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(54) Title: BAGS MADE FROM ETHYLENE COPOLYMER FILMS, AND FILMS AND USES OF SUCH COPOLYMERS FOR MAKING SUCH BAGS

(57) Abstract: The invention relates to bags with a heat seal zone formed by a composition comprising an interpolymer of ethylene and an alpha-olefin having an MI of from 1.5 to 4.5 g/10 min, preferably from 1.7 to 3.5 g/10 min, and especially from 1.8 to 2.5 g/10 min and a density of from 0.88 to 0.94 g/cm<sup>3</sup>, preferably from 0.91 to 0.93 g/cm<sup>3</sup> and especially from 0.912 to 0.922 g/cm<sup>3</sup> and a CDBI of at least 50 %, preferably at least 55 % and especially at least 60 %, and less than 20 wt% of LDPE; and to uses of films for making such bags.

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**Bags made from ethylene copolymer films, and films and uses of such copolymers for making such bags.**

[0001] The invention relates to bags made with improved sealing performance  
5 made from ethylene copolymer films, and such films and uses of such  
interpolymers for making such films, for use especially but not exclusively in high  
speed packaging lines.

Background

10 [0002] It is known to convert ethylene based copolymers made using a  
metallocene catalyst, such as in gas phase or solution or high pressure  
polymerization, into film by blown film extrusion and cast film extrusion in either  
a mono or multilayer structure. Such copolymers are sold under the trade name  
EXACT or EXCEED by ExxonMobil Chemical Company. The composition for  
15 the film may comprise a single polymer with the usual additives (anti-oxidant,  
anti-block additive etc.) It is also known to blend different polymers. An example  
of that is the use of varying amounts of low density polyethylene made in a high  
pressure free radical initiated process, referred to as LDPE, with ethylene based  
copolymers, whether made using metallocene catalyst or the conventional catalyst  
20 types produced using titanium chloride as then transition metal component. In the  
density range of from 0.91 g/cm<sup>3</sup> to 0.94 g/cm<sup>3</sup> such copolymers are often  
referred to as linear low-density polymers, LLDPE's for short. LDPE's have broad  
molecular weight distributions and contain significant long chain branching  
(LCB).

25

[0003] The conversion of the copolymer composition into film can proceed by  
two principal routes: A) blown film extrusion, which requires melt strength to  
sustain the bubble formed as it cools and the polymer composition solidifies; and  
B) cast film where the molten polymer is cooled on a chilled metal roll. Melt  
30 strength is influenced by the molecular weight (the lower the Melt Index (MI) the  
higher the melt strength at the same extrusion temperature) and LCB. Low MI's of  
around 1 g/10 min have been favored to achieve bubble stability in blown film

extrusion. MI's of over 2.5 g/10 min are favored in cast extrusion to achieve good flowability and reduced neck in. The films produced are frequently converted on the packaging line into some sort of containment structure referred to herein as a bag, which may be a pouch, a bread bag or any other type of bag. A form, fill and seal machine may be used to form the bag.

[0004] Once the film has been formed, a critical performance factor is the speed at which the packaging line can be operated. On most bag producing machines, the bottleneck that limits further speed increases of the packaging line is the speed at which the film can be sealed to form the bag. The most important indicators for high line-speed potential are

- A) the heat seal strength (HSS) at different temperatures;
- B) The hot tack influences the time taken before the product to be packed can be dropped on the freshly made seal and ensure package integrity,
- C) the seal initiation temperature (SIT), which determines the lowest temperature at which sufficient heat seal strength is developed to keep the bag closed.

[0005] A higher heat seal strength and/or a broader hot tack would provide a broader operating window, lowering the SIT and decreasing the heat seal cycle time and so increase the line speed with which the machine can reliably bag the products. It is among the objects of the invention to broaden the operating window while maintaining a reasonable balance of other properties for processability and film formation.

25

#### Summary

[0006] We have found surprisingly that small differences in the molecular weight of the ethylene interpolymers can have favorable influence on the sealing behavior of films composition comprising metallocene derived ethylene interpolymers. Such differences are less pronounced to the point of having been ignored in the past using interpolymers derived from classical titanium chloride based catalyst systems.

30

[0007] Various aspects of the invention are more clearly identified in the claims. The invention generally provides in one aspect a bag with a heat seal zone formed by a composition comprising an interpolmer of ethylene and an alpha-olefin having an MI of from 1.5 to 4.5 g/10 min, preferably from 1.7 to 3.5 g/10 min, and especially from 1.8 to 2.5 g/10 min and a density of from 0.88 to 0.94 g/cm<sup>3</sup>, preferably from 0.91 to 0.93 g/cm<sup>3</sup>, and especially from 0.912 to 0.922 g/cm<sup>3</sup> and a CDBI of at least 50, preferably at least 55 % and especially at least 60 %, and less than 20 wt% of LDPE. Within the scope of the invention, more than one interpolmer may be used, preferably differing by less than 0.5 in MI g/10 min and less than 0.01 g/cm<sup>3</sup> in density.

