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- (73) Patenthaver: **ERGIS S. A., ul. Tamka 16, 00-349 Warszawa, Polen**
- (72) Opfinder: **Lukomska, Agnieszka, ERGIS S.A., ul. Tamka 16, 00-349 Warszawa, Polen**
Knor, Marek, ERGIS S.A., ul. Tamka 16, 00-349 Warszawa, Polen
- (74) Fuldmægtig i Danmark: **Dennemeyer & Associates S.A, P.O. Box 700425, DE-81304 Munich, Tyskland**
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DESCRIPTION

[0001] The invention relates to multilayer stretch film and the method for producing the multilayer stretch film.

[0002] Stretch films are widely used in many areas of economy: in packaging, food, construction industry, in transport among others. Due to universal use of this type of products and the increasing production of stretch film, manufacturing technologies in this sector are also being developed. There are two basic methods for producing stretch film - the method of extrusion by air blast and the currently dominating method performed with the use of slit heads (the so called "cast" or "slit"). In the case of the slit method, the raw material is pre-plasticised in one or several extruders and then extruded at higher temperature by flat and narrow slit or slits, and having left the slits the film is stretched and cooled down on rotating rollers. The stretch films are commonly produced from polyolefins, including mostly copolymers of polyethylene of different density (e.g. linear LDPE, LLDPE, VLDPE, ULDPE), copolymers from metallocene catalysis, etc. The film of this type may include additives (e.g. polypropylene). Currently produced films consist usually of more than one layer and the layers may have different raw material composition. In practice they may consist of from several up to several dozen of layers. This allows the film to have better (compared to one-layer film) performance parameters, such as strength, impact resistance, stretchability, among others, while preserving relatively small thickness.

[0003] The Polish patent specification No. PL 223808(B1) entitled "*Polyolefin five-layer stretch type film*" reveals the stretch film consisting of five layers, consisting respectively of copolymer of ethylene with n-hexane, with MFR of 4.0 g/10 min; the mixture of the above-mentioned copolymer of ethylene with n-hexene and the copolymer of ethylene with n-hexene obtained in metallocene catalysis with 50/50% proportions; the mixture of the above-mentioned copolymer of ethylene with n-hexene with the mass percentage of 60% and with 40% of polypropylene with MFR of 5.0 g/10 min; and the mixture of 80% by mass of the above-mentioned copolymer of ethylene with n-hexene with 20% of copolymer of ethylene with n-hexene from the metallocene catalysis with MFR of 3.0 g/10 min.

[0004] Another Polish patent specification, No. PL 182545(B1), reveals the method for producing the multilayer polyethylene film, and the maximum number of layers is not defined. The method involves extrusion of the mixture of the linear low-density polyethylene (LLDPE) and the low-density polyethylene (LDPE) with specific mass proportion (LDPE accounts for 8-40% of the mixture) and feeding the extruded mixture to the rollers interacting in determined conditions.

[0005] The European patent specification No. EP 2799235 (A1) entitled "*Multilayer films*" reveals the multilayer stretch film consisting of many (from 6 to even 2000) 10-50µm layers consisting of linear low-density polyethylene (LDPE). In this document, it is optionally specified that LDPE may constitute the copolymer of ethylene with octene, may have density of 0.918

g/cm³, MFR of 3.7 or 4.0 g/10 min, it is also specified that the layers may consist of the same type of LDPE in each layer. In this case the improvement of properties of the stretch film would not result from combining (melting) layers of different composition, but from the very layering of the film.

[0006] And the Patent application entitled "*Stretch wrapping film*" published under number WO 2016094281(A1) reveals the multilayer stretch film with at least one layer composed of ionomer, which is the copolymer of ethylene and methacrylic acid (1-25%) and acrylic acid (1-99%). At least one of the remaining layers contains polyolefins and does not contain ionomers and preferably there is also a layer with adhesive properties (adhesive layer).

