STUDIES AND MECHANICAL TRIES REGARDING THE CUTTING PROCESS BY PUNCHING OF THE PACKAGE POLYURETHANE-PAD-PROTECTIVE PAPER, COMPONENTS OF A MEDICAL DEVICE (DRESSING)

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Abstract

In this paper we analyzed in first part on a virtual model made in SolidWorks, mechanical stresses occurring in the mechanism for cutting the dressing, determining optimal cutting force and in second part, on physical model built I determined, using specialized measuring devices, cutting forces. This paper is intended as an analysis of the technical solutions adopted in virtual construction phase by the physical model based on achieved results.

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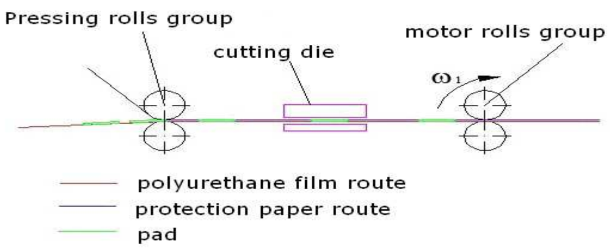
1. INTRODUCTION

The mechanism for cutting the dressing is a part of an equipment design to produce dressing of different sizes and shapes. It executes the last technological phase that means to cut the final product in different shapes and sizes.



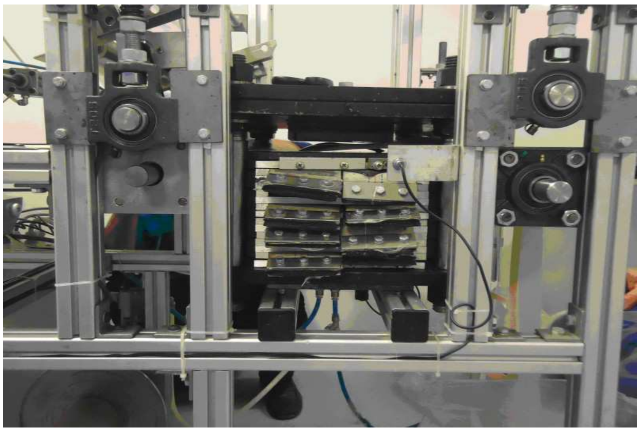


Figure1 Positions of cutting die in work process.

The cutting die has construction from figure 1 and 2 and is made of:

- Cutting die: base plate, the active plate, the column;
- Package support-shaped knife;
- Drive system: pneumopillows sets and separator plates.

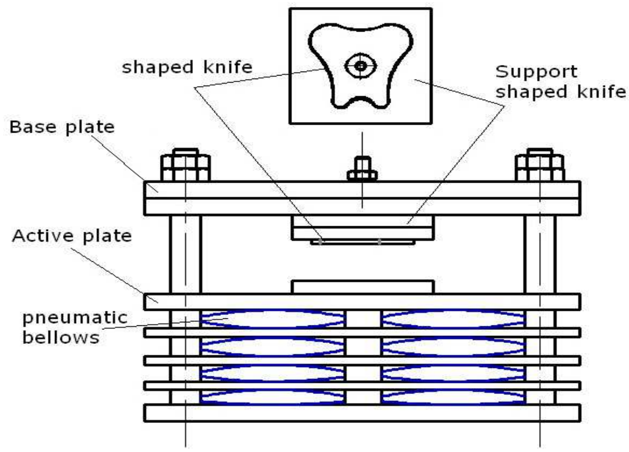


Figure2. Cutting Die

Cutting Die of Final Product

Cut by stamping of final product on physical model developed asked a series of problems since the initial tests, duet o the material of polyurethane film (polyurethane foam), the force to cut the package , that was determinate initial only theoretical, was not big enough for the knife to penetrate the whole package.

The composition and properties of polyurethane made it to stick to the knife of the cutting die, and made it difficult the material cutting, in the way material stretched and flow on knife, all leading to that desired contour cutting is incomplete and the whole package was not removed from the cutter.

