The design and research of the liquid bag folding mechanism

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Abstract

Based on the analysis of artificial folding liquid container bags, designed a automatic folding structure which can fold liquid container bag with 7400 mm length and 3950 mm width.The institution reduces the labor intensity of workers, enhances the efficiency of the work. The structure include crease compaction mechanism, crease position clamping mechanism, the sending mechanism and steering mechanism, and then in SolidWorks three-dimensional model is established, in order to make sure the structure is reliable , made a finite element analysis in the workbench.

Keywords

Liquid bags crease compaction automatic folding structure finite element analysis.

1. Introduction

The company Trans Ocean Distribution Limited was the first one to introduce liquid container bag transportation to our country, the capacity of each container liquid bag is of 16 to 24m3,which can store up to 24000 litres of liquid. In literature [1] a clothes folding machine is designed, which include the main body setting in the front of ontology and two trap at the back of. Having a folding part to press clothes, it is suitable for heated, and produce an obvious fold. Literature [2] studied object processing tasks ,which is used to perform complex man-machine collaboration for folding non-rigid. Literature [3] implements a flake of flexible object dynamic operations with two high speed manipulator and two high speed skating. The article [4]introduces a simple T-shirt folding machine, it is a kind of automatic folding machine, the motor control T-shirt carrying the photovoltaic system.By pressing a button,the folding machine automatically folding.Refer to the folding mechanism, this paper designed a liquid container bag folding machine.

2. The analysis of traditional manual folding process

Traditional manual will fold the liquid bag with length of 7400 mm and the width of 3950 mm, then change them into less than 1130 mm length, 550 mm width, and 450 mm height.

The action Involved in the process of folding mainly include:

1 adopting the laser to posite the liquid bag;

2 flat liquid bag,rule out the air inside the bag as much as possible;

3 crease position, human put two feet step on the both sides of the crease line, on one side

of the foot as crease line then fold;

4 folding, two men stand on both sides of the liquid bag, using both hands grasping the liquid side of the bag, and then along the crease line folding;

5 compaction, creases after each folding, avoid folding rebound.

2.1 The design of the liquid container bag folding machine

The working principle of the folding machine was shown in figure 1

As shown in figure 1, the folding machine is divided into five modules, include the conveying mechanism, fluid bags crease clamping mechanism, the compaction mechanism, steering mechanism,and the folding mechanism:

1. Conveying mechanism is composed of 17 conveyor belt ,18 conveyor belt wheel ,motor and reducer, complete liquid bag's delivery, 19 position sensor can detecte fluid bags, and transfer the signal to PLC, the PLC control conveyor's on/off.

2. Clamping mechanism is composed of 5 clamping cylinder and clamping plate, its is powered by clamping cylinder and drive clamping plates, put the clamping plate on the crease of positioning, complete the liquid bag crease's positioning and clamping liquid bag;

3. Compaction mechanism is composed of 4 compaction cylinder and the pressure plate, it is powered by compaction cylinder and drives the platen to complete crease the compaction work;

4. Upthrust cylinder 6 is fixed on the frame, the cylinder rod is connected with 7 upthrust slider, 7 upthrust slider is on the 8 upthrust sliding rail, 6 upthrust cylinder support the power, drive the 7 upthrust slider's movement along 8 upthrust sliding rail;9.10 lifting cylinder is fixed on the 7 upthrust slider, cylinder rod is fixed on the plate 11, powered by 9.10 lift cylinder, drive the plate 11 to complete the movement up and down;12 servo motor and reducer is fixed on the lifting plate 11, servo motor movement can achieve 13 stents rotate 90 °;14 bracket cylinder is connected to 13 stents , cylinder rod connecting with 15 bracket slider, powered by 14 bracket cylinder, drive 15 bracket slider sliding around 16 bracket sliding rail; liquid bag knuckle mechanic is composed of 6 upthrust cylinder,7 upthrust slider ,8 upthrust sliding rail ,9.10 lifting cylinder ,11 lifting plate ,12 servo motor,13 stents,14 bracket cylinder,15 bracket slider,and 16 bracket sliding rail, they together complete a folding body rotate 90 °;