[0007] International patent application published under the no. WO 2016/106123 entitled "*Multilayer heat-shrinkable film comprising a plurality of microlayers*" presents heat-shrinkable multilayer film made of blend of polymers, including polypropylene copolymer, having at least one bulk layer and at least one microlayer section comprising at least 10 microlayers, where each microlayer has at least half thickness of the bulk layer. Overall density of the heat shrinkable film according to said application is less or equal to 0,911 g/cc.

[0008] The state of the art includes a number of other solutions describing multilayer films and the methods for producing them. These solutions differ in the type of copolymers included in particular layers, MFR index, frequently they also contain additional ingredients. The main problem is to obtain the film with as small thickness as possible and, at the same time, to either maintain or improve its performance properties, including mostly the stretchability, adhesion, the maintained strength of the film after being stretched, and obtain the best possible dart impact resistance, etc. The final properties of the stretch film usually result from the synergy of layers which in the final product melt into each other. Hence, not only thickness, quantity and composition of layers are important, but also their proper sequence of distribution in the film.

[0009] As a result of numerous production tests, the stretch film with perfect performance properties has been developed, while maintaining small thickness and therefore providing considerable material savings.

[0010] According to the invention, the solution is the film consisting of at least 7 layers, with a central layer, 2 outer layers, 2 blocks of microlayers and at least 2 intermediate layers, where at least 1 layer of film consists of 50-99% of the copolymer propylene with ethylene with ethylene content ranging from 1-10%, mixed with other copolymer of propylene with ethylene, with ethylene content ranging from 3-20% or with elastomer. The main component is the linear low-density polyethylene with density ranging from 0.912 to 0.935 g/cm³ and the mass flow rate ranging from 0.5 to 10 g/10 min. (2.16 kg, 190°C), with the total percentage in the film composition ranging from 50 to 95%. Between the outer layers and the central layer, there are two blocks of layers with the percentage by volume compared to the volume of the entire film ranging from 10 to 60%, and each block of the layers is placed between core and one of the outer layer and consists of at least 10 microlayers with the thickness of less than 0.5 µm per each one, preferably less than 0.2 µm. The already mentioned blocks of thin layers may

consist of both the layers with identical and different composition, and, additionally, they may be separated from both the central layer and the outer layers by at least one additional intermediate layer. At least one layer of the film (preferably the intermediate layer) contains LLDPE with density ranging from 0.912 to 0.935 g/cm³ and mass flow rate ranging from 0.5 to 10 g/10 min (190°C, 2.16 kg) in the amount of 50-90% and the polypropylene copolymer in the amount of 1-10% or elastomer. The polypropylene or elastomer added to the intermediate layer may come from the raw material which has been either materially recycled and recovered from offcuts, or other post-production waste of the stretch film.

[0011] The elastomer may be one of the following components: copolymer of ethylene and methyl acrylate; copolymer of ethylene and ethyl acrylate; copolymer of ethylene and butyl acrylate; block copolymer of hydrogenated isoprene and styrene; block copolymer of propylene and ethylene, copolymer of styrene and isoprene; copolymers of styrene and hydrogenated isoprene; terpolymer of styrene, hydrogenated isoprene and hydrogenated butadiene; terpolymer of ethylene, propylene and butene.

[0012] The total percentage of intermediate layers (between the central layer and outer layers) ranges from 50 to 80 % by volume of the entire film.

[0013] Preferably overall share of the blocks of microlayers constitutes 10-60% volume of the entire film.

[0014] One of the film layers may contain ultra low-density polyethylene (ULDPE) ranging from 0.880 to 0.910 g/cm³.

[0015] In turn, the linear low-density polyethylene (LLDPE) may be preferably the copolymer of ethylene with α -olefin (butene, octene or hexene) from synthesis on Ziegler-Natta-type catalyst, metallocene catalyst or post-metallocene catalyst with specific density ranging from 0.915 to 0.925 g/cm³ and the mass flow rate ranging from 2.5 to 5 g/10 min (2.16 kg, 190°C).