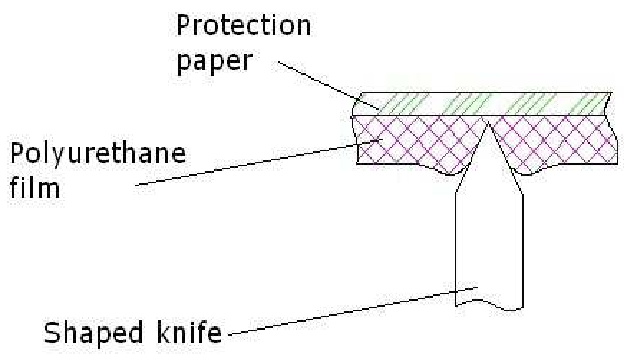


Figure 3 Knife crossing through polyurethane film

Final product has different sizes and shapes:

- Rectangular shape main dimensions from 75 mm to 220 mm;
- anatomical:
- sacrum;
- Heel.

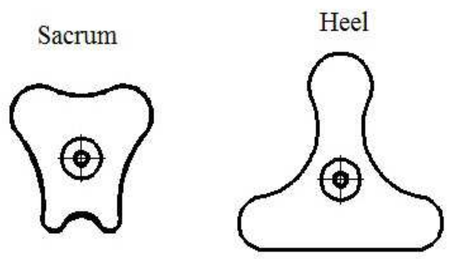


Figure 4 Different anatomical shapes for dressings

The problem for cutting these shapes is complicated to apply a mathematical computing device. Uncertainties and variables in this case are many. The physical model developed, by determining, for each product type, the center of pressure, the only problem was to determine the cutting force. So, from functioning test made was found that it is not enough a single layer of pneumopillows, at the end for anatomical shapes and maximum rectangular shapes to be necessary 4 levels (figure 1 şi 2).

2. VIRTUAL MODEL, DEFORMATION AND STRESS ANALYSIS FROM CUTTING DIE.

For mechanical analysis of stress, the cutting die was made in SolidWorks (figure 5). The cutting knife (figure 6) was chosen for sacrum shape of dressing profile. I made a virtual analysis of stresses that occur in active plate in order to check its stability in the forces of pneumopillows system.

