Title: IMPROVED METHOD FOR THE SEALING OF PLASTIC BAGS IN A FORM FILL AND SEAL PROCESS

Abstract: The present invention relates to a method for the preparation of sealed packaging in a form, fill and seal process comprising the step of: - providing a plastic web (1) on a form, fill and seal machine; - intermittent pre-heating of said plastic web on preselected zones (4) where longitudinal seals meet cross seals; - forming and filling of the packaging; - sealing the packaging.
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IMPROVED METHOD FOR THE SEALING OF PLASTIC BAGS IN A FORM FILL AND SEAL PROCESS

Field of the invention

[0001] The present invention relates to an improved method for the sealing of plastic packaging, in particular for the sealing of contact zones where longitudinal seals meet cross seals on a packaging obtained in a vertical or horizontal form fill and seal packaging process (VFFS and HFFS process).

State of the art

[0002] Tubular bags produced on vertical and horizontal form fill and seal machines are well known by those skilled in the art of flexible packaging.

[0003] The packaging obtained in a vertical or horizontal form fill and seal packaging process, called VFFS and HFFS packaging's, often show leakages which result in bags with a lower gas barrier than targeted. The consequence of such leakages are in the best case higher scrap rates when noticed during the packaging process and in the worst case a shorter shelf life of the packed food item than promised to the consumer.

[0004] The key to lower rates of defective packaging within a form fill and seal process is a correct seal of thickened sections consisting of multiple plies and in particular the seal on the transition point from two to multiple layers of superposed plastic film between the sealing jaws. The leakages are mostly located specifically in those areas (see Fig. 1).
Various means have been tested to improve seals on plastic films. Document US 4,070,222 discloses a method for the pre-treatment of superposed layers of thermoplastic film which are to be heat-sealed together. The heat pre-treatment is performed by hot air below the welding temperature. US 4,812,192 discloses a process for cutting multiple plies of thermoplastic material to be sealed adjacent to a zipper via a heating cutting and sealing element.

**Aims of the invention**

The present invention aims to provide an improved method for the sealing of plastic bags on a vertical or horizontal form fill and seal machine. The present invention aims in particular to improve the seal quality on transition points to multiple plies, in particular in zones where longitudinal seals meet cross seals of form fill and seal packaging’s.

**Summary of the invention**

The present invention discloses a method for the preparation of sealed packaging’s in a form, fill and seal process comprising the step of:

- providing a plastic web on a form, fill and seal machine;
- intermittent preheating of said plastic web on preselected zones where longitudinal seals meet cross seals;
- forming and filling of the packaging;
- sealing the packaging.

Preferred embodiments of the present invention disclose at least one, or an appropriate combination of the following features:
- the intermittent preheating of said plastic web is performed by a hot stamp system;
- the intermittent preheating is linked to a detection of the position on the plastic web to be heated;
- the plastic web is selected from the group consisting of monolayer polymer film, coextruded and/or laminated multilayer polymer film and polymer laminates comprising metallic layer or paper, or mixtures thereof.

**Short description of the drawings**

[0010] Fig.1 to Fig.3 represent critical zones of form, fill and seal packaging's where longitudinal seals meet cross seals.

[0011] Fig.4 to Fig.6 represent the relevant part of a VFFS machinery where a preheating means (piston in this particular case) is connected to an eye-mark detection and a film-monitor counter. The eye-mark detection allows the preheating of a critical zone of the FFS packaging by applying a hot piston stamping said critical zone just before it is longitudinally sealed, filled and then cross-sealed and cut in the same step.

**Key**

25 1. Plastic reel
2. Forming tube
3. Preheating piston
4. Eye mark on the plastic film
5. Sealing jaws

30 6. Critical zone where longitudinal seals meet cross seals (preheated zone)
Detai\l description o\f the invention

[0012] The vertical or horizontal form fill and seal process is well known by those skilled in the art and can be performed on any thermoplastic polymer films.

[0013] Among those films, monolayer polymer films as well as coextruded and/or laminated multiple layer polymer films are most frequently used, each layer having its own function and at least one layer being generally dedicated to the sealing function.

[0014] The quality of a heat seal with a specific polymer film on a vertical or horizontal form fill and seal machine depends on contact time, applied pressure and temperature of the seal jaws as well as on the thickness of the polymer film.