[0016] According to the invention, the film may contain at least one layer containing mixture of copolymer of polypropylene with ethylene and terpolymer-propylene with ethylene and butene, with the propylene percentage in the mixture ranging from 50 to 99%.

[0017] Any of the layers may contain mixture of copolymer of polypropylene with ethylene and the copolymer of polypropylene with α -olefin (e.g. butene, hexene, octene) with the propylene percentage ranging from 50 to 99%.

[0018] Regarding the outer layer, it preferably contains copolymer of propylene with α -olefin such as ethylene or butene. In another, advantageous variant of the solution, one of the outer layers comprises mixture of 40-99% of plastomer being α -olefin copolymer of ethylene (where α -olefin may be butene, hexene, octene) with specific density ranging from 0.860 to 0.910 g/cm³ (preferably 0.880-0.905 g/cm³) and the mass flow rate ranging from 0.5 to 10 g/10 min.

(190°C, 2.16 kg) (preferably 4-8.5 g/10 min.) with α -olefin copolymer of LLDPE (where α -olefin may be butene, hexene, octene) with specific density ranging from 0.912 to 0.940 g/cm³ (preferably 0.912-0.920 g/cm³) and the mass flow rate ranging from 0.5 to 10 g/10 min. (190°C, 2.16 kg), preferably 2.5-5 g/10 min.

[0019] In another variant of the solution compliant with the invention, at least one of the outer layers comprises mixture of α -olefin copolymer of ultra low-density polyethylene (where α -olefin may be butene, hexene, octene) with specific density ranging from 0.880 to 0.910 g/cm³ (preferably 0.900-0.910 g/cm³) and the mass flow rate ranging from 0.5 to 10 g/10 min. (190 °C, 2.16 kg) (preferably 3-6 g/10 min.) with α -olefin copolymer of LLDPE (where α -olefin may be butene, hexene, octene) with specific density ranging from 0.912 to 0.940 g/cm³ (preferably 0.912-0.920 g/cm³) and the mass flow rate ranging from 0.5 to 10 g/10 min. (190 °C, 2.16 kg), preferably 2.5-5 g/10 min.

[0020] The opposite, outer layer preferably comprises mixture of α -olefin copolymer of ethylene (where α -olefin may be butene, hexene or octene) with specific density ranging from 0.925 to 0.960 g/cm³ and the mass flow rate ranging from 0.5 to 10 g/10 min. (190°C, 2.16 kg), preferably 2.5-5 g/10 min., with α -olefin copolymer of LLDPE (where α -olefin may be butene, hexene, octene) with specific density ranging from 0.912 to 0.925 g/cm³ and mass flow rate ranging from 0.5 to 10 g/10 min. (preferably 2-4 g/10 min.).

[0021] In the next variant of the solution, the intermediate layer may consist of 1-5 thinner alternate layers.

[0022] In the disclosed method for producing the multilayer film compliant with the invention, the film is produced by extruding linear low-density polyethylene LLDPE (0.912-0.935 g/cm³) and with mass flow rate ranging from 0.5 to 10 g/10 min. (190°C, 2.16 kg), with the percentage by volume ranging from 50 to 95%, and the copolymer of propylene containing 1-10% of ethylene, mixed with the copolymer of propylene with ethylene, with the ethylene content ranging from 3 to 20%, then these raw materials are extruded through the slit head at the temperature ranging from 260 to 300°C and stretched by cooling down the extruded film in a way that the film crystallization and solidification takes place 0.05-1 second after the material leaves the head.

[0023] The invention is applied in production of widely used multilayer stretch films, from the films used in the packaging industry to special construction and protective films. During the performed production tests with different proportions of copolymers of ethylene and propylene with different density and mass flow rate, the disclosed film showed unexpectedly very good performance properties, while preserving small thickness. In advantageous variants of the solution describing the composition of the outer layer, the film is also characterised by extremely good adhesion, desired for films used to protect different types of goods.

Example 1.

