

Evaluation of Rice Starch Adhesion to Aluminum Boards

CS-FNX Series Compact Ultracentrifuge, S110AT Fixed Angle Rotor, and NS-C200 Adhesion Measurement device

In the processes (blending, transporting and charging powder) of manufacturing powder products such as medicine tablets, foods, cosmetics and toners, those powder were adhere to the containers or pipelines. It may be a trouble in fixed-quantity transportation, and the cause of reducing productivity. It is important to detect the adhesion of the powder to identify the cause.

This article report the results of the effects of rice starch adhesion to aluminum boards by changing in temperatures.

Content

1. Sample

Rice starches

2. Test conditions

Centrifuge : CS150FNX compact ultracentrifuge

Rotor : S110AT fixed angle rotor

Adapter : T-AL adapter (The material of adhesion surface is aluminum.)

Centrifugal force : Five levels at 2,000, 5,000, 20,000, 50,000 and 100,000xg

Time : 5 minutes

Temperature : 20°C and 40°C (A rotor mounted with an adapter is placed in a thermostatic bath for pretreatment until a preset bath temperature is reached)

Adhesion measurement device : NS-C200 (configured by tele-centric lens, image analyzing system, and other components; manufactured by Nano Seeds Corp.)

3. Adhesion measurement method

1) Apply rice starch on the base plate surface on the adapter.

2) Having mounted the adapter on the rotor, perform treatment in a thermostatic bath regulated at 20°C or 40°C.

3) Record the state of initial rice starch adhesion on the base plate in the form of images.

4) Centrifuge for five minutes at the predetermined levels of centrifugal force.

5) Record the state of rice starch residue on the base plate in the form of images (Figure 1).

6) Calculate the residual rice starch rate by comparing the projected area of adhered rice starch before centrifugation that of the residual rice starch after centrifugation.

7) Calculate the rice starch adhesion.

Rice starch separation occurs instantaneously when the centrifugal force applied to particles exceeds the rice starch adhesion to the base plate. Calculate the centrifugal force (separating force) acting at this moment by the following calculating formula.

$$F(N) = (\pi/6) \cdot \rho \cdot d^3 \cdot r \cdot (2\pi N/60)^2$$

ρ : Particle density (kg/m³) d : Particle diameter (m)

r : Centrifugal radius (m) N : Speed (rpm)

8) Calculate the average adhesion.

In the method using projected areas, the residual rice starch rate after centrifugal separation is plotted on the lateral axis with separation force acting on the rice starch at respective revolutions on the vertical axis. Then the average adhesion (F_{50}) at a residual rate of 50% on the approximated curve is calculated (Figure 1). This method simplifies the measurement due to the use of average particle diameter in the calculation, thereby enabling prompt analysis of a number of samples.

4. Result

The average adhesion of rice starch to an aluminum surface was calculated at 20°C: F_{50} =685 nN and at 40°C: F_{50} =503 nN. Thus, the average adhesion was found to be higher at an ambient temperature of 20°C. This result supported that the characteristic of powder products can be grasped by measuring the influence of the adhesion under the environment of various temperature.

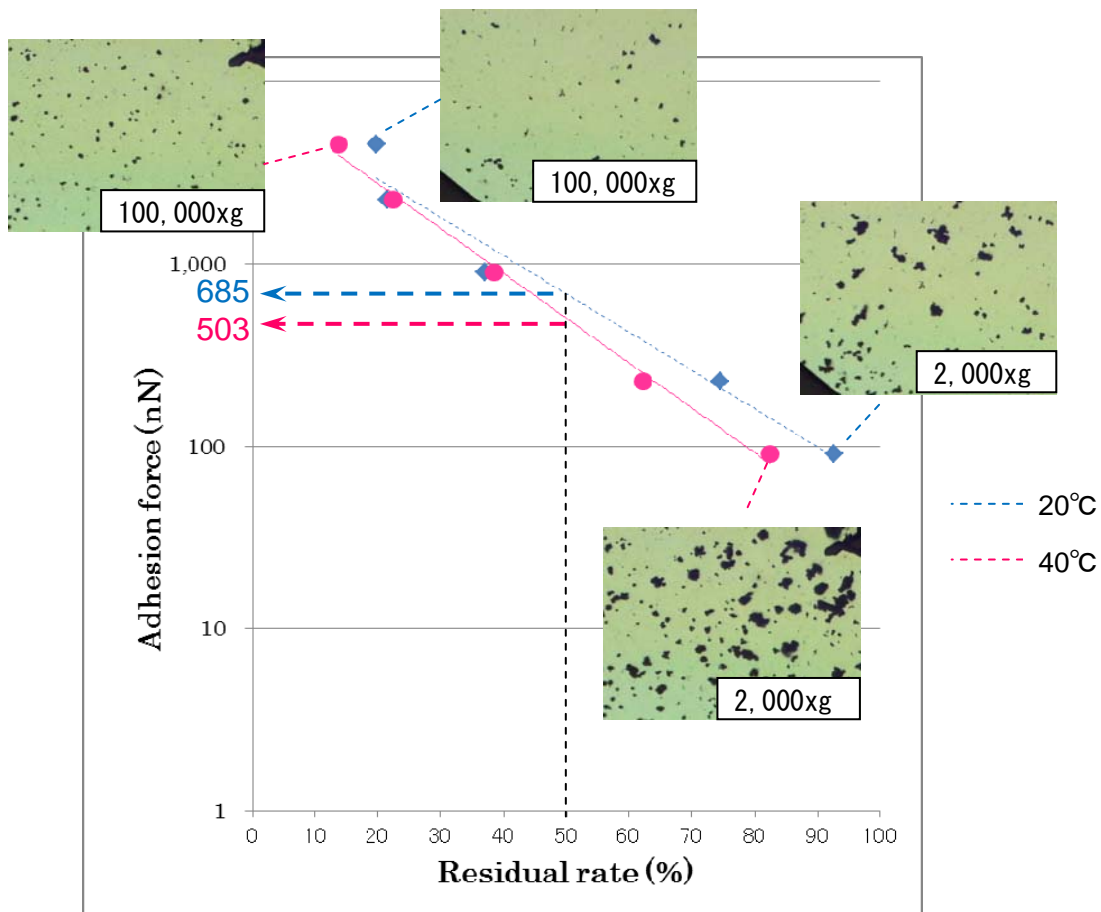


Fig. 1 Relative adhesion force and residual rate

Temperature(°C)	20	40
Average adhesion: F_{50} (nN)	685	503

* The data was obtained in cooperation with Nano Seeds Corp.

Adhesion force measurement system



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