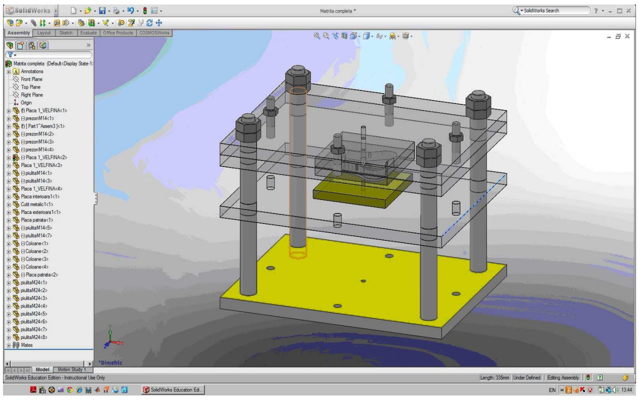


Figure5. Cutting die

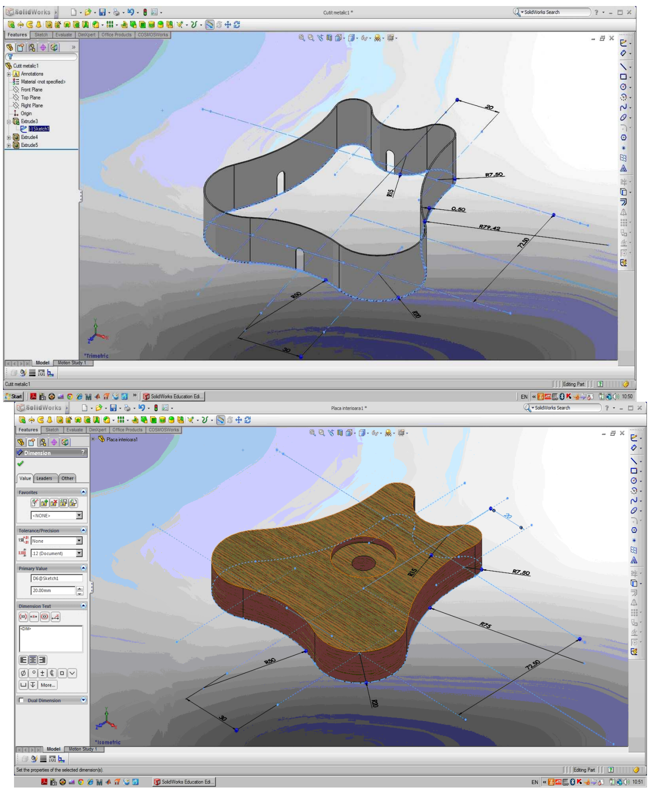


Figure6. Design of knife for sacrum shape

Stress loading I made it on the knife perimeter (fig. 7).

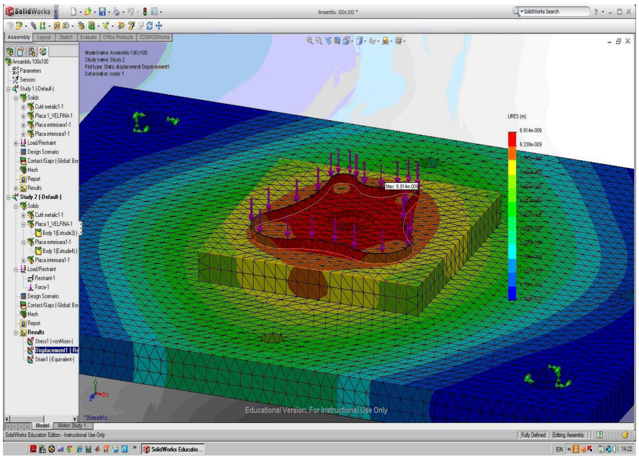


Figure7. Pressing forces on knife perimeter

Following this analysis it shows the fact that from mechanical view, the cutting die in well dimensioned, main issue is the determination of optimal cutting force and also of pressure and number of pneumopillows required to develop this force.

Using the mechanism of force developed a system pneumopillows (figure 1 and 2), force is not constant throughout a cutting drives.

That is why I tested, on physical model developed, with help of forces transmitter, what values obtain the force develop by the air bellow system. Trials were made with forces transmitter of 20 kN and 50 kN, used individually and together.

Transmitters are piezoelectric, the dates were taken with two different types of interface (figure 8).

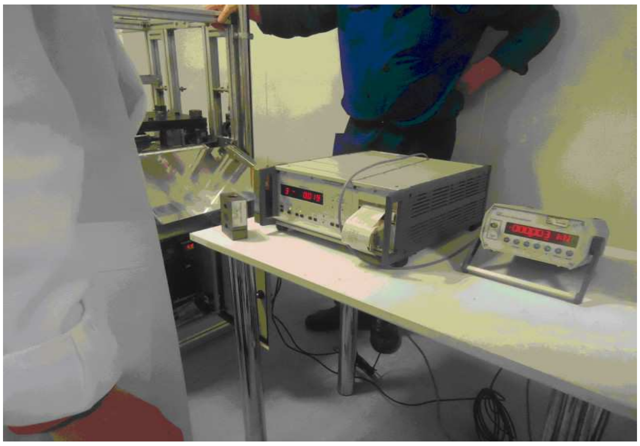


Figure8. Forces transmitter and two types of interfaces

Tests were made for a pressure of 8 bars and multiple configurations, with one pair of pneumopillows and with two pairs of pneumopillows. In both configurations were used the two types of transmitters of 20 kN and of 50 kN, individually and together. So, values that were determined varied in the following intervals:

a) on force transmitter of 50 kN and one pair of pneumopillows: 26,414 kN and 27,484 kN
b) on force transmitter of 50 kN and two pairs of pneumopillows: 33,420 kN and 34,470 kN
c) on force transmitter of 50 kN and one of 20kN and two pairs of pneumopillows: 16,616 kN and 16,864 kN

The recorded values of forces, depending on pressure variation applied in the two pneumopillows, readings can be seen in chart 1.