[0024] In the example of executing the film in accordance with the invention, the film consists of 33 layers, and some of the layers differ when it comes to their composition. There are six different compositions of the film layers. The outer layer consists of 25% of the linear ultra low-density polyethylene (0.903 g/cm^3) with mass flow index (MFI) of 8.2 g/10 min (190°C , 2.16 kg) and 74.5% of linear low-density copolymer of ethylene with n-butene (0.918 g/cm^3) and MFI of 2.8 g/10 min . (190°C , 2.16 kg). The remaining 0.5% of the layer composition is the fluorine flow modifier. The percentage by volume of the layer in the entire film is 8%. The opposite outer layer consists of 99.5% of the copolymer of linear low-density polyethylene with n-butane (0.918 g/cm^3) with MFI of 2.8 g/10 min (190°C , 2.16 kg). The percentage by volume of the layer in the entire film is 8%. The core of the film is the layer with the percentage by volume of 10% in the entire film, consisting of the mixture of 50% of the copolymer of polypropylene with ethylene and ethylene content of 5% and with density of 0.905 g/cm^3 and mass flow index of 1.7 g/10 min (230°C , 2.16 kg) with another copolymer of propylene with ethylene, having ethylene content of 7.2% and density of 0.905 g/cm^3 and the mass flow index of 8.2 g/10 min (230°C , 2.16 kg). Between the core layer and the outer layer, and between the core layer and the opposite outer layer there are 15 intermediate layers on each side of the core. 4 of them on each side of the core consist of the linear low-density polyethylene (0.918 g/cm^3) and 3% of the additive of copolymer of propylene with ethylene, with density of 0.905 g/cm^3 and the mass flow index of 1.7 g/10 min (230°C , 2.26 kg). 5 of them on each side of the core consist of the mixture of 80% linear low-density polyethylene (0.918 g/cm^3) and mass flow rate of 4.5 g/10min (190°C , 2.16 kg) with 20% of the copolymer of propylene with ethylene with density of 0.902 g/cm^3 and mass flow rate of 6.1 g/10 min (230°C , 2.16 kg). The remaining intermediate layers consist of the linear low-density polyethylene with density of 0.927 g/cm^3 and mass flow are of 3.5 g/10 min (190°C , 2.16 kg), and the thickness of these layers is less than $0.2 \text{ }\mu\text{m}$.

Example 2.

[0025] In another example of the execution of the film, like in example 1, the film has the core layer comprising 90% of the copolymer of polypropylene with ethylene, with density of 0.905 g/cm^3 and mass flow index of 1.7 g/10 min (230°C , 2.16 kg) and 10% of the copolymer of ethylene and ethyl acrylate.

Example 3.

[0026] In another example of the film's execution compliant with the invention, the film consists

of 53 layers. There are five different compositions of the film layers. The outer layer consists of 25% of the linear ultra low-density polyethylene (0.903 g/cm^3) with mass flow index (MFI) of 8.2 g/10 min (190°C , 2.16 kg) and 74.5% of linear low-density copolymer of ethylene with n-butene (0.918 g/cm^3) and MFI of 2.8 g/10 min. (190°C , 2.16 kg). The remaining 0.5% of the layer composition is the fluorine flow modifier. The percentage by volume of the layer in the entire film is 9%. The opposite outer layer consists of 99.5% of the copolymer of linear low-density polyethylene with n-butane (0.918 g/cm^3) with MFI of 2.8 g/10 min (190°C , 2.16 kg). The percentage by volume of the layer in the entire film is 9%. The core of the film is the layer with the percentage by volume of 9% in the entire film, consisting of the mixture of 50% of the copolymer of polypropylene with ethylene and ethylene content of 16% and with density of 0.889 g/cm^3 and mass flow index of 3.7 g/10 min. (230°C , 2.16 kg) with another copolymer of propylene with ethylene, having ethylene content of 7.2% and density of 0.905 g/cm^3 and the mass flow index of 8.2 g/10 min (230°C , 2.16 kg). Between the core layer and the outer layer, and between the core layer and the opposite outer layer there are 25 intermediate layers on each side of the core. 2 of them consist of linear low-density polyethylene (0.918 g/cm^3) with MFI of 2.8 g/10 min on each side of the core. The remaining layers consist of the mixture of 95% of the linear low-density polyethylene (0.918 g/cm^3) with mass flow rate of 4.5 g/10 min (190°C , 2.16 kg) with 5% of the copolymer of propylene with ethylene with density of 0.889 g/cm^3 and mass flow rate of 3.7 g/10 min (230°C , 2.16 kg), and the thickness of these layers is less than $0.3 \text{ }\mu\text{m}$.