[0015] Increasing pressure of the seal jaws does not necessarily improve the seal quality and some sealing jaws present a recess in the critical zone where longitudinal seals meet cross seals to allow a homogeneous appliance of the pressure on the seal zones of the packaging. Higher temperatures would cause shrinking or even burning of the outside layer of the plastic film in direct contact with the seal jaw. At this point, the maximum applicable temperature for a specific plastic web is reached.

[0016] The sealing performance can also be improved by increasing the sealing time (contact time). Nevertheless, increasing the sealing time will lower the speed of the packaging machine and consequently, the output of the packaging line.

[0017] An important parameter on a form fill and seal process is the sealing initiation temperature (S.I.T.) of the sealing layer of the plastic web. Sealing initiation temperatures of the most common sealing polymers, such as various types of polyethylene or polypropylene as homo or copolymer, range between 80 and 160 °C and most preferably
between 90°C and 140°C. Low melting sealing layer are generally specific polymer grades which are often more expensive.

[0018] A sufficient amount of heat energy needs to be applied to the polymer layer to be sealed. This heat energy is proportional to the temperature difference between the ambient temperature, which is the temperature of the plastic web, and the seal initiation temperature of the polymer used as seal layer of the packaging ($\Delta T = S.I.T. - T_{ambient}$).

**Illustration**

[0019] For an "expensive" very low density polyethylene, obtained for instance by metallocene catalysis, the so-called mVLDPE with a density below 0.910g/cm³, the S.I.T. is about 90°C. If the ambient temperature is 20°C, the polymer layer to be sealed is also at 20°C and the $\Delta T$ to overcome is 70°C.

[0020] For a "cheap" low density polyethylene (obtained in a high pressure reactor and with a density between 0.915 and 0.930 g/cm³), the S.I.T. is about 110°C. If the ambient temperature is 20°C, the $\Delta T$ to overcome is 90°C.

[0021] In the present invention, the $\Delta T$ is reduced by preheating the polymer layer to be sealed specifically on the critical zone where longitudinal seals meet cross seals.

[0022] In particular, a selective or partial and intermittent preheating of the single web of plastic material before the actual sealing on the sealing jaw increase the temperature of the polymer film in those critical zones from room temperature (varying between -10°C until 40°C) until a defined temperature between 50°C and
80°C with the condition that this temperature always has to be lower than the s.i.t.

[0023] It has been experimented that a continuous heating would lead to a temperature increase of the forming tube which contains the item to be packed, item which does not always resist to temperatures above 30 °C (chocolate, for instance). Intermittent preheating does not have this drawback.

[0024] Consequently when applying such an intermittent preheating, by heating means such as a piston producing a "hot stamp" for instance, in an existing form fill and seal process, the following scenarios can be exploited:

- keeping the same contact time, temperature and pressure, on the seal jaw and obtain a lower leakage rate;

- keeping the same temperature and pressure on the seal jaw but lower the contact time and therefore increase the output of the FFS machine;

- keeping the same contact time, temperature and pressure, of the seal and use an "ordinary commodity plastic material" with a higher s.i.t. and a lower price and an unchanged leakage rate.

[0025] The preheating according to the present invention is performed selectively, partially and intermittently on specific transition points before the final sealing on the plastic film and without losing the control on the coefficient of friction of said plastic film. The final goal being to save energy, to avoid product damage and to guarantee the sealing behaviour, including hot-tack properties, of the plastic film.

[0026] Preheating means are all those means allowing an intermittent and selective preheating. Among them, without being limitative, a piston with a stamp heated
electrically and a laser beam, infra-red, ultra-sonic, localised hot air, ...

Examples

5 [0027] Trials have been performed on two different sealants, a first "common" LDPE film of 50 µm and a second specific film with polyethylene obtained by a specific metallocene catalysis (more expensive).

10 Type A: Ordinary LDPE film (commodity)

[0028] 50 µm LPDE monolayer-film, produced on a conventional air-quenched blown film line, based on Dow LDPE 300 E with a density of 0.924 g/cm3 and a melt-index of 0.8 dg/min (measured at 190°C with a 2.16kg load).

