ASCERTAINING OF WELD STRENGTH OF PACKING MATERIALS

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ABSTRACT

The objective of the paper was to determine optimum weld strength values of the examined packing materials used for packing of wafers. Overlapped joints of the packing materials were welded by the discontinue indirect impulse weld machines BH 04 and BH 07 at the pressures of 0.1 and 0.3 MPa. The optimum weld strength values 3.35 ÷ 3. 38 N.15 mm-1 were reached at the temperature of 160 ÷ 162 °C.Using measured values were characterising the relationship between the temperature of welding and the weld strength. The gained values were evaluated by the parabola formula.

INTODUCTION

Welding is a process of connecting of two or more parts of thermoplasts using temperature and pressure. Temperature as one of the basic parameters of the welding causes decreasing of the intermolecular binding forces by which materials become plastic. By using the pressure the macromolecules of connected materials get interlocked whereby intermolecular secondary forces develop, being directly dependant on welding temperature. Having cooled the weld binding forces increases and provide the weld with the strength (Martinec and Pinkavova, 1989, Martinec *et al.*, 1991, and Nemcov and Khandl, 1996). If composite materials are used it is necessary to count with substantial decrement of weld strength (Nemcov and Kandl, 1996).

Weldability or quality of the weld is in a substation extent affected by the so called degradation of plastics caused by ultraviolet radiation known as thermo oxidation. Stabilisers in plastics prevent them from these effects however, the process of ageing takes its toll. This is another reason for further protection of plastic products in order to secure their abilities to get cennected by welding (Taudner, 1984 and Nemcov and Khandl,1996).

In the case of thermo oxidation, the result of which is the decrement of the weld strength from the short point of view but in particular the long term point of view, it is currently possible to study a trend of decreasing temperature parameters and shortening of the time allowing the air oxygen to act during the welding process (Nemcov and Khandl, 1996)

MATERIALS AND METHODS

To ensure the optimum quality of the weld it is necessary to control welding values regularly. In the welding process it is necessary to respect a formula between breadth of the weld and material thickness which is stipulated in the STN 77 0140 Standard 1996. For welding of packaging material indirect impulse discontinuous welding was used. The packaging machines BH 04 and

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BH 07 were used for welding of packaging material. For determining of the weld strength it is recommended a trial sample has a shape of band with a breadth of 15 mm that determines weld length. Trial samplings were conditioned at the temperature of 23 °C and humidity 50 %. Experimental measures were carried out in the Research Institute of Applied Plastics in Nitra, Slovak Republic on the tearing machine TIRA - 2700 at the sliding speed of the fasten jaws 250 $mm.min^{-1}$. Determination of the weld strength according to the STN 77 0140 Standard 1990 was ascertained in the longitudinal and cross directions. The optimum welding conditions were determined graphically from the gained measured values.

The following materials were used for measuring:

1. TATRAFAN® KX - biaxial oriented polypropylene coextructed foil. It has a good resistance against fat, oil and dissolving agents. It has excellent mechanical and optical fetures and does not pose a health hazard. Thickness of the packaging material is 35 µm, weight area 31,8 g.m-2 and penetration of water vapour 4 g.m-2.d-1.
2. TATRAFAN® KXM - composite foil made of metallic and non-metallic coextructed foils glued together. It is heat weldable from both sides with an inner texture and steamed layer of aluminium. It has good barrier features and is produced from the raw materials posing no health hazards. Thickness of the packaging material is 48 µm and penetration of water vapours 4 g.m-2.d-1, weight area 50 g.m-2

RESULTS AND DISCUSSION

Reached results of the weld strength for packaging material TATRAFAN® KX for longitudinal and cross welds are depicted on the fig. 1 The surface temperature of welding jaw was 140, 164,170, 180, and 190 °C at the pressure of 0.1 MPa and welding time ranging from 0.66 to 0.68 seconds for a packaging machine BH 04 with a capacity of 88 ÷ 90 Pieces.min-1. The weld strength for a longitudinal weld measured at the temperature of 140 °C was 3.15 N.15 mm-1.

As a result of the increment of the surface temperature of the welding jaws on 164 °C the weld strength rose by 20 %. From the graph it is visible that by further increasing of the temperature the weld strength decreases. The final result of the weld strength is an average value of longitudinal and cross welds. The sought optimum value of the weld strength lays close to the curve summit representing 3.38 N.15 mm-1 at the temperature of 160 °C, whereas the producer declares the weld strength 2.5 N.15m-1 at the temperature of 130 °C. For the difference of 10 °C the weld strength has risen by 0.65 N.15mm-1 what represents 26 % increment for the longitudinal direction and 77.9 % increment for the cross direction. The average weld strength value at the temperature of 140 °C is 2.37 N.l5 mm-1 what is by 0.13 N.l5 mm-1 or 5 % less than declared by the producer. Measured results of the weld strength for the packaging material

TATRAFAN® KXM were graphically processed and are depicted on the fig. 2. The surface temperature of welding jaws ranged from 145 °C to 192 °C at a pressure of 0.3 MPa, welding time 0.69 seconds and capacity of 86 Pieces.min-1 for a packaging machine BH 07.

