Application Brief

SII

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TA NO.14 DEC.1983

Determination of Free Water and Bound Water by DSC

1. Introduction

The water can be classified as free and bound water. The water which does not have any interaction with materials and melted at 0°C is called free water. The water which is not frozen at minus temperature region or start melting below 0°C due to the interactions with materials is called bound water. Bound water is researched in the various fields as it has the influence on the quality of foods and medicines. By observing the melting phenomena of water using DSC, free and bound water can be identified.

In this brief, the starch and dextran gel are measured using sealed sample container.

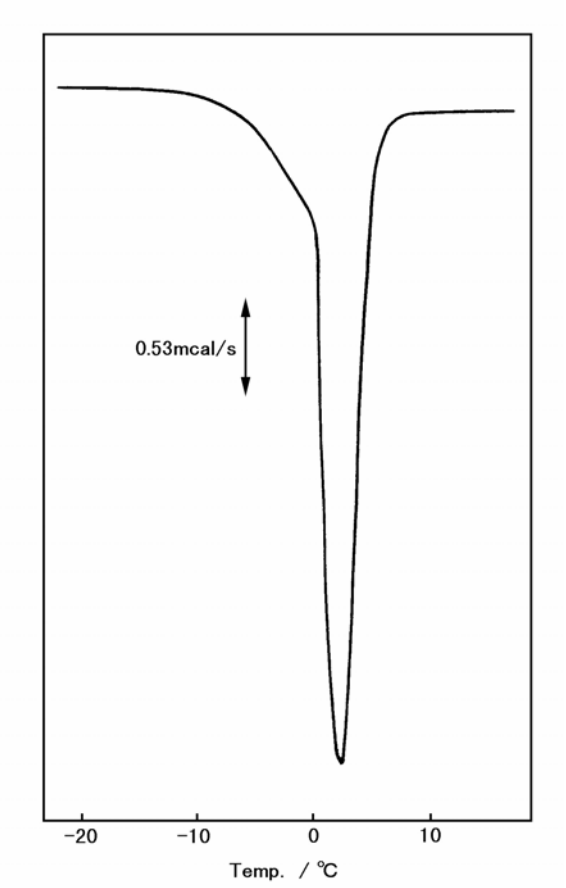

Figure 1 DSC curve for aqueous starch (50%) before gelatinization

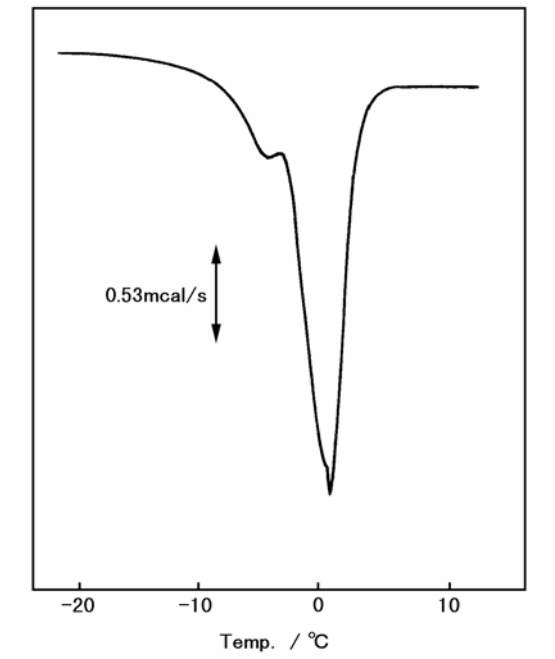

Figure 2 DSC curve for aqueous starch (50%) after gelatinization

2. Measurements

2-1 Starch

Figure 1 shows the DSC measurement result of the melting of water for the starch of 50% water content ratio. Figure 2 shows the DSC measurement result of the melting peak after the heating from minus temperature region after the gelatinization of Figure 1 sample. These are the result of the sample of 20mg and the heating rate 2°C/min. The different melting profile can be seen between before and after the gelatinization of the starch. The sharp endothermic peaks in the vicinity of 0°C shown in Figure 1 and 2 are considered by the melting of free water. The endothermic peaks in the vicinity of minus 5°C shown in Figure 2. It is due to the melting of bound water which is the changed from the part of free water.