[0008] The interpolmer is preferably of the type containing short chain branches derived from an alpha-olefin comonomer having from 4 to 8 carbon atoms, and preferably from butene-1, hexene-1 and/or octene-1. Such interpolymers may be made in solution processes, high-pressure processes and heterogeneous processes such as gas phase or slurry polymerization using a transition metal catalyst. The inter-polymers are preferably obtained through processes using single site transition metal catalysts such as metallocene which may be used with activating systems of various types such as aluminum alkyl derivatives, including alumoxane, and/or non-co-ordinating anions such as various boranes or borates. Such catalysts preferably are associated with the presence of Zr or Hf catalyst residues.

[0009] It is believed that the effect will be most pronounced by using homogeneous polymer compositions as far as possible. Suitably the heat seal zone is formed by a composition comprising a composition comprising from 85 wt % to 100 % of the ethylene interpolmer, preferably at least 90% of the ethylene interpolmer, and especially at least 95 wt % and, a balance of an interpolmer of ethylene and an alpha-olefin having a CDBI less than 50 % and/or LDPE. Some long chain branching may be present. However preferably the composition of the heat seal zone contains less than 5 wt % of an LDPE material made in an

autoclave or tubular reactor, which generally have a broad molecular weight distribution and significant levels of long chain branches that lead to shear sensitive behavior.

5 [0010] Processing into film of compositions referred to above can be facilitated in blown film extrusion by extruding at a lower temperature to compensate for the lower melt strength resulting from the higher MI. Where the machinery permits, the extrusion temperature can be maintained and the output increased. Use of LDPE as a processing aid can then be reduced or avoided,  
10 minimizing the associated disadvantageous effect on the film properties such as reduction in impact strength.

[0011] Suitably the bags are of films have a heat seal strength of more than 50% of the maximum heat seal strength at less than 105 °C and/or a maximum  
15 hot tack force at a temperature of less than 110 °C.

[0012] Film can be adapted for use in making bags according to the invention by providing a heat seal zone extending over at least one surface of the film. The film may then be a mono-layer film consisting substantially of the inter-polymer  
20 throughout or it may be a multi-layer film, with three or five or more layers, formed by coextrusion or lamination so as to provide a heat zone face on one or both sides.

[0013] In another aspect of the invention there is provided the use of an  
25 interpolymer of ethylene and an alpha-olefin having an MI of from 1.5 to 4.5 g/10 min , preferably from 1.7 to 3.5 g/10, and especially from 1.8 to 2.5 g/10 and a density of from 0.88 to 0.94 g/cm<sup>3</sup>, preferably from 0.910 to 0.93 g/cm<sup>3</sup>, and especially from 0.912 to 0.922 g/cm<sup>3</sup> and a CDBI of at least 50, preferably at least 55 % and especially at least 60 %, and less than 20 wt% of LDPE for improving  
30 the hot tack and/or seal strength of a film having a heat seal zone made from such inter-polymer, and preferably so that the film has a heat seal strength of more than

50% of the maximum heat seal strength at less than 105 °C and/or a maximum hot tack force at a temperature at less than 110 °C. Such use can help speed up the packaging line speed without significant disadvantage for film properties or film extrusion capacity.

5

#### Measurements

[0014] Calculations involved in the characterization of polymers by C<sup>13</sup> NMR for comonomer content follow the work of F.A. Bovey in "Polymer Confirmation and Configuration" Academic Press, New York, 1969. For example  
10 hexene content was determined using C<sup>13</sup> NMR integrating the 2B4 peak at 23.4 ppm.

[0015] The Melt Index was determined according to ASTM-1238 Condition E  
15 190 °C, 2.16kg.

15

[0016] Density was determined according to ASTM D4883 on plaques prepared according to ASTM D1928.

[0017] Composition Distribution Breadth Index (CDBI) is measured by the  
20 procedure described in PCT publication WO93/03093, published Feb 18, 1993. Fractions having a molecular weight (Mw) less than 15,000 were ignored.