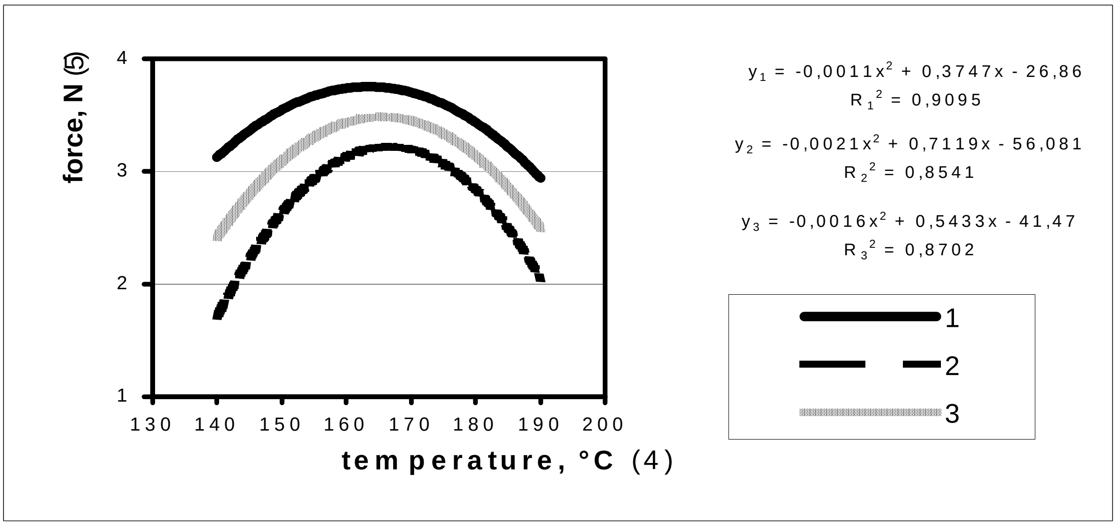

Fig.(1): Weld strength packaging materials **TATRAFAN® KX**

1 – Weld strenght in logitudinal direction load. 2 – Weld strenght in cross direction load. 3 – Average value weld strength.

It may be said that the weld strength of the trial sample loaded with the strength in the longitudinal direction rises with the temperature increment. For temperature of 145 °C the weld strength was 1.26 N.15 mm-1, whereas for the temperature of 166 °C the weld strength has risen to 3.05 N.15 mm-1 what represents 3.5 times increment. The weld strength in the cross direction rises slightly. The average weld strength value at the temperature of 145 °C is 1.76 N.15 mm-1 whereas the value declared by the producer is 2.4 N.15 mm-1. The difference of the two values is 0.64 N.15 mm-1 what represents 36.3 %. The optimum weld strength value is 3.35 N.15 mm-1 at the temperature of 162°C.

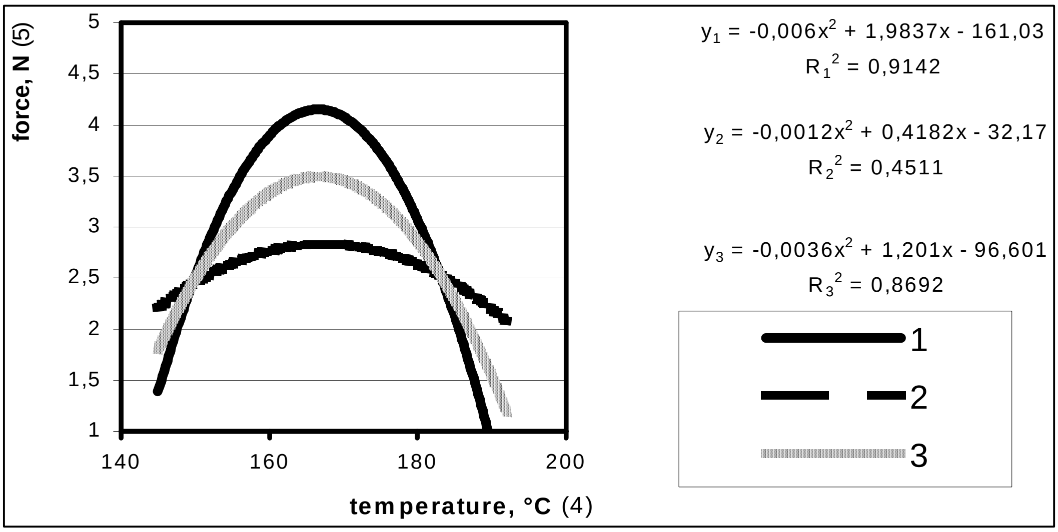

Fig. (2): Weld strength packaging materials **TATRAFAN® KXM**

1 – Weld strenght in logitudinal direction load. 2 – Weld strenght in cross direction load. 3 – Average value weld strength.

From the experimental measures at the given weld strength the optimum values of weld temperatures for selected packing materials were ascertained. Using the measured values the regression curves were plotted characterising the relationship between the temperature of welding and the weld strength.

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الخلاصة

ان موضوع البحث هذا يتعلق بتحديد قيم قوة اللحام المثالية للمواد الخاصة بالتغليف التي تم فحصها و المستخدمة في تغليف البسكويت. فقد تم لحم المفاصل المتداخلة (المتراكبة) للمواد الخاصة للتغليف حيث تم لحمها بواسطة الات اللحام ذات النبضات غير المستمرة و غير المباشرة , BH04

BH07 و بضـغط مقداره 0.3MPa , 0.1MPa. ان قيم قوة اللحـام المثاليـة كانـت 3.35-3.38 N.
15mm^{-1} وقد تم الحصول عليها في درجة حرارة 162 -160درجة مئوية. ان القياسـات التـي اجريـت اكـدت حقيقـة العلاقـة بـين درجـة الحـرارة اللحـام و قوتـه و بـنفس الوقـت اكـدت ان قـوة اللحـام فـي الاتجاهات المتداخة تزداد بوضوح. لقد جرى تقيم النتائج التي تم الحصول عليها بواسطة Parabola Formula.

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