

## The Analysis on Causes of Flexible Package Breakage and Corrective Methods

**Abstract:** The breakage of flexible package is the main factor affecting the actual packaging quality. How to solve the problem has been a main obsession for manufacturers. This article introduces the causes of package breakage and the methods for processing improvements.

**Key Words:** heat-seal property, heat-seal strength, filling, storage, package breakage

The breakage of flexible packages/pouches is one of the main factors influencing product packaging quality. Usually, breakage occurs in the following two situations: first, during filling process, the content would produce a heavy impact onto the bottoms of the pouches. If the bottoms can not withstand the impact, they would leak and hinder the filling efficiency as well as pollute the manufacturing environment. Second, during storage, if the pouches can not withstand the inner pressure increase caused by stack or other factors, they would also result in breakage and lead to content extinguishment and even pollution to the surrounding environment. How to solve the problem of breakage has been an obsession for the manufacturers. It's usually believed that breakage has close relationship with heat-seal strength of the packaging materials, but such opinion is not completely correct. This article will introduce the causes of breakage and methods for processing improvements.

### 1. Breakage during Filling

#### 1.1 Causes

With the increasing popularity of Form-Fill-Seal Machine in food, pharmaceutical, cosmetics and other industries, the time gap and space gap between package manufacturing and filling have been completely bridged. As to the new type of filling line, flexible packages are manufactured simultaneously with filling process. Yet, when filling, the heat sealing parts of the pouch bottoms are not completely cooled, and would withstand less impact.

The common definition for heat-seal strength is the bond strength of two films that have undergone heat seal process and have completely cooled down. However, in product line, there is no sufficient cooling time for the materials to cool down. Therefore, it's not proper to apply heat seal strength alone to evaluate heat seal performance of the materials; and hot tack force, that is, the peeling force of the heat seal places before cooling down, should also be applied.

#### 1.2 Hot Tack Force Testing and Application

As is shown in Fig.1, there is certain universality between hot tack force, heat seal temperature and heat seal time. A proper temperature spot is needed to achieve the most suitable hot tack force. When the heat seal temperature surpasses this temperature spot, the hot tack force would be in a declining tendency. Analyzing from the data, prolong the heat seal time at a certain heat seal temperature will increase hot tack force. A case in point is the following picture, that under the same heat seal temperature, the hot tack force of the specimen at a heat seal time of 0.3s is obviously lower than that of 0.5s.

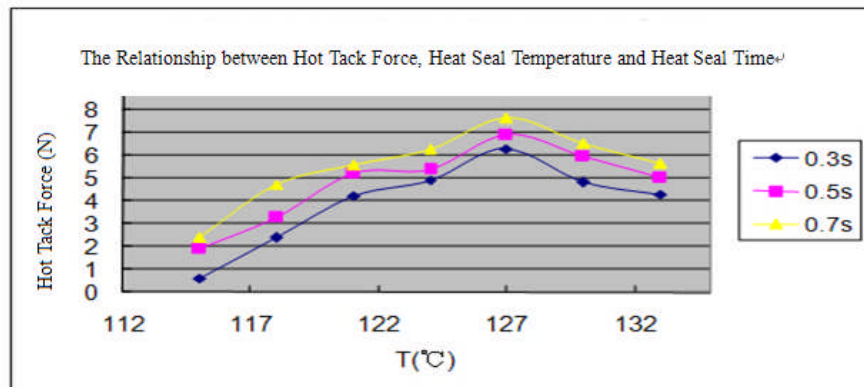


Fig. 1. The Relationship between Hot Tack Force, Heat Seal Temperature and Heat Seal Time

In actual application, the impact onto the bottom of the flexible packages during filling process should be calculated according to the target content. Then, adjust the heat seal strength, heat seal pressure and heat seal time of the hot tack tester to draw the hot tack force curves and choose the best group of heat seal parameters based on the facts of the production line.

## 2. Pouch Breakage during Storage

### 2.1 Causes

Except vacuum packages, the inner pressures of flexible packages would increase owing to the stacking of finished products during storage and transportation, which may lead to package breakage. Since breakage happens mostly in the heat seal places of materials, it can be avoided through heat seal strength testing, changes of materials and adjustments of heat seal parameters.

According to its testing methods, the heat seal strength is classified into two kinds: stretching heat seal strength and the expanding heat seal strength. Usually, we use tensile tester to test the stretching heat seal strength for the capability of heat seal place of packaging material against a single and even force separation. It's especially suitable for the evaluation of flexible package open easiness, and not suitable to solve the problem of package breakage. The reason is that the direction and volume of the inner pressure can not be confirmed, and deformation would occur near the heat seal places by pressure. Yet, the problem of breakage caused by pressure can be resolved through the testing of expanding heat seal strength.

### 2.2 The Testing of Expanding Heat Seal Strength and its Application

Leak and heat seal strength tester is for the expanding heat seal strength testing. Pressure should be increased inside the flexible package. The places with the worst strength can be found. Such places include, but are not limited to the heat seal places. Since expanding heat seal strength can not take the place of average heat seal strength, there is no relationship between expanding heat seal strength and stretching heat seal strength. Expanding heat seal strength relates to the size, shape and material of the pouches. If the material is so soft that it can be extended to several times its original length, obvious deformation would occur with the testing pressure increase. Therefore, slabs should be applied as the testing device to restrain the expansion caused by pressure increase and material deformation.

With the help of leak and seal strength tester, the maximum breaking force can be determined. Through pressure setting, the breaking time can also be determined. The operator can design the stack structure according to testing data, and adjust the parameters of heat seal process so as to improve the packaging effects, or analyze the existing problems according to the breaking places on the flexible packages.

### **3. Points for Attention**

The adjustment of the heat seal parameters through the heat seal property testing can reduce the breakage probability during filling, storage or the transportation process. However, the following points need to be noticed: First, the pollution to the sealing mouth by the content should be especially noticed. The heat seal strength or the hot tack force would be remarkably reduced by the pollution, and would lead to breakage caused by insufficient strength. Especially for the powdered products, the simulation test is a must.

Second, based on the design requirement, there should be a margin for the hot tack force and the expanding heat seal strength that are obtained from the selected heat seal parameters in the production line.(Concrete analysis should be carried out according to the instrument and material conditions.) This is because the evenness of both the heat seal components and packaging materials (especially the film material used in flexible packages) is not so good, and the accelerated error would lead to uneven heat seal effect in the heat seal place. Third, through testing the hot tack force and expanding heat seal strength of the material, the suitable heat seal parameters of specific product and specific product line can be obtained. We should combine the suitable heat seal parameters with the heat seal curves obtained in testing to consider comprehensively and select the most suitable.

### **4. Conclusions**

It has been widely accepted as an effective means to shorten packaging cycling time by optimizing the heat seal process. However, the heat seal parameter selection has direct influence on the rate of breakage, the filling efficiency and the losses in transportation. Therefore, heat seal parameters can not be set by experiences, and should be tested pertinently as well as further analyzed and confirmed. Meanwhile, adjustment based on the content and packaging materials should be made so as to have perfect guarantee.