[0018] Mw and Mn were measured by GPC (Gel Permeation  
25 Chromatography) on a Waters 150 gel permeation chromatograph equipped with a differential refractive index (DRI) detector and Chromatix KMX-6 on line light scattering photometer. The system was used at 135°C with 1,2,4-trichlorobenzene as the mobile phase. Shodex (Showa Denko America, Inc) polystyrene gel columns 802, 803, 804 and 805 were used. This technique is discussed in "Liquid Chromatography of Polymers and Related Materials III", J. Cazes, editor, Marcel  
30 Dekker. 1981, p. 207, which is incorporated herein by reference. No corrections for column spreading were employed; however, data on generally accepted

standards, e.g. National Bureau of Standards Polyethylene 1484 and anionically produced hydrogenated polyisoprenes (an alternating ethylene-propylene copolymer) demonstrated that such corrections on Mw/Mn (=MWD) were less than 0.05 units. Mw/Mn was calculated from elution times. The numerical analyses were performed using the commercially available Beckman/CIS customised LALLS software in conjunction with the standard Gel Permeation package.

[0019] The heat seal strength (and energy if required) determine the firmness of the seal established at the end of the packaging line after the seal has cooled and stabilized. The procedure for testing it is as follows. Seals were made on a J&B instruments sealing machine. The film was folded between TEFLON<sup>TM</sup> film and inserted between the sealing bars. At various temperatures, the sealing bars were closed with a pressure of 0.5 MPa for 0.5 seconds. The film was removed from the J&B machine and conditioned for a minimum of 12 hours at 23°C +/- 3°C and 50 % +/-5% humidity.

[0020] Seal strength was tested according to the following procedure. After conditioning for a minimum of 12 hours at 23°C +/-3°C and 50% +/- 5% humidity, the seal strength of 15 mm wide sample was measured in a Zwick tensile instrument under the following conditions: speed 500 mm/min, load cell-200N, and clamp distance 50 mm. The film was placed between the clamps and the clamps were moved apart at a speed of 500mm/min. During the test the force (N) was recorded as a function of elongation (%). Four test specimens were measured and the average seal strength curve was recorded. The seal strength was the force at which the test specimen registered the maximum force. This is reported in N/15mm. The seal energy is the integration of the stress/strain curve. The seal energy is the amount of energy (J) necessary to break a seal reportable in J/15mm.

30

[0021] The hot tack determines the initial seal strength before the film has had much opportunity to cool and represents the force that holds the seals of a bag

together on a packaging line after initial sealing for the remainder of the operations on the packaging line. It was measured in the Examples as follows. Seals were made on a J&B instruments sealing machine. The films are laminated to a PET backing tape to prevent stickiness to the sealing bars. Taped films are  
5 conditioned at  $23 \pm 3^\circ\text{C}$  and  $50 \pm 5\%$  humidity during a minimum of 12 hours before measuring the hot tack force. Samples were cut into strips of  $30 \pm 0.5$  mm width with a minimum length of 40 cm using a 30 mm Karl Frank cutter. At various temperatures, the sealing bars are closed with a pressure of 0.5 MPa for 0.5 seconds. The seals are allowed to cool down during 0.4 seconds after which  
10 the hot tack force is measured by applying a force to opposed sides of the seal according to the following conditions: speed 200 mm/min, a load cell of a piëzo crystal with a sensitivity between 0-100 N. During the test the force (N) was recorded as a function of elongation (%). Four test specimens were measured and the average maximum seal force was recorded. The hot tack strength is the force  
15 at which the test specimen registered the maximum force. This is reported in N/30mm.

[0022] The information from the seal strength and hot tack measurements can be used to assess the seal initiation temperature (SIT). A threshold seal strength  
20 can be defined and the temperature at which that threshold is reached. A realistic assessment is possible using the heat seal strength data as obtained above and by setting a fixed threshold such as 4 N/15 mm or a threshold expressed as a fraction of the maximum seal strength such as 50% depending on the application.

## 25 Examples

[0023] The starting compositions for the films are as follows:



Table 1

Sample	Grade Designation	Monomer types	Comonomer content wt%	Melt Index g/10 min	Mw/Mn	Density g/cm <sup>3</sup>	CDBI %
A	Exceed MX2027ED*	E-H 1)	5.1	2.0	2.3	0.927	59
B	Exceed ML1027FE*	E-H	4.7	1.0	2.3	0.927	59
C	Exceed 1018CA*	E-H	8.0	1.0	2.3	0.918	67
D	Exceed ECD357*	E-H	8.6	2.0	2.3	0.918	67
E	Exceed 2518CB*	E-H	8.8	2.5	2.3	0.918	67
F	Exceed 3418CB*	E-H	9.1	3.5	2.3	0.918	67
G	Escorene LD 185 BW**	LDPE	N/A	2.0	4.9	0.922	N/A
H	ExxonMobil LL1001XV** *	E-B 2)	8.0	1.0	3.5	0.918	N/A
I	ExxonMobil LL1004YB** *	E-B	8.5	2.8	3.5	0.918	N/A
J	ExxonMobil LL1002YB** *	E-B	8.8	2.0	3.5	0.918	N/A

5 [0024] [026] EXCEED<sup>TM</sup> is a trade name owned by ExxonMobil Chemical Company.