Example 4.

[0027] The method for producing the multilayer film is characterised with the use of seven extruders, one of which contains the raw material in the form of the mixture of 40% of linear ultra low-density polyethylene (0.903 g/cm^3) with mass flow index of 8.2 g/10 min (190°C , 2.16 kg) and 59.5% of the linear low-density copolymer of ethylene with n-butene (0.918 g/cm^3) with mass flow index of 2.8 g/10 min (190°C , 2.16 kg). The next two extruders contain the raw material in the form of the linear low-density polyethylene (0.918 g/cm^3) with mass flow index of 2.8 g/10 min (190°C , 2.16 kg). The next two extruders contain the same raw material as the previous two extruders with the addition of 2% of the copolymer of polypropylene with density of 0.905 g/cm^3 and mass flow index of 1.7 g/10 min (230°C , 2.26 kg). The sixth extruder contains the raw material in the form of the mixture of 80% of the copolymer of polypropylene with ethylene with density of 0.905 g/cm^3 and mass flow index of 8.2 g/10 min (230°C , 2.16 kg) with 20 % of another copolymer of propylene with ethylene, with density of 0.905 and mass flow rate of 1.7 g/10 min (230°C , 2.16 kg). The seventh extruder contains a raw material in the form of the mixture of 60% of the copolymer of linear low-density polyethylene (0.918 g/cm^3) with mass flow index of 2.8 g/10 min (190°C , 2.16 kg) with 39.5% of the copolymer of linear low-density polyethylene (0.903 g/cm^3) with mass flow index of 8.2 g/10 min. (190°C , 2.16 kg).

The raw material, preheated under high pressure, is fed from the extruders through a multi-application system to the slit head, where, at the temperature of 265 °C, the combined layers of the film are extruded and the thickness of individual layer is less than 10% of the volume of the entire film. The individual layers are extruded through a narrow slit onto the rotating, cooled roller, and then the combined layers comprising the pre-formed film are stretched by 5000 % compared to the original thickness of the film extruded from the slot, created from the combined layers, and at the same time the film is cooled down in such a manner that within approx. 2 seconds its temperature drops to 40 °C.

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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- [EP2799235A1 \[0005\]](#)
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FLERLAGSFILM OG FREMGANGSMÅDE TIL FREMSTILLING AF FLERLAGSFILM**Patentkrav**