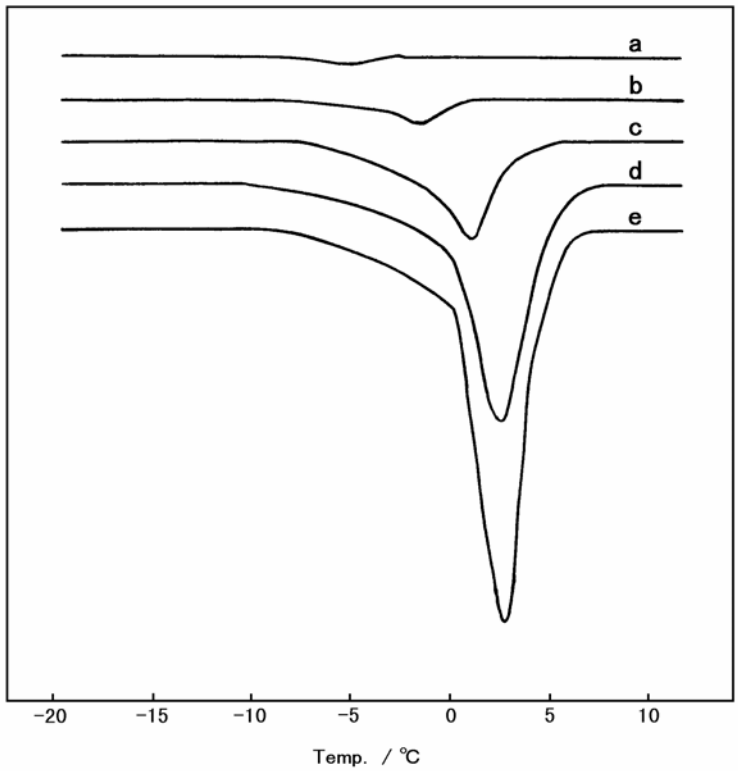

Figure 3 DSC curve for aqueous starch (50%)
added amount of water
a: 2.5mg
b: 5mg
c: 10mg
d: 15mg
e: 20mg

2-2 Dextran gel

Figure 3 shows the DSC measurement result of the dextran gel with the different water content ratios. The measurement conditions are the sample of dextran gel 20mg plus 2.5, 5, 10, 15, and 25mg water added with the heating rate of 2°C/min. The endothermic peak in the vicinity of 0°C is considered by the melting of free water. Part of water start melting in the vicinity of -10°C which is considered by the bound water that has the interaction with dextran gel.

Figure 4 shows the comparison of the added amount of water and the calculated amount of water from the endothermic peak. Nonfreezing water is shown due to the fact that the amount of water calculated is less than added.

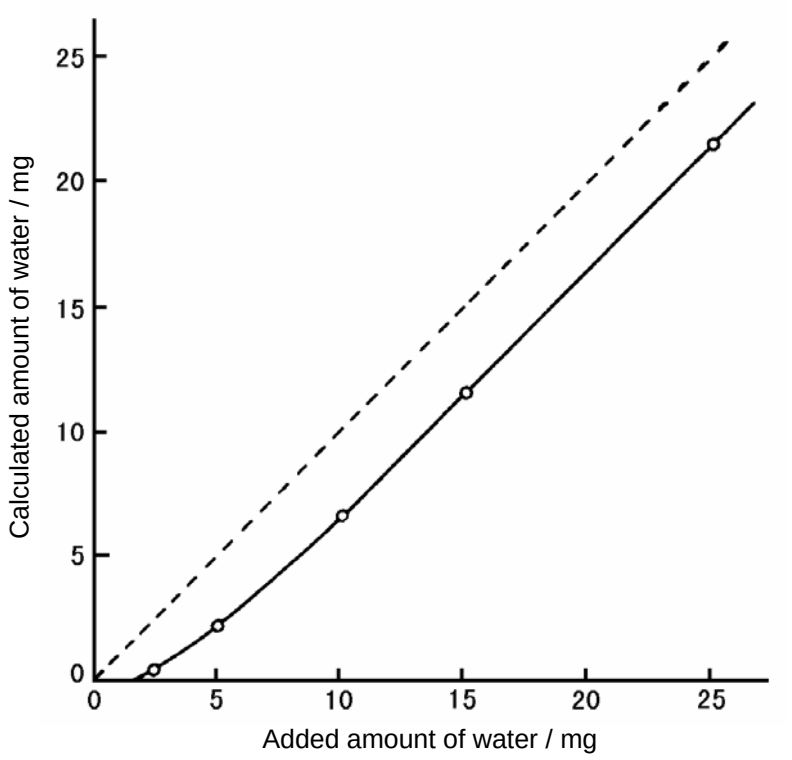

Figure 4 Comparison of the added amount of water and the calculated amount of water