1) E-H indicates ethylene hexene-1 copolymer.

2) E-B indicates ethylene butene-1 copolymer.

10

\* These grades are produced using a non-bridged bis cyclopentadienyl metallocene catalyst and alumoxane supported on silica in a gas phase process.

\*\* This grade is produced in high-pressure polymerization using free-radical initiation on a tubular reactor.

5 \*\*\* These grades are produced using a titanium chloride based catalyst and aluminum alkyl supported on silica in a gas phase process.

[0025] In the table FE stands for grades containing a blown film additive package containing 1250 ppm erucamide, 750 ppm anti-block additive and anti-oxidant package and polymer processing aid. CA stands for a blown film additive  
10 package containing only anti-oxidant and polymer processing aid. CB and YB stand for cast film additive packages containing an anti-oxidant package only and acid scavenger. XV stand for blown film additive package, anti-oxidant package and acid scavenger. BW stands for a blown film additive package containing an anti-oxidant package only.

15

#### Mono-layer films

[0026] Mono-layer films were blown on an Alpine extruder under the conditions in Table 2A (50µm thick) and Table 2B (25 µm thick). Test data for the resulting films are reported in Table 3 to 9. The comparative examples, not  
20 according to the invention are marked with an asterisk.

Table 2A

50  $\mu\text{m}$  mono-layer films:

Polymer Sample	H* MI=1.0 D=0.918	J* MI=2.0 D=0.918	I* MI=2.8 D=-0.918	C MI=1.0 D=0.918	D MI=2.0 D=0.918	E MI=2.5 MI=0.918	F MI=3.5 D=0.918	K=80% C + 20% G	L=80% + 20%
Film Sample	I	II	III	IV	V	VI	VII	VIII	IX
Barrell Temp									
Settings (°C)									
Zone 1	180	180	180	180	180	175	175	190	190
Zone 2	180	180	180	180	180	175	175	190	190
Zone 3	180	180	180	180	180	175	175	190	190
Zone 4	180	180	180	180	180	175	175	190	190
Zone 6	180	180	180	180	180	175	175	190	190
Zone 7	180	180	180	180	180	175	175	195	195
Zone 8	180	180	180	180	180	175	175	195	195
Zone 9	180	180	180	180	180	175	175	195	195
Zone 10	190	180	180	190	180	175	175	200	200
Zone 11	190	180	180	190	180	175	175	200	200
Zone 12	200	180	180	200	190	175	175	200	200
Diegap (mm)	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1	1
Cooling Air Temp (°C)	21	21	23	22	22	20	20	16	16
Die Diameter (mm)	200	200	200	200	200	200	200	200	200
Melt Temp (°C)									
T1	193	191	185	205	197	193	185	212	206
T2	201	194	188	207	201	200	190	219	211
T3	203	196	190	208	203	203	191	224	214
T4	200	194	188	207	200	200	189	219	210
T5	191	190	184	201	195	191	183	210	204
T Melt	189	188	181	202	193	188	181	208	202
Melt Pressure (Bar)									
P1	250	191	154	90	88	75	121	620	447
P2	288	223	191	250	190	189	191	530	533
P3	291	244	217	312	150	166	212	420	281
P4	413	309	289	475	350	293	277	641	471
P5	418	303	286	489	333	309	275	643	474
P6	269	274	257	453	312	288	253	360	367
Screw Speed (RPM)	38	40	44	38	44	44	40	52	56
Output (Kg/H)	78	78	82	80	80	78	78	121	122
Lay-Flat (mm)	781	785	786	785	785	789	777	785	785
BUR	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Haul-off Speed (m/min)	18	18	18	18	18	18	19.7	28	28
Thickness ( $\mu\text{m}$ )	50	50	50	50	50	50	46	50	50

Table 2B

25  $\mu\text{m}$  mono-layer films:

