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MEASUREMENT OF THE CLOSING FORCE ON THE MEDICAL BOTTLES

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Abstract: *This paper deals with measurement of the force needed to close a medical bottle on the "L60" machine. This machine is situated in the "JADRAN" – Galenic Laboratory (JGL), Rijeka, Croatia. During the process of capping the bottles some problems occur, like big vibrations or breaking glass bottles. The aim of this article is to discover the right combination of bottles and caps which can be filled and capped on the "L60" machine whithout occuring any side effects.*
Key words: *measurement, force, bottle, cap*

1. INTRODUCTION

"JADRAN" – Galenic Laboratory is Croatian pharmaceutical company situated in Rijeka (http://www.jgl.hr, 2010). Most of their products are filled and capped on the "L60" machine. "L60" is automatic filling machine produced by CAM manufacturer (automatic cartoninig machine). This machine combines the simplicity of the volumetric filling with follow-on movement with the reliability of the rotative continuous movement in closing area. The filling starwheel, made free from dosing units, makes this machine particularly suitable for sterilised environments (http://www.campackaging.info, 2010). It is suitable to handle a wide range of glass or plastic bottles, as well as of stoppers and caps and of liquids and semi-thick products, at high production speed. An independenty driven, variable speed conveyor conveys and exits bottles from the machine, transferring them to downstream equipment. Machine operation is automatic, providing that the infeed of products, bottles, caps and stopper is constant. Appropriate photocells control that bottle, cap and stopper level is constant, that stopper and cap are perfectly centered on the bottle and that bottle outfeed is not jammed (CAM, 1997).

Manufacturing of sterile products is subject to special requirements because of the risk of microbiological contamination, and contamination from particles and pyrogens. It depends a lot on the knowledge, education and attitude of staff working in this production. Quality assurance is particularly important in this kind of manufacturing and procedures and processes must be strictly followed (http://narodne-novine.nn.hr, 2003).

Bottles and caps are designed for one time closing, this method is widely used for closing medical bottles. Closing method is designed to function as aguaranteed seel and may enclose a sealing gasket or stopper received in an elasticcaly yielding claw ring which has claws held engaged with a bottle mouth rim (Bodenman, 1981).

In the process of capping the bottles a problem occurs. When force needed for bottle to be properly closed is too big then vibrations appear. That happens because machine struggles to properly close the bottle. Side effects of vibrations are collapsing of the plastic bottles on the conveyer and breaking the glass bottles. Both of this sideeffects stop the production, specialy when a glass bottle brakes because the whole machine has to be cleaned to restore the sterilized conditions.

Bottles are capped by the revolving head which turns constantly while her pistons travel up and down on the curve depending on the position. Together with revolving head a stand (situated beneath the revolving head) which holds the bottles revolves at the same speed, so in the exact position every closing is performed. On the end of every piston there is a very simple cap holder which holds cap by friction.

On the "L60" machine there is no direct way to regulate closing force which is constant. Only way to regulate it is to choose the right combination of bottles and caps. If a reference combination (combination in which there is no problems on closing) is known the force which is needed to properly close the bottle can be determined. When we know the reference value of the force then we can test different combinations of bottles and caps to determine which one is suitable and which one is not.

2. MEASUREMENT SAMPLES

As explained, only possibility of avoiding vibration is the correct choice of the bottle and cap. To test the closing force there were obtained four types of bottles and two types of caps, as shown in the figure 2. These four types of bottles and two types of plugs made five different combinations, as shown in the table 1. For the first combination (AKBS006 bottle and cap Pfeiffer) is known to satisfy the closing conditions of the machine, there is no vibration and therefore, this force is taken as the reference and the other measuring results will be compared with it.

Fig. 2. Measurement samples

Comb.	Bottle	Bottle material	Cap	Bottle diametar	Total height of bottle
1	AKBS006	Glass	Pfeiffer	34 mm	65 mm
2	Stolzle	Glass	Pfeiffer	45 mm	106 mm
3	AKBP019	Plastic	Pfeiffer	31 mm	65 mm
4	AKBP076	Plastic	Pfeiffer	31 mm	65 mm
5	AKBP076	Plastic	Aero pump	31 mm	65 mm

Tab. 1. Measurement samples combination and description

3. CLOSING FORCE MEASUREMENT

As mentioned, there was obtained five different combinations. For each combination two series of five measurements were carried out, a total of fifty results.

