

Analogue Study on Parameters of Paper Pulp to Buffering Properties

Wang Yu¹, Geng Dongwei²

¹ Dept. Printing & Packaging, Beijing Institute of Graphic Communication, Beijing, China

² Dept. Chemistry Engineering, Beijing Institute of Petrochemical Technology, Beijing, China

Email:1 wangyugdw@hotmail.com, 2 gengdongwei@bipt.edu.cn

Abstract: Recently, paper pulp is developed greatly in our country. As a new buffering material, it has occupied a great deal of market share through the packaging field and it is widely used in the buffering packaging of industrial production, such as the packaging of poultry eggs, fruits and electronic production. There are good prospects about it. But the current study on making pulp, forming equipment and processes in the pulp manufacturing process is a lot, while the product performance evaluation criteria and theory of structure design is studied little. Drop and impact of cushioning packaging products as well as performance of cushioning materials can be determined by physical tests. But such tests are difficult to control and the measured physical quantity is limited with high costs. In industrialized countries, the traditional drop test and performance testing of cushioning materials are increasingly done by computer simulation technology, which can be quickly and accurately to get the stress, strain and other parameters, as well as animation of dropping the process. In this paper, ANSYS/LS_DYNA analysis software did a lot studies on simulation of parameters of pulp molding structure and material to lay the foundation of actual structure design of buffering package.

Key words: stimulation; paper pulp; buffering property

1 Introduction

Molded pulp material as a new buffer material, in the packaging field, has been gradually occupied much of the market. The traditional drop test and buffer material performance testing is almost accomplished by the computer simulation technology, which greatly increase the competitive ability of production. The stress, strain, other parameters and drop process animation can be quickly and accurately got to analysis^[1-2]. In this paper, the buffer properties of structure and material parameters is studied on simulation by ANSYS / LS_DYNA analysis software to be a basis for the actual design of buffering package.

2 Model of molded products

In the actual application of packaging products, the structure is diverse, and applications of each are complex. We can extract of these structures to establish the most important part of the analysis model. There are many kinds of structures, most of them have 3 forms: rib type, barrel type, step-type^[3]. After having a model of structure, a model of material should be constructed. The material of pulp molding on the test confirmed nonlinear. Bilinear material model of enhanced movement is chosen here, the pulp module can be seen as Figure 1. The height is 80mm, the geometric gradient is 5°, and the bottom circumference of 80mm. Poisson's ratio is 0.3, elastic modulus is 150MPa, and the shear modulus is 10MPa, the

yield strength is 0.075MPa^[4-5].

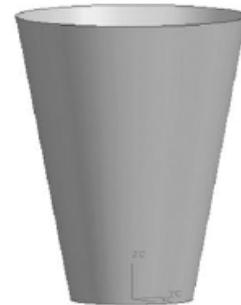


Fig.1 Paper pulp moulding product model.

3 Experiments and discussion

Experimental model and method is based on dynamic compression test of package cushioning materials GB / T 8167 – 1987. The experimental model is on the experimental platform. The model bottom (Z direction) displacement is 0. A rigid mass free fall from a certain height and then impact buffer material model to reflect the real situation. The software of ANSYS/LS_DYNA is used to simulate the dynamic compression of molded pulp products. The process is divided into pre-processing, solving and post-treatment in 3 steps^[6-7].

3.1. Influence of buffering properties of different heights

Falling height of 10mm, 40mm and 80mm is chosen to

simulate, shown in Figure 2. With other parameters are unchanged, the curves of acceleration to time in different height can be seen in Figure 2.

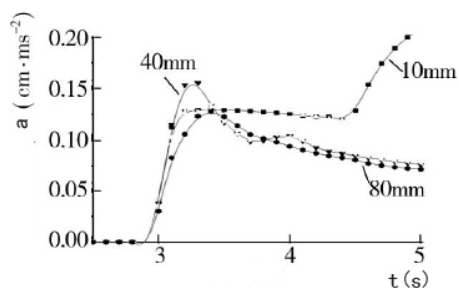


Fig. 2 Acceleration and time curve of different height.

When the height is 40mm, the peak of inflection point is the maximum. And the curve of 10mm and 80mm rise first and then go down.

3.2 The effect of different circumference to buffering performance

Molded pulp products were taken on the bottom perimeter of a situation 20,30,40,60 and 80mm, simulation results shown in Figure 3.

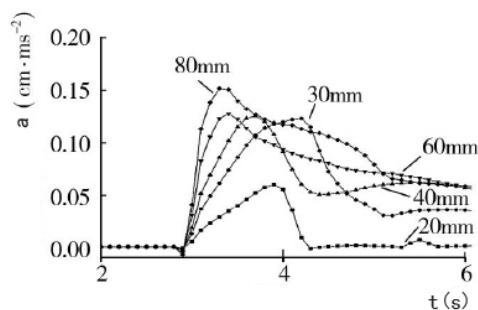


Fig. 3 Acceleration and time curve of different perimeter

From Figure 3, we can see that the value of peak increases with the circumference, which of 30mm, 40mm and 60mm is very close, but at different times.

3.3. Effect of different Poisson's ratio to buffering properties of pulp material

Parameters of materials were taken in the Poisson's ratio 0.01, 0.1, 0.4, taking Young's modulus 150MPa, shear modulus obtained 10MPa, the yield strength to take 0.075MPa. The situation on the three kinds of simulation results, can be seen Figure 4.

From Figure 4, we know that the trends of three curves

whose Poisson's ratio were taken 0.01, 0.1, 0.4 are basically same.

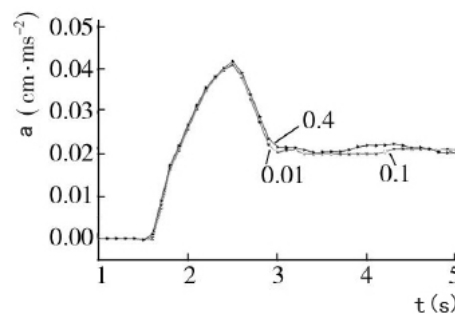


Fig. 4 Acceleration and time curve of different poisson's ratio

3.4 Influence of different Young's modulus to buffering properties of pulp materials

We choose 3 conditions of the material properties parameters to simulate in Figure 5, which were taken in the Young's modulus of 50,150 and 250MPa, Poisson's ratio to take 0.3, shear modulus obtained 10MPa, the yield strength to take 0.075MPa.

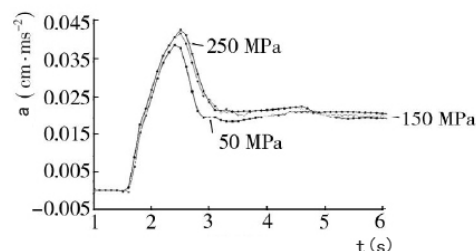


Fig. 5 Acceleration and time curve of different Young modulus

From Figure 5, the three trends of Young's modulus obtained 50,150 and 250MPa respectively are close, and the curve peaks is basically the same.

4 Conclusion

From simulation, we can draw some conclusions as following.

- 1) Changing the fall height of pulp molding products has a large effect to the acceleration time curve and its buffering properties.
- 2) Changing the circumference of pulp molding products affect largely to the acceleration time curve and its buffering properties.
- 3) Changing the Poisson's ratio of pulp molding products has little influence to the acceleration time curve and its buffering properties.
- 4) Changing the Young's modulus of pulp molding

products has little influence to the acceleration time curve and its buffering properties.

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