Polymer Sample	C MI=1.0 D=0.918	D MI=2.0 D=0.918	B MI=1.0 D=-0.927	A MI=2.0 D=0.927
Film Sample	X	XI	XII	XIII
Barrell Temp Settings ( $^{\circ}\text{C}$ )				
Zone 1	180	190	170	175
Zone 2	190	180	175	180
Zone 3	190	175	175	180
Zone 4	190	180	175	180
Zone 6	190	180	185	185
Zone 7	190	180	185	185
Zone 8	190	180	185	185
Zone 9	190	180	190	190
Zone 10	190	180	190	190
Zone 11	200	190	200	200
Zone 12	200	190	200	200
Diegap (mm)	1.5	1.5	1.5	1.5
Cooling Air Temp ( $^{\circ}\text{C}$ )	20	19	19	19
Die Diameter (mm)	200	200	200	200
Melt Temp ( $^{\circ}\text{C}$ )				
T1	224	213	200	199
T2	238	225	206	196
T3	243	229	211	199
T4	237	224	205	196
T5	221	210	198	200
T Melt	213	203	197	193
Melt Pressure (Bar)				
P1	278	107	N/A	N/A
P2	358	N/A	114	245
P3	119	N/A	113	46
P4	471	345	589	531
P5	524	396	625	533
P6	209	192	246	328
Screw Speed (RPM)	61	71	49	46
Output (Kg/H)	121	123	121	122
Lay-Flat (mm)	785	785	785	785
BUR	2.5	2.5	2.5	2.5
Haul-off Speed (m/min)	56	56	56	56
Thickness ( $\mu\text{m}$ )	25	25	25	25

[0027] The sealing behavior was as follows:

Table 3A

50  $\mu\text{m}$  film

Polymer Sample	H MI=1.0 D=0.918	J MI=2.0 D=0.918	I MI=2.8 D=0.918	C MI=1.0 D=0.918	D MI=2.0 D=0.918	E MI=2.5 MI=0.918	F MI=3.5 D=0.918	K=80%C +20%G	L=80% +20%
Film Sample	I	II	III	IV	V	VI	VII	VIII	IX
Hot Tack Force									
90 (all in C)	0.2	0.3	0.2	0	0	0	0	0	0
95	0.3	0.2	0.2	0.1	0	0.1	0.1	0	0.1
100	0.2	0.4	0.7	0.4	1	0.7	1.3	0.9	1.3
105	1.3	0.9	2.2	5	12.8	6	5.4	4.1	6.6
107	1.9	1.4	2	6.4	13.5	11.3	12.5	8.3	12.8
110	3.2	2.2	3	12.9	13.4	12.8	12.6	15.2	14.6
115	6.7	4.7	4.7	15.7	10.3	11.4	10.8	13.7	13.5
120	4.8	4.4	4.1	11.4	9.2	6.6	6.1	9.6	7
125	3.9	3	3.2	9.5	6.7	5.6	6.4	7.5	6.1
130	4.3	3.4	3.4	7.3	7.4	5.9	5.7	6.9	5.9
140	4.2	3.4	2.9	6.4	5.3	4.3	4.2	5.6	5.3
Heat Seal Strength									
95	0.4	0.3	0.3	0.1	0.1	0.2	0.2	0.2	0.1
100	0.7	0.6	0.6	0.3	7.2	5	3.5	0.4	0.3
105	1.8	1.3	1.8	8	8.2	7.9	7.6	8.5	8.9
110	8.5	7.2	8.2	9.8	8.9	8.8	8.5	12.1	11.8
115	9.6	9	9.4	10.9	9.5	9.7	10.5	13.5	13.0
120	10.7	10.1	10.6	12.3	10.7	11.1	12.2	16.4	14.5
125	12.9	10.9	11	11.8	11.3	11.6	11.7	15.7	15.0

Table 3B

25 µm mono-layer films:

Polymer Sample	C MI=1.0 D=0.918	D MI=2.0 D=0.918	B MI=1.0 D=0.927	A MI=2.0 D=0.927
Film Sample	X	XI	XII	XIII
Hot Tack Force				
90 (all in C)				
95				
100	0.3	2.2		
105	3.2	9.1	0.2	0.1
110	6.2	8.2	0.3	0.5
115			1.7	8.7
117				6.2
120	7.2	6.5	5.6	6.2
125			9.1	5.2
130	4.9	5	6.7	5.2
135			4.9	4.7
Heat Seal Strength				
95	0	0.2		
100	0.4	3.1		
105	4	4.2		
110	4.7	5	0.1	0.2
115	5.8	5.5	0.1	1.1
120	5.7	5.8	0.5	6.3
125			6.3	7.2
130			7.0	6.8
140			7.4	7.6

[0028] The hot tack and heat seal strength data are converted into graphs.

