

TESTING THE STRENGTH OF LASER-BONDED ANIMAL INTESTINES

Bartel S., Domin J., Karczewski J., Kciuk M., Kozielski L., Pilch Z., Wyciśłok P.



Abstract

The paper presents the test results of the tensile strength of animal intestines bonded by laser technique. Laboratory studies were carried out on pig intestines using red laser light. The studies were performed according to four different procedures with and without albumin adjuvants

Laboratory tests

The main aim of the research was to check the connection strength between laser-bonded intestines.

Procedure no. 1

- cutting two pieces of the casing, about 10 cm long each,
- placing the first intestine on the glass tube (see fig. 1),
- placing the second intestine on the glass tube, in a way that one overlaps the other (see fig. 1),

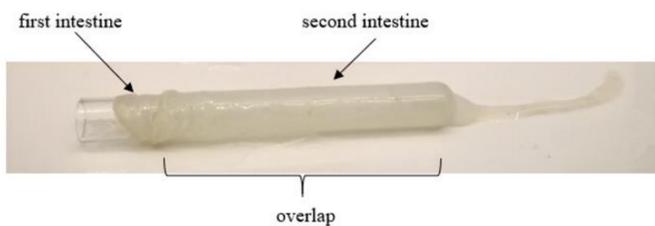


Fig. 1 Intestines over the glass tube

- heating the overlap area by a red laser beam by the following diagram (see-fig. 2.a.),
- carrying out a test of breaking the connection and its evaluation with the measurement of the force carried out.

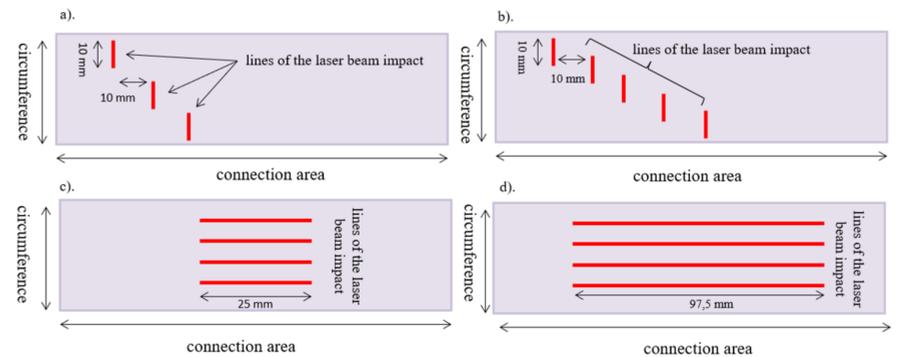


Fig. 2 The location of the lines of laser beam impact on the casings in the connection area for a). procedure no. 1, b). procedure no. 2, c). procedure no. 3, d). procedure no. 4

Procedures no. 2-4

In the comparison with the first procedure, albumin solution (covering between the intestines) was used additionally and heating the overlap area by a red laser beam by the following diagrams, shown in Fig. 2.

Results

Tab. 1 The results of laboratory tests according to procedures no.1, 2, 3, and no. 4

	Procedure 1			Procedure 2			Procedure 3			Procedure 4		
Laser power [%]	15	15	15	15	15	15	11	11	11	11	11	11
Laser speed [mm/s]	3.0	3.0	3.0	3.0	3.0	3.0	1.9	1.9	1.9	1.9	1.9	1.9
Connection force [N]	5.1	5.4	4.7	10.4	2.9	12.3	11.6	11.2	9.8	13.1	24.1	15.5
Adhesive substance	No	No	No	50% albu min	100% albu min	100% albu min	100% albu min					

Conclusions

- The use of a red laser by the following procedure no. 1 allows for obtaining the bond strength despite the lack of a bonding substance.
- During the implementation of connecting casings according to procedures 1-4, the temperature value (250 °C) was not exceeded in the place of the laser beam impact (Fig. 3).
- The phenomenon of strong intestinal contraction was observed under the influence of the laser beam, therefore it is necessary to apply mechanical pressure on the edges of the joined intestines.
- The use of mechanical pressure increases the strength of the connection by 3-4 times, which results from the results presented in the 1, compiling the results of the tests carried out by the following procedure no. 2.
- Reducing the laser power and the laser speed results in less intestinal contraction, even in the absence of mechanical pressure.
- Based on laboratory tests carried out by the following procedures no. 1, 2, and 3, it was found that the water in the area between the interconnected intestines was justified initially, and therefore another method of applying the adhering substance (albumin in powder form) was proposed. By using the method of blowing powdered albumin, the effect of partial binding of water in the area between the joined intestines was obtained.
- The mechanism of connecting tissues with laser light is not yet well understood to decide whether protein coagulation or other modifications taking place in the ECM determine its quality. NC supplemented with protein substances such as albumin allows testing hypotheses regarding this process.

Acknowledgment

The presented results are the result of the implementation of a research project at JELUX Polska sp. z o.o. "Introduction of process innovation to a business activity consisting in the automation of the production of natural casings from intestines and product innovation in the form of a new assortment of welded intestines", co-financed by the Polish National Center for Research and Development (contract number: POIR.01.01.01-00-0207 / 17-00).