Mesurement was performed with the dynamometer PCE – FM 1000. In order to properly measure the force it was necessary to make a device for measuring. Device is shown in figure 3. The measurement was carried out on two ways, manually and on the testing machine.

3.1 Device for measuring

Purpose of the device is to enable a straight line measurement. Device is very simple and it consists from four major parts:

- Mechanism for pillar drilling machine
- Sensor holder
- Cap holder
- Bottle holder

Fig. 3. Device for measuring

3.2 Manual closing force measurement

Manual measurement means to provide the force necessary to properly close the bottle by arm strength. Table 2 shows the results measured manually and average values.

Comb.	Manual closing force [N]					
	Measurement					Aver.
	1	2	3	4	5	
1	187,2	193	194,8	202,8	259,2	207,4
2	308,4	298	257,6	283,4	286,2	286,7
3	229,2	214,6	215,8	195,8	174,8	206,0
4	202,8	236,6	278	290,2	280,8	257,6
5	387,4	230,6	346,6	293,6	266,4	304,9

Tab. 2. Results measured manually

3.3 Force measured on the testing machine

Force necessary to properly close the bottle was given by R-5 testing machine. Speed of closing was constant. Figure 4 shows closing force measurement on the testing machine.

Fig. 4. Force measurement on the testing machine

Table 3 shows results measured on the testing machine and average values.

Comb.	Testing machine closing force [N]					
	Measurement					Aver.
	1	2	3	4	5	
1	174,8	191,8	189,4	160	175,92	175,9
2	280	275	274,2	255,4	271,4	271,4
3	173,4	184,2	157,6	188,8	174,36	174,3
4	244,4	248,2	185	189,2	223,92	223,9
5	447,2	166	274,4	289,6	351,96	351,9

Tab. 3. Results measured on testing machine

4. RESULTS ANALYSIS

From tables 2 and 3 we can see that the closest average closing force is to combination 1 is combination 3. Combinations 2 and 4 have higher values. Combination 5 has highest and most inconsistent values. Figure 5 shows comparison between manual and testing machine closing force. Manual force is higher on every combination except combination 5.

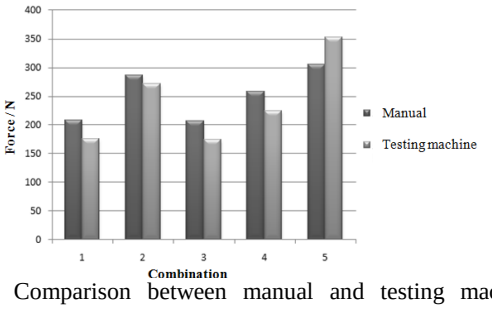

Fig. 5. Comparison between manual and testing machine closing force

5. CONCLUSION

Closing force on the combination 1 was taken as a referent from the other four it was concluded that only combination 3 satisfies the closing conditions on the "L60" machine. The reason for satisfying the conditions for sample 3 is probably in the shape of the bottle AKBP019 mouth rim. Sample 2, 4 and 5 differ and are not suitable for filling on the machine"L60". Sample 5 has given very bad results in the measurement and the opinion is that this combination of bottle AKBP076 and cap Aero pump is not suitable.

Figure 6 shows comparison of bottles AKBP076 and AKBP019. They are practically the same, both of them have the same cap but the values differ. Only difference is in the bottles mouth rim.

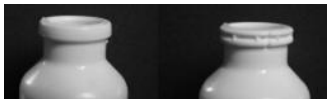

Fig. 6. Comparison of bottles AKBP076 and AKBP019

6. REFERENCES

Bodenman, P. (1981). *Bottle closing device,* United States Patent

CAM (1997), *"L60" machine manual*, Bologna

*** (2010) http://www.jgl.hr/eng/index.php, *Acessed on: 2010-09-29*

*** (2010) http://www.campackaging.info/machines.php?pid=23&cid=27, *Acessed on: 2010-09-25*

*** (2003) http://narodne-novine.nn.hr/ clanci/sluzbeni/ 288316.html - Rulebook for manufacturing sterile drugs, *Acessed on: 2010-09-23*