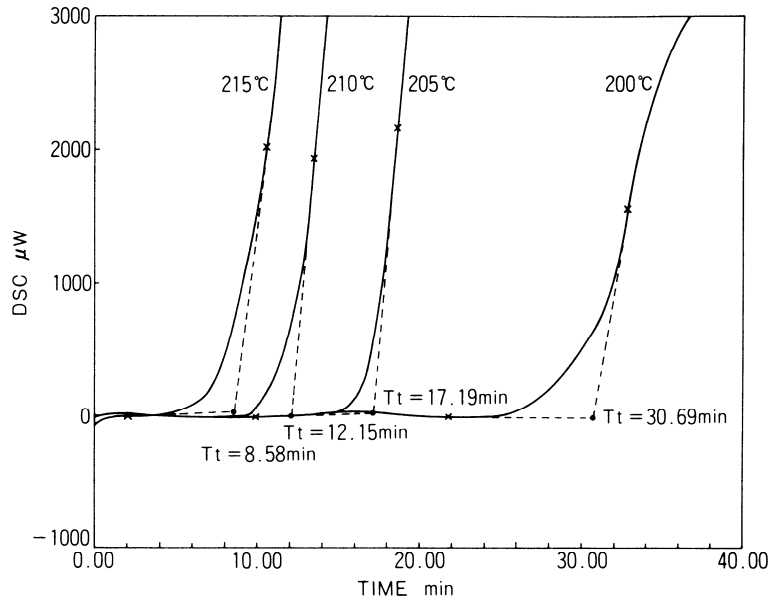


Figure 2 Temperature dependence of oxidation induction time for PE

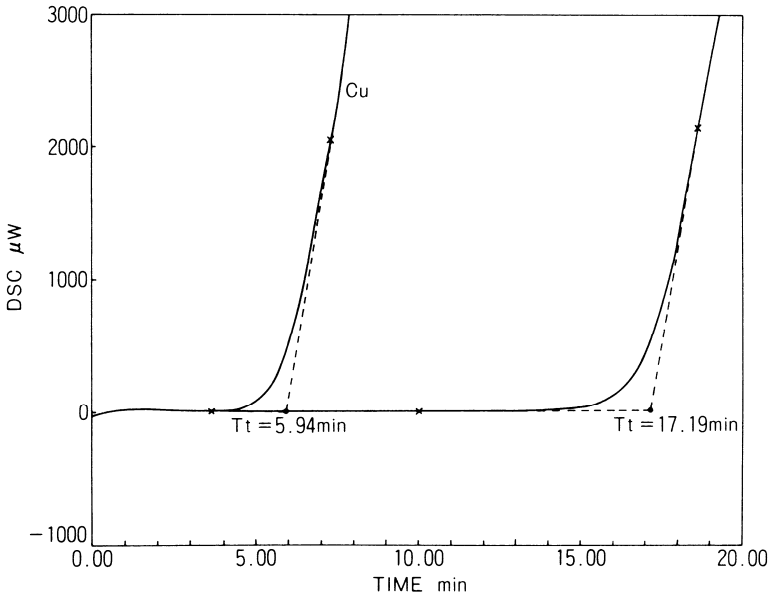


Figure 3 Cu influences on the oxidation induction time for PE
Isothermal temperature : 205°C

Figure 2 shows the measurement results at the 200°C, 205°C, 210°C, and 215°C. The higher the isothermal temperature is, the shorter the oxidation induction time becomes. Higher temperature results in a higher rate of oxidization.

Figure 3 shows the analysis of Cu influences on the oxidation induction time for PE. Contrary to the 17 minutes of oxidation induction time of PE, it is 6 minutes in the case that Cu is contacted to PE. It shows that Cu accelerates the oxidization reaction of PE. PE is used as a wire coating material. The oxidation induction time enables the material evaluation considering the catalyst effect of Cu.

Figure 4 shows the measurement results of three different grades of PE. In this result, C, B, A, is long, in the order. It shows the oxidation induction time differs depends on the grade of PE.

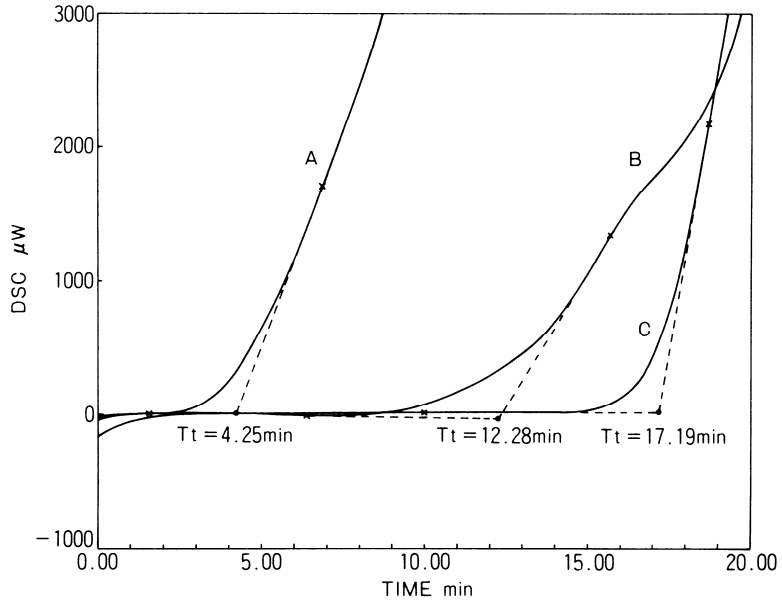


Figure 4 Measurement results of three different grades of PE
Isothermal temperature : 205°C

## 4. Summary

DSC can analyze the oxidation induction time (OIT). By this method, oxidative stability of various polymer materials can be evaluated effectively.