5. Folding mechanism is composed of rod 1.2.3, joints O.A.B ,terminal actuators C, complete the liquid container bag's folding work;

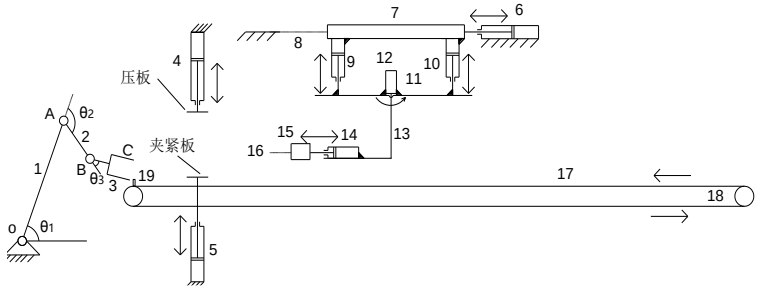

Figure 1 The working principle of the folding machine

1.2.3 connecting rod 4 compaction cylinder 5 clamping cylinder 6 upthrust cylinder

7 upthrust slider 8 upthrust sliding rail 9.10 lifting cylinder 11 lifting plate

12 servo motor 13 stents 14 bracket cylinder 15 bracket slider 16 bracket sliding rail

17 conveyor belt 18 conveyor belt wheel 19 position sensor

Folding machine working process: length 7400 mm, width 3950 mm liquid container bags on the conveyor belt 17, long edge is placed along the conveyor belt, the short side is opposite the folding mechanism, liquid bag move to the left,when position sensor 19 detecte the fluid bag, conveyor stop working, and the clamping plate drived by clamping cylinder 5 clamp the fluid bags, folding mechanism's actuator clamp the liquid bag and move to the right to complete liquid bag folding, pressure plate drived by compaction cylinder 4, leads downward movement until the clamp pressure crease, realize the liquid bag crease compaction, then clamp and the clamp plate reset, the belt move forward, repeat the above for six times.Liquid bag continue to move forward for a folding distances, upthrust cylinder 6 push upthrust slider 7 move forward the left , lifting cylinder 9 and 10 move down at the same time until the bottom of stent 13 come to the conveyor belt 17, at this time ,the folding mechanism repeat folding, then put folded body on 15 bracket slider, then 6 upthrust cylinder return to the beginning station. servo motors 12 drive stents 13 counterclockwise rotation the 90 °, then bracket slider 15 leaded by 14 bracket cylinder move backward, folding body fell to the conveyor belt, the short edge folding body is opposite the folding mechanism, change the position of the position sensor and procedures of folding mechanisms, folding mechanism complete 5 times folding.

3d model of liquid bag automatic folding machine

In SolidWorks, establish 3d model.The final design of the 3d model of the folding machine is shown in figure 2.

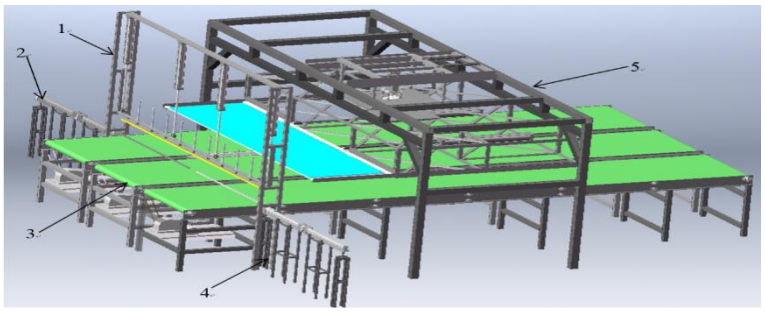

Figure 2 3d model of the folding machine

1 is crease compaction mechanism, 2 and 4 is crease positioning and clamping mechanism, 3 is conveying mechanism, 5 is liquid bag steering mechanism.