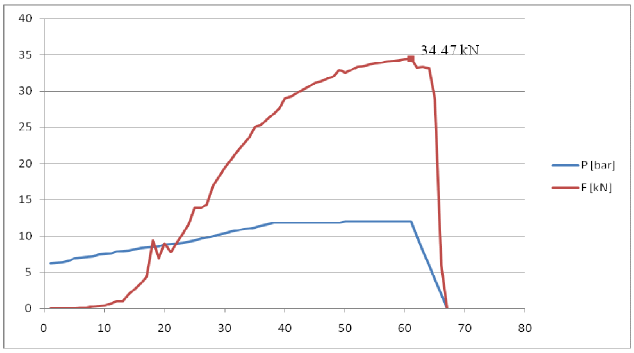
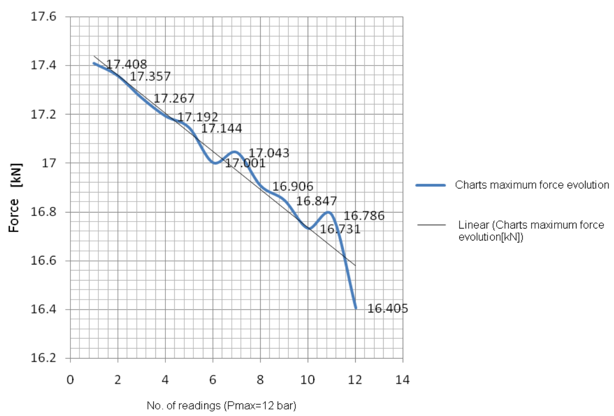


Chart1. Recorded values of forces depending on applied pressure

When using two pairs of pneumopillows but the determination of the forces have been made with a transmitter of 20 kN and taking only the part of the maximum pressure, readings can be seen in chart 2.

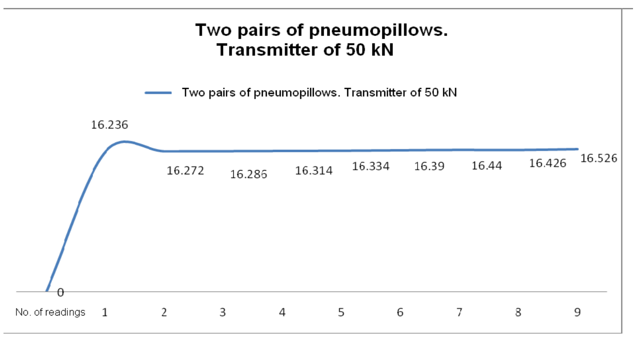
Values determined:

Number of readings	Maximum force development [kN]
1	17.408
2	17.357
3	17.267
4	17.192
5	17.144
6	17.001
7	17.043
8	16.906
9	16.847
10	16.731
11	16.786
12	16.405



Maximum force development during maximum pressure p = 12 bars. Transmitter 20 kN

For two pairs of pneumopillows but with an transmitter of 50 kN and taking only the part of the maximum pressure, readings can be seen in chart 3.



Maximum force development during maximum pressure p = 12 bars. Transmitter 50 kN

CONCLUSIONS

Using pneumopillows to achieve pressure force (stamping/cutting) does not lead to a force of constant pressure, it has some variation given by the way it swells and sits the pneumopillows, as it shows in charts, however, the maximum value obtained is enough for cutting the final product in good condition.

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