[0029] Figure 1 plots the heat seal strength data from Table 3A for 50  $\mu\text{m}$  thick films. Sufficient seal strength is developed at 100  $^{\circ}\text{C}$  and above. With  
5 LLDPE grades made from metallocene based catalyst systems, the plots vary with MI. A material improvement is provided an MI of above 1.5 g/10 min. The Table 3B show that the effect is also observable for films of 25  $\mu\text{m}$ . Table 3B also shows that the shift is observable at different densities

10 [0030] Figure 2 plots the hot tack data from Table 3A for 50  $\mu\text{m}$  thick films. The 2.0 MI Exceed grade D provides significant hot tack forces below 105  $^{\circ}\text{C}$ . The grade conventionally used for blown film extrusion is the 1.0 MI grade, which develops hot tack only above 105  $^{\circ}\text{C}$ . Corresponding LL grades made using a titanium chloride based catalyst do not develop equivalent hot tack forces.  
15 Such LL grades do not show significant variations of hot tack with different MI.

[0031] Figure 3 plots the heat seal strength for the blends with 20 wt% LDPE. Addition of such levels of LDPE reduces the beneficial effects of the invention.

## CLAIMS

1. Bag with a heat seal zone formed by a composition comprising an  
5 interpolymer of ethylene and an alpha-olefin having an MI of from 1.5 to 4.5 g/10 min, preferably from 1.7 to 3.5 g/10 min, and especially from 1.8 to 2.5 g/10 min and a density of from 0.88 to 0.94 g/10 min, preferably from 0.91 to 0.93, g/cm<sup>3</sup> and especially from 0.912 to 0.922 g/cm<sup>3</sup> and a CDBI of at least 50 %, preferably at least 55 % and especially at least 60  
10 %, and less than 20 wt% of LDPE.
2. Bag according to claim 1 in which the interpolymer contains short chain branches derived from an alpha-olefin comonomer having from 4 to 8 carbon atoms, and preferably from butene-1, hexene-1 and/or octene-1 or  
15 mixtures thereof.
3. Bag according to Claim 1 or Claim 2 in which the ethylene interpolymer is characterized by the presence of Zr or Hf catalyst residues.
- 20 4. Bag according to any of the preceding claims in which the heat seal zone is formed by a composition comprising from 85 wt % to 100 % of the ethylene interpolymer, preferably at least 90% of the ethylene interpolymer, and especially at least 95 wt % and, a balance of an interpolymer of ethylene and an alpha-olefin having a CDBI less than 50  
25 % and/or LDPE.
5. Bag according to any of the preceding claims, in which the heat seal zone is formed by a composition comprising less than 5 wt % of LDPE.
- 30 6. Bag according to any of the preceding claims in which the film has a heat seal strength of more than 50% of the maximum heat seal strength at less



than 105 °C and/or a maximum hot tack force at a temperature of less than 110 °C.

7. Bag according to any of the preceding claims, in which the bag is formed  
5 from a multi-layer film having a heat seal zone on at least one side.
8. Film suitable for producing a bag according to any of the preceding claims  
having a heat seal zone extending over at least one surface of the film.
- 10 9. Film according to claim 8 which is a multi-layer film, with from three to  
six layers, formed by coextrusion or lamination so as to provide a heat  
zone face on each side.
- 15 10. Use of an interpolymer of ethylene and an alpha-olefin having an MI of  
from 1.5 to 4.5 g/10 min, preferably from 1.7 to 3.5 g/10 min, and  
especially from 1.8 to 2.5 g/10 min and a density of from 0.88 to 0.94  
g/cm<sup>3</sup>, preferably from 0.91 to 0.93 g/cm<sup>3</sup>, and especially from 0.912 to  
0.922 g/cm<sup>3</sup> and a CDBI of at least 50, preferably at least 55 % and  
especially at least 60 %, and less than 20 wt% of LDPE for improving the  
20 hot tack and/or seal strength of a film having a heat seal zone made from  
such inter-polymer, and preferably so that the film has a heat seal strength  
of more than 50% of the maximum heat seal strength at less than 105 °C  
and/or a maximum hot tack force at a temperature at less than 110 °C.