2.2 The finite element analysis of steering stents

Steering stents is shown as figure 3

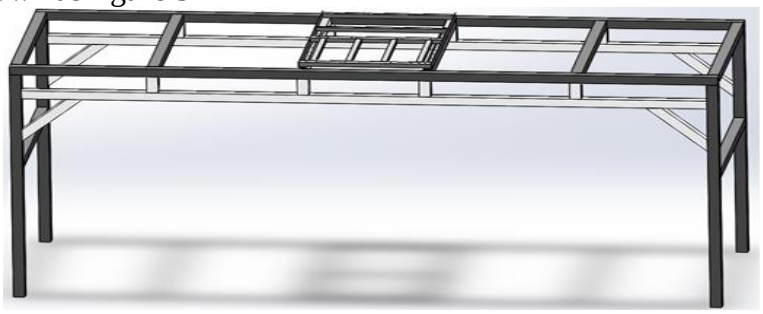

Figure 3 Steering stents

Import the 3d model into Workbench,adopt Static Structural,after adding the model of material properties,meshing, adding load and constraints,and the post-processing of results,we get figure 4-7.

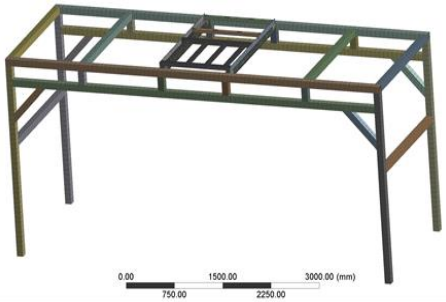

Figure 4 the meshing of stents

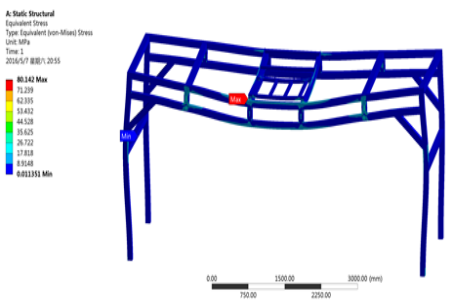

Figure 5 stress analysis of Stents

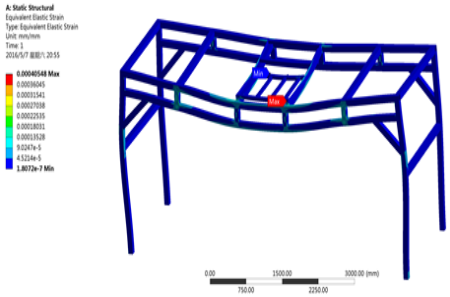

Figure 6 analysis of the strain nephogram

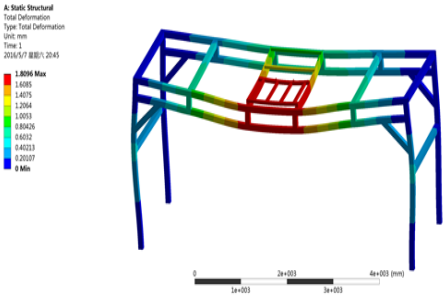

Figure 7 the total deformation

As shown in Figure 5, the maximum stress is 80.142 MPa, far less than Q235 material yield strength 225 Mpa,shown as Figure 6, the maximum strain is 0.0004mm, Figure 7 shows the maximum total deformation is 1.81mm,in theory all of them can meet the requirements.

3. Conclusion

In this paper, the traditional liquid bag folding process is improved, based on the analysis of the traditional manual folding, automatic folding mechanism is designed.In SolidWorks three-dimensional model was established, make finite element analysis in Workbench, and according to the results of the analysis ,the mechanism can meet the requirements.The agency can significantly improve the production efficiency of enterprises, enhance the enterprise the competitive ability.For the enterprises to improve production technology has a certain reference value.

Reference

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