1. Flerlagsfilm med 50-95 % indhold af lineær lavdensitetspolyethylen (LLDPE) med en specifik densitet i intervallet fra 0,912 til 0,935 g/cm³ og en massestrømningshastighed i intervallet fra 0,5 til 10 g/10 min. (190 °C, 2,16 kg) bestående af mindst 7 lag, hvor mindst ét af lagene indeholder 50-99 % copolymer af propylen med ethylen med et ethylenindhold på 1-10 % blandet med 1-50 % af en anden copolymer af propylen med ethylen med et ethylenindhold i intervallet fra 3 til 20 % eller med elastomer, **kendetegnet ved, at** mindst ét af lagene, der er lokaliseret mellem det midterste lag (filmkernen) og det yderste lag, indeholder den lineære lavdensitetspolyethylen med en specifik densitet i intervallet fra 0,912 til 0,935 g/cm³ og en massestrømningshastighed i intervallet fra 0,5 til 10 g/10 min. (190 °C, 2,16 kg) og copolymer af polypropylen eller elastomer i en mængde på 1-10 %, og der mellem det midterste lag og overfladelagene er mindst 2 mellemliggende lag på hver side af det midterste lag, og sådanne mellemliggende lag udgør 50-80 % af hele filmens samlede volumen, og 2 mellemliggende lag er blokke af mindst 10 mikrolag med en tykkelse på mindre end 0,5 µm hver især.
2. Flerlagsfilm ifølge krav 1, der er **kendetegnet ved, at** mindst ét lag indeholder en blanding af copolymer af polypropylen med ethylen og copolymer af polypropylen med α -olefin såsom buten, hexen eller octen, hvor propylenmasseprocenten er i intervallet fra 50 til 99 %.
3. Flerlagsfilm ifølge ét af de ovennævnte krav, der er **kendetegnet ved, at** mindst ét lag indeholder en blanding af copolymer af polypropylen med ethylen og terpolymer af propylen med ethylen og buten, hvor molprocenten for propylen ligger i intervallet fra 50 til 99 %.
4. Flerlagsfilm ifølge ét af de ovennævnte krav, der er **kendetegnet ved, at** elastomeren kan være copolymer af ethylen og methylacrylat, copolymer af ethylen og ethylacrylat; copolymer af ethylen og butylacrylat; blok-copolymer af hydrogeneret isopren og styren; blok-copolymer af propylen og ethylen, copolymer af styren og isopren; copolymerer af styren og hydrogeneret isopren; terpolymer af styren, hydrogeneret isopren og hydrogeneret butadien; terpolymer af ethylen, propylen og buten.
5. Flerlagsfilm ifølge ét af de ovennævnte krav, der er **kendetegnet ved, at** ét af de

yderste lag omfatter en blanding af 40-99 % plastomer, som er α -copolymer af ethylen (hvor α -olefin kan være buten, hexen, octen) med en specifik densitet i intervallet fra 0,860 til 0,910 g/cm³ (fortrinsvis 0,880-0,905 g/cm³) og en massestrømningshastighed i intervallet fra 0,5 til 10 g/10 min. (190 °C, 2,16 kg), fortrinsvis 4-8,5 g/10 min., med α -olefin-copolymer af LLDPE (hvor α -olefin kan være buten, hexen, octen) med en specifik densitet i intervallet fra 0,912 til 0,940 g/cm³ (fortrinsvis 0,912-0,920 g/cm³) og en massestrømningshastighed i intervallet fra 0,5 til 10 g/10 min. (190 °C, 2,16 kg), fortrinsvis 2,5-5 g/10 min.

6. Flerlagsfilm ifølge ét af de ovennævnte krav, der er **kendetegnet ved, at** ét af de yderste lag omfatter en blanding af α -olefin-copolymer af lineær ultralavdensitetspolyethylen (ULDPE) (hvor α -olefin kan være hexen, octen) med en specifik densitet i intervallet fra 0,880 til 0,910 g/cm³ (fortrinsvis 0,9-0,91 g/cm³) og en massestrømningshastighed i intervallet fra 0,5 til 10 g/10 min. (190 °C, 2,16 kg), fortrinsvis 3-6 g/10 min., med α -olefin-copolymer af LLDPE (hvor α -olefin kan være buten, hexen, octen) med en specifik densitet i intervallet fra 0,912 til 0,940 g/cm³ (fortrinsvis 0,912-0,920 g/cm³) og en massestrømningshastighed i intervallet fra 0,5 til 10 g/10 min. (190 °C, 2,16 kg), fortrinsvis 2,5-5 g/10 min.
7. Flerlagsfilm ifølge ét af de ovennævnte krav, der er **kendetegnet ved, at** ét af de yderste lag omfatter en blanding af α -olefin-copolymer af ethylen (hvor α -olefin kan være buten, hexen, octen) med en specifik densitet i intervallet fra 0,925 til 0,960 g/cm³ og en massestrømningshastighed i intervallet fra 0,5 til 10 g/10 min. (190 °C, 2,16 kg), fortrinsvis 2,5-5 g/10 min., med α -olefin-copolymer af LLDPE (hvor α -olefin kan være buten, hexen, octen) med en specifik densitet i intervallet fra 0,912 til 0,925 g/cm³ og en massestrømningshastighed i intervallet fra 0,5 til 10 g/10 min. (fortrinsvis 2-4 g/10 min.).
8. Flerlagsfilm ifølge ét af de ovennævnte krav, der er **kendetegnet ved, at** blokkene af mikrolag består af mindst 10 alternerende tynde lag med en tykkelse på mindre end 0,2 μ m for hvert mikrolag.
9. Flerlagsfilm ifølge ét af de ovennævnte krav, der er **kendetegnet ved, at** volumenprocenten for begge blokke af tynde lag ligger i intervallet fra 10 til 60 % af hele filmens volumen.
10. Flerlagsfilm ifølge et hvilket som helst af kravene 1-9, der er **kendetegnet ved, at** den