FIGURE 2 : Hot Tack at 50  $\mu\text{m}$ , 0.918  $\text{g}/\text{cm}^3$  (TABLE 3A)

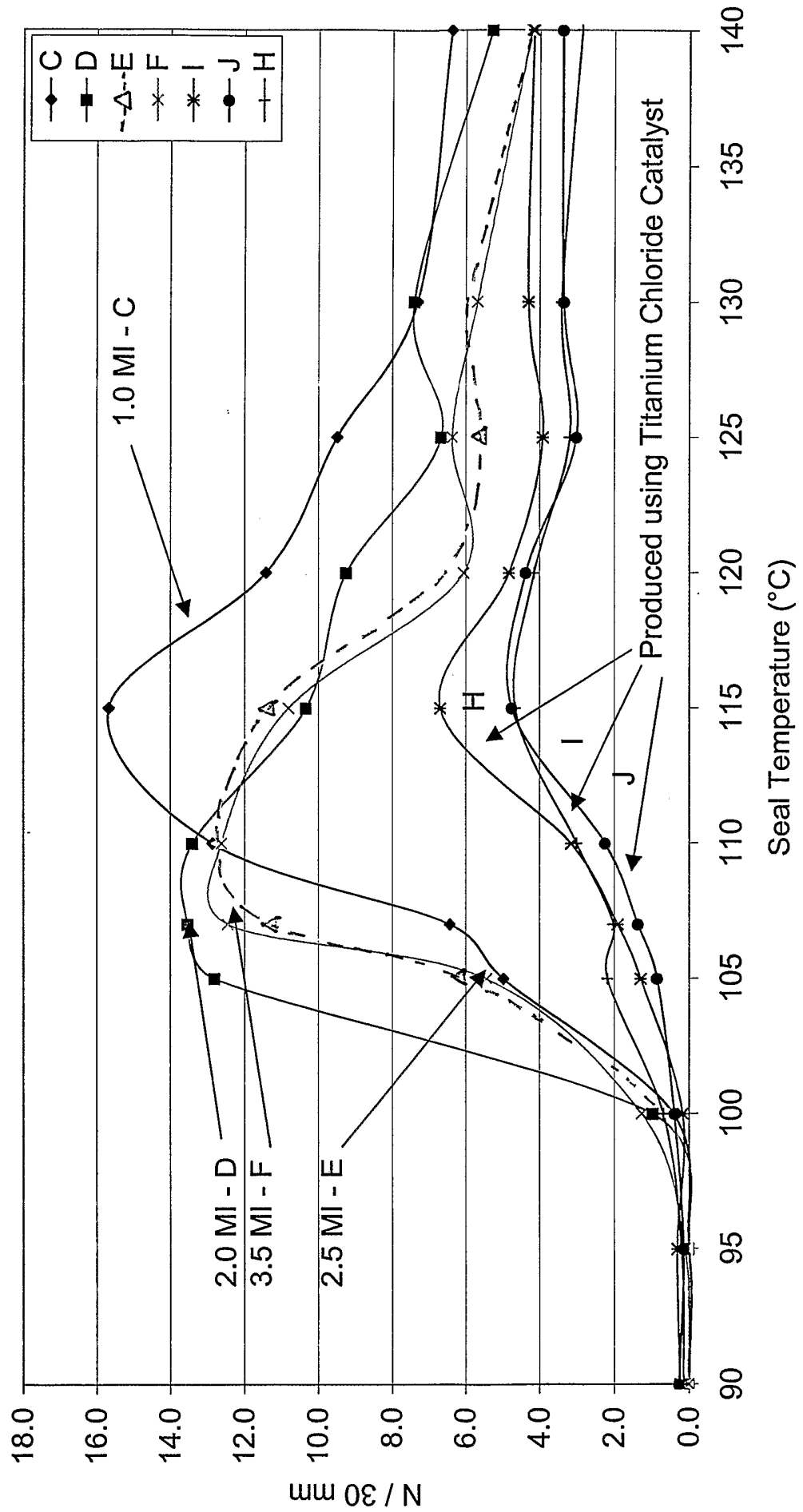
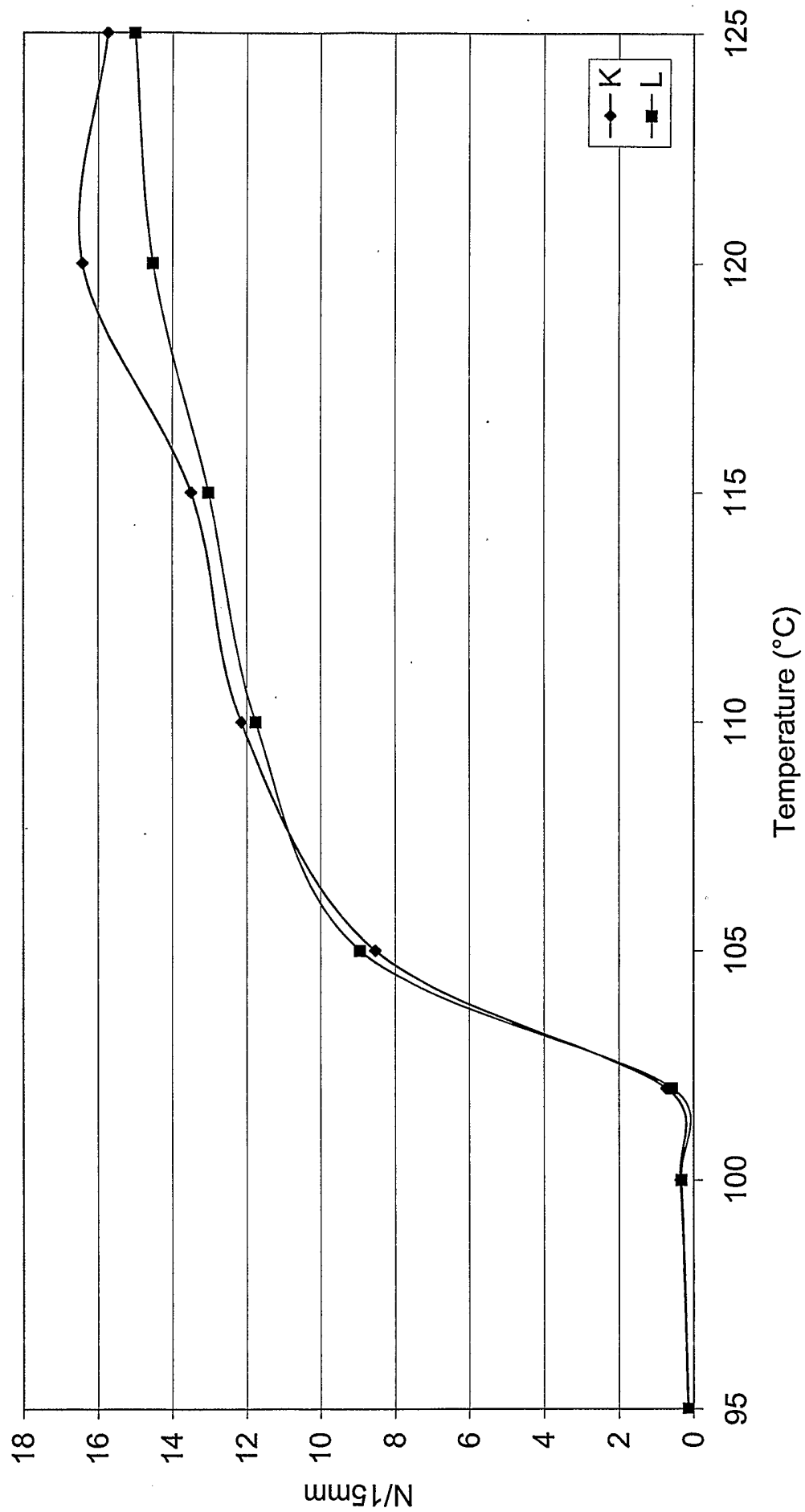


