Application Note TA5008

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TA5008 - Water absorption and dehydration of organic compound α-cyclodextrin

Introduction

Users can study the detail of influenced heating process of raw material by changing water vapor partial pressure in the atmosphere using TG-DTA connected to the humidity generator.

In the case of quantitative water in the material for thermal analysis (constant heating method, Sample Controlled TG), it is available to measure each amount of water for adhered water and crystal water because of different of dehydration temperature due to the binding forces difference. On the other hand, if there are less difference of binding forces in each water, then it is difficult to perform separated determination because of overlapping of dehydration temperature.

However, performing TG measurement in changing the water vapor concentration at the isothermal measurement condition after heating, it is available to perform separated determination for two amount of water by only one measurement, changing adsorbed amount depending on the water vapor concentration and independent of, hard to dehydrate due to the high binding force.

Instrument

The compact humidity generator is connected to the TG-DTA for measurements under water vapor atmosphere with a constant relative humidity.

Equipped with a polymer type relative humidity sensor and high precision temperature sensor, its response to various water vapor concentrations is quick and stability for longer measurement is realized.

Measurement and analysis

TG measurement of α-cyclodextrin in water vapor atmosphere is shown in Figure 1. The measurement performs 1st heating in dry atmosphere (25℃, 2%RH) before cooling until 25℃, and then changing water vapor concentration 90%RH to dry for twice at holding temperature 25℃, and performs second heating at dry atmosphere continuously.

The measurement result can observe the two steps of mass loss (3.5%, 6%) due to dehydration on first heating(①). On cooling, the measurement result can be observed mass gain at amount of water at around 1.5% due to water adsorb (②), and then adding water vapor (25℃, 90%RH), the measurement sample can be observed the mass gain at around 11% due to water adsorb (③). Thus, the measurement sample can adsorb water around 12.5% in 25 ℃ 90%RH atmosphere from anhydrous state. Then, it can be observed around 6.5% for mass loss region (④, ⑤, ⑥) when changing the water vapor concentration. Thus, we can understand the total amount of adsorb water at around 12.5%, of this total, around 6% of water doesn't dehydrate in dry atmosphere at 25℃, it can dehydrate by heating. Hence in the results, amount of absorption and desorption of water is around 6.5% which depending of water vapor concentration.

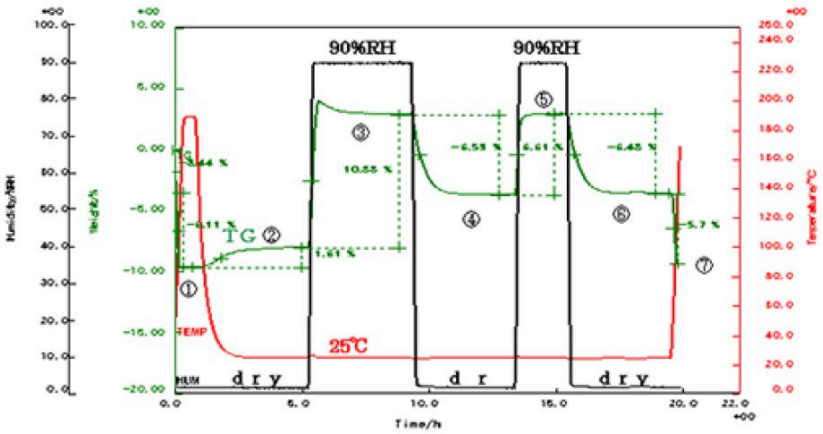

Figure 1: The behavior of water absorption and dehydration of α-cyclodextrin