polypropylen eller elastomer, som tilsættes til det mellemliggende lag, kan komme fra et råmateriale, der i det væsentlige er blevet genanvendt.

11. Fremgangsmåde til fremstilling af flerlagsfilmen, der indeholder fra 50 til 95 % af den lineære lavdensitetspolyethylen (LLDPE), som består af mindst 7 lag, med specifik densitet i intervallet fra 0,912 til 0,935 g/cm³ og en massestrømningshastighed i intervallet fra 0,5 til 10 g/10 min. (190 °C, 2,16 kg), når mindst ét lag består af lineært lavdensitetspolyethylen LLDPE (0,915-0,925 g/cm³) med en massestrømningshastighed i intervallet fra 2 til 5 g/10 min. (190 °C, 2,16 kg), med en volumenprocent i intervallet fra 50 til 95 %, med blanding af copolymer af propylen med ethylen, der indeholder 1-10 % ethylen, blandet med en anden copolymer af propylen med ethylen med et ethylenindhold i intervallet fra 3 til 20 % eller med elastomer, såsom; copolymer af ethylen og methylacrylat; copolymer af ethylen og ethylacrylat; copolymer af ethylen og butylacrylat; blok-copolymer af hydrogeneret isopren og styren; blok-copolymer af propylen og ethylen, copolymer af styren og isopren; copolymerer af styren og hydrogeneret isopren; terpolymer af styren, hydrogeneret isopren og hydrogeneret butadien; terpolymer af ethylen, propylen og buten, **kendetegnet ved, at** komponenterne ekstruderes gennem spaltehovedet ved en temperatur i intervallet fra 260 til 300 °C og udstrækkes ved samtidig afkøling af den ekstruderede film, således at filmkrystalliseringen og størkningen finder sted efter 0,05-1 sekund, og filmen, der ekstruderes gennem spaltehovedet, formes i lag, således at der mellem kernelaget og overfladelagene er mellemliggende lag, der er placeret på begge sider af kernelaget, og som udgør 50-80 % af hele filmens volumen, og hvor 2 af disse mellemliggende lag er blokke af mikrolag, der hver især har mindst 10 mikrolag med en tykkelse på mindre end 0,5 µm
12. Fremgangsmåde til fremstilling af flerlagsfilmen ifølge krav 11, der er **kendetegnet ved, at** mindst 1 lag af filmen, der er ekstruderet under anvendelse af spaltehovedet, indeholder en blanding af copolymer af polypropylen med ethylen og copolymer af polypropylen med α-olefin såsom buten, hexen eller octen, hvor propylenprocenten er i intervallet fra 50 til 99 %.
13. Fremgangsmåde til fremstilling af flerlagsfilmen ifølge krav 11 eller 12, der er **kendetegnet ved, at** mindst ét lag af filmen, der er ekstruderet under anvendelse af spaltehovedet, indeholder en blanding af copolymer af polypropylen med ethylen og terpolymer af propylen med ethylen og buten, hvor molprocenten for propylen ligger i

intervallet fra 50 til 99 %.