15 Type B: Specific polyethylene grade (more expensive)

[0029] 50 µm mVLDPE/LDPE two-layer coextruded blown film with a sealant first layer of 10 µm mVLDPE Exact 0201FX layer with a density of 0.902 g/cm3 and melt-index of 1.1 (measured at 190°C with a 2.16kg load) and a 40 µm second layer consisting of Dow LDPE 300 E with a density of 0.924 g/cm and a melt-index of 0.8 dg/min (measured at 190°C with a 2.16kg load).

25 Leakages:

[0030] In order to identify leakages, bags are tested with the Rhodamine test. In this test, you cut away the seal and put Rhodamine solution in the seal. The seals are considered as closed if no single visible migration of Rhodamine is observed from the inside to the outside of the seal (pass-fail test).

[0031] An alternative test is the under-water Dinkelberg leakages tester with an applied under pressure
(300–760 mbar) where you insert the whole bag and you can visually check whether or not air can escape from the bag.

**Decreasing the sealing time by intermittent preheating**

5 **Example 1**

[0032] Various sealing times have been performed on the polyethylene film of type A with preheating parameters going from no preheating until a preheating to 80°C of the polymer film.

10 [0033] According to the sealing speed and the kind of polymer film, the temperature of the preheating means (piston for instance) have to be adapted to reach the desired temperature of the polymer film.

[0034] The T° of the jaws is constant at 110°C on each trial. Pressure is constant and equal to 400 N.

[0035] The seals are made and are tested with the Rhodamine test on leakages. So the result is OK / NOK (pass-fail test).
[0036] No leakage-free packaging could be obtained without intermittent preheating and with sealing times between 100 and 1000 milliseconds.

[0037] Leakage-free packaging could be obtained with intermittent preheating of the polymer film at 50°C with sealing times starting from 900 milliseconds.
Leakage-free packaging could be obtained with preheating temperatures of the film at 75°C with sealing times starting from 700 milliseconds. These examples show clearly the reduction of the sealing time obtained by intermittent preheating.

**Example 2**

Various sealing times have been performed on the polyethylene film of type B with preheating parameters going from no preheating until a preheating at 80°C.

The jaws $T^\circ$ is constant at 120°C on each trial. Pressure is constant and equal to 400 N. Pressure $p$ is constant and equal to 40 psi.

The seals are made and are tested with the Rhodamine test on leakages. So the result is OK / NOK (pass-fail test).

From the beginning, lower sealing times (500 milliseconds) were possible even without intermittent preheating.
[0043] Preheating at 50 °C of the polymer film allowed to decrease the sealing time down to 400 milliseconds.

[0044] Preheating at 80°C of the polymer film allowed to decrease the sealing time down to 300 milliseconds.
milliseconds and the speed of the packaging line could be increased.

**Conclusion**

The present invention allows either to:

- keep the same contact time, temperature and pressure, on the seal jaw and obtain a lower leakage rate;
- keep the same temperature and pressure on the seal jaw but lower the contact time and therefore increase the output of the FFS machine;
- keep the same contact time, temperature and pressure, of the seal and use an "ordinary commodity plastic material" with a higher s.i.t. and a lower price and an unchanged leakage rate.
CLAMS

1. Method for the preparation of sealed packaging's in a form, fill and seal process comprising the step of:
   - providing a plastic web on a form, fill and seal machine;
   - intermittent preheating of said plastic web on preselected zones where longitudinal seals meet cross seals;
   - forming and filling of the packaging;
   - sealing the packaging.

2. Method according to Claim 1 wherein the intermittent preheating of said plastic web is performed by a hot stamp system.

3. Method according to Claim 1 or 2 wherein the intermittent preheating is linked to a detection of the position on the plastic web to be heated.

4. Method according to any of the previous claims wherein the plastic web is selected from the group consisting of monolayer polymer film, coextruded and/or laminated multilayer polymer film and polymer laminates comprising metallic layer or paper, or mixtures thereof.
A: piston
B: eyemark detection
C: film motion counter
INTERNATIONAL SEARCH REPORT

A CLASSIFICATION OF SUBJECT MATTER

INV. B29C65/02 B65B51/26 B65B9/20
ADD. B29K23/00

According to International Patent Classification (IPC) arts, both national classifications and IPC

B RELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B29C B65B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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X Further documents are listed in the continuation of Box C

X See patent family annex

A Document defining the general state of the art which is not considered to be of particular relevance

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