FIGURE 3: Heat Seal Exceed/LD blends 50  $\mu\text{m}$



<p><b>A. CLASSIFICATION OF SUBJECT MATTER</b>                  IPC 7 C08L23/08 C08J5/18</p>		
<p>According to International Patent Classification (IPC) or to both national classification and IPC</p>		
<p><b>B. FIELDS SEARCHED</b></p>		
<p>Minimum documentation searched (classification system followed by classification symbols)                  IPC 7 C08L C08J</p>		
<p>Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched</p>		
<p>Electronic data base consulted during the international search (name of data base and, where practical, search terms used)                  EPO-Internal, WPI Data</p>		
<p><b>C. DOCUMENTS CONSIDERED TO BE RELEVANT</b></p>		
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<p><input checked="" type="checkbox"/> Further documents are listed in the continuation of box C.      <input checked="" type="checkbox"/> Patent family members are listed in annex.</p>		
<p>* Special categories of cited documents :</p> <p>*A* document defining the general state of the art which is not considered to be of particular relevance</p> <p>*E* earlier document but published on or after the international filing date</p> <p>*L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>*O* document referring to an oral disclosure, use, exhibition or other means</p> <p>*P* document published prior to the international filing date but later than the priority date claimed</p> <p>*T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>*X* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone</p> <p>*Y* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.</p> <p>* &amp; * document member of the same patent family</p>		
<p>Date of the actual completion of the international search  1 December 2004</p>		<p>Date of mailing of the international search report  10/12/2004</p>
<p>Name and mailing address of the ISA                  European Patent Office, P.B. 5818 Patentlaan 2                  NL - 2280 HV Rijswijk                  Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,                  Fax: (+31-70) 340-3016</p>		<p>Authorized officer  Schmidt, H</p>

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PCT/EP2004/008425

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Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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