14. Fremgangsmåde til fremstilling af flerlagsfilmen ifølge kravene 11, 12 eller 13, der er **kendetegnet ved, at** mindst ét lag af filmen, der er ekstruderet under anvendelse af spaltehovedet, indeholder en blanding af 40-99 % plastomer, som er α -olefin-copolymer af ethylen (hvor α -olefin kan være buten, hexen, octen) med en specifik densitet i intervallet fra 0,860 til 0,910 g/cm³ (fortrinsvis 0,880-0,905 g/cm³) og en massestrømningshastighed i intervallet fra 0,5 til 10 g/10 min. (190 °C, 2,16 kg), fortrinsvis 4-8,5 g/10 min., med α -olefin-copolymer af LLDPE (hvor α -olefin kan være buten, hexen, octen) med en specifik densitet i intervallet fra 0,912 til 0,940 g/cm³ (fortrinsvis 0,912-0,920 g/cm³) og en massestrømningshastighed i intervallet fra 0,5 til 10 g/10 min. (190 °C, 2,16 kg), fortrinsvis 2,5-5 g/10 min.
15. Fremgangsmåde til fremstilling af flerlagsfilmen ifølge ét af kravene 11-14, der er **kendetegnet ved, at** der til den ekstruder, hvorfra det materiale, som anvendes til fremstilling af mindst ét af de yderste lag, kommer, tilsættes følgende: en blanding af α -olefin-copolymer af lineær ultralavdensitetspolyethylen (ULDPE) (hvor α -olefin kan være hexen, octen) med en specifik densitet i intervallet fra 0,880 til 0,910 g/cm³ (fortrinsvis 0,9-0,91 g/cm³) og en massestrømningshastighed i intervallet fra 0,5 til 10 g/10 min. (190 °C, 2,16 kg), fortrinsvis 3-6 g/10 min., med α -olefin-copolymer af LLDPE (hvor α -olefin kan være buten, hexen, octen) med en specifik densitet i intervallet fra 0,912 til 0,940 g/cm³ (fortrinsvis 0,912-0,920 g/cm³) og en massestrømningshastighed i intervallet fra 0,5 til 10 g/10 min. (190 °C, 2,16 kg), fortrinsvis 2,5-5 g/10 min.
16. Fremgangsmåde til fremstilling af flerlagsfilmen ifølge ét af kravene 11-15, der er **kendetegnet ved, at** der til den ekstruder, hvorfra det materiale, som anvendes til fremstilling af mindst ét af de yderste lag, kommer, tilsættes følgende: en blanding af α -olefin-copolymer af ethylen (hvor α -olefin kan være buten, hexen eller octen) med en specifik densitet i intervallet fra 0,925 til 0,960 g/cm³ og en massestrømningshastighed i intervallet fra 0,5 til 10 g/10 min. (190 °C, 2,16 kg), fortrinsvis 2,5-5 g/10 min., med α -olefin-copolymer af LLDPE (hvor α -olefin kan være buten, hexen, octen) med en specifik densitet i intervallet fra 0,912 til 0,925 g/cm³ og en massestrømningshastighed i intervallet fra 0,5 til 10 g/10 min. (fortrinsvis 2-4 g/10 min.).
17. Fremgangsmåde til fremstilling af flerlagsfilmen ifølge ét af kravene 11-16, der er

kendetegnet ved, at de to blokke af tynde lag, der formes af spaltehovedet, fremstilles af mikrolag med en tykkelse på mindre end 0,2 μm hver især.

18. Fremgangsmåde til fremstilling af flerlagsfilm ifølge kravene 11-17, der er **kendetegnet ved, at** den polypropylen eller elastomer, der kommer fra et i det væsentlige genanvendt råmateriale, tilsættes til mindst ét mellemliggende lag.