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(54) **Process for producing composite monofilaments.**

(57) A process for producing a composite monofilament of sheath-and-core type having heat-adhesive properties, superior strengths, no curl and no peeling of the composite components is provided, which process comprises subjecting a low melting polyolefin selected from high density polyethylene, linear chain, low density polyethylene, polypropylene (PP) of m.p. 135°C or lower, or mixture thereof, and a high melting PP of m.p. 150°C or higher, to a sheath-and-core type composite spinning using the former resin as the sheath component and the latter resin as the core component, into a composite monofilament, the melt flow index ratio of the former component to the latter being 1.5 ~ 7, and the composite ratio being 30 : 70 to 60 : 40; and stretching the composite filament to 6 ~ 9 times.

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SPECIFICATION

TITLE OF THE INVENTION

Process for producing composite monofilaments

BACKGROUND OF THE INVENTION

Field of the Invention

This invention relates to a process for producing composite monofilaments (hereinafter abbreviated to "composite MF") having heat-adhesive properties and excellent strengths. More particularly, it relates to a process for producing composite MF of polyolefin resins having heat-adhesive properties and excellent strengths, obtained by using a low melting polyolefin resin component on the sheath side and a high melting polypropylene (hereinafter abbreviated to "high melting PP") component on the core side, and melt-extruding these components through a sheath-and-core type spinneret, followed by cooling, solidifying and stretching.

Description of the Prior Art

In general, monofilaments as a single component (hereinafter abbreviated to "ordinary MF") obtained by melt-extruding a polyolefin resin, followed by cooling and then stretching are superior in mechanical strengths, chemical strengths, corrosion resistance, water resistance, moldability, etc.; hence they have been fabricated into ropes, materials of fishing such as fishermen's nets, nets for land such as insect screening, windbreak net, golf net, light-shielding net, filter, sheet for public works, etc. and the resulting products have been widely used.

Among them, nets for land have been in most cases knitted or woven and the resulting knitted or woven products have been used, and their specific feature for practical use consists in their high mechanical strengths. However, since the intersecting parts of warps and wefts of the nets (hereinafter referred to as "mesh") are not bonded together, but relatively free, the meshes shift at the time of knitting or weaving or at the time of applying net products or depending on the practical state of the nets; thus such drawbacks occur that the shielding or protecting effect of net products as their main object is lost or a good appearance thereof is damaged.

On the other hand, there have been known a technique of molding polymers directly into the form of net by melt-extrusion through a specific rotating spinneret to obtain a net having the meshes bonded together and a technique of further stretching the net product obtained above in both the longitudinal and lateral directions. However, as to the monofilaments (hereinafter abbreviated to "MF") constituting these nets, as compared with conventional nets wherein the strength of each MF in the longitudinal direction and that in the lateral direction are both 3g/d or more, the strength of each MF of the above particular nets in the longitudinal and that in the lateral direction are both 1.5 g/d or less, that is, extremely lower; thus a problem has been raised that the particular nets could have been applied only to extremely limited uses such as use for packaging simple, light-weight goods.

Further, in the field of non-woven fabrics, those obtained by processing composite fibers having a hot-melt adhesive function imparted thereto, into a bag form material, which is then subjected to heat-treatment to bring the mesh parts to hot-melt adhesion, have been in recent years applied to various uses. However, since hot-melt adhesive composite fibers used therefor have as very small a fineness as about 1 to 30 d, if it is intended to use such composite fibers in the form of a thick material having 100 d or more which has been used for ordinary MF, then it is necessary to process composite fibers into a fiber bundle; hence drawbacks occur that the process is complicated and accordingly very expensive.

The object of the present invention is to provide a process for producing composite MF having heat-adhesive properties, superior strengths, no curl and no peeling between the layers thereof.

SUMMARY OF THE INVENTION

The present invention resides in

a process for producing a composite MF having heat-adhesive properties and superior strengths which comprises

subjecting a low melting polyolefin resin selected from the group consisting of high density polyethylene (hereinafter abbreviated to "HDPE"), linear chain, low density polyethylene (hereinafter abbreviated to "LLDPE"), polypropylene having a melting point of 135°C or lower (hereinafter abbreviated to "low melting PP") and mixtures of the foregoing, and a high melting polypropylene having a melting point of 150°C or higher, to a sheath-and-core type composite spinning using the former low melting polyolefin resin as the sheath component and the latter high melting polypropylene as the core component, into an unstretched composite MF,

the melt flow index ratio (hereinafter abbreviated to "FR ratio") of the former low melting polyolefin resin component to the latter high melting polypropylene component being in the range of 1.5 to 7, and the composite ratio being in the range of 30 : 70 to 60 : 40; and

stretching the unstretched composite MF to 6 to 9 times the original length.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

As for HDPE and polypropylene (hereinafter abbreviated to "PP") used in the present invention, homopolymer of ethylene or propylene is not only used, but also copolymers of ethylene with propylene, butene-1, etc. composed mainly of ethylene or copolymers of propylene with ethylene, butene-1, etc. composed mainly of propylene may be preferably used. Further, to these polymers or mixtures thereof may be, if necessary, added additives which are usually added to polyolefin resins, such as stabilizers, e.g. antioxidant, ultraviolet absorber, etc., coloring agent, lubricant, antistatic agent, delustering agent, etc.

In the present invention, in the case where HDPE, LLDPE or low melting PP is mixed with each other and the mixture is used as the sheath component, mixing may be carried out employing a conventional means such as extruder, Banbury mixer, tumbler mixer, Henschel mixer, etc. and in a conventional manner. Further, as for the composite extrusion method and apparatus, although known techniques may be employed such as composite extrusion by means of two extruders and composite spinnerets of side-by-side or sheath-and-core type, it is preferred in the present invention to employ composite spinnerets of sheath-and-core type which is advantageous in the aspects of spinning, stretching stability and peel resistance of the boundary surface layer between the sheath component and the core component of stretched composite MF.

As to the FR ratio in the present invention, the high melting PP and the low melting PP are based on MFR measured according to ASTM D 1238 (L), and HDPE and LLDPE are based on MI measured according to ASTM D 1238(E).

The melt flow index (MFR) of the high melting PP used on the core side of the composite MF may be in the range of 0.3 to 15 which has been used for ordinary MF, but its melting point is required to be 150°C or higher, and as for the FR ratio of the low melting polyolefin resin component on the sheath side to the high melting PP on the core side, when the ratio is in the range of 1.5 to 7, the effectiveness of the present invention is remarkable. If the melting point of the core component is lower than 150°C, its strength as a basic performance of the core component is reduced, and also its shrink properties increase so that when a net prepared by knitting or weaving the above composite MF is subjected to heat set, shrink-deformation is notable. If the FR ratio is lower than 1.5, spinning and stretching properties are unstable and the resulting net is inferior in heat-adhesive properties. If it is higher than 7, the fluidity of the sheath component in the nozzle is different from that of the core component therein, and also there occurs a large stress strain due to the difference in the crystallization behavior between the two components or the difference in the volume shrinkage between the two components during the process from molten state to cooling and solidification, so that extruded unstretched MF bends or curls at the exit of the nozzle to make spinnability inferior. Further since the difference between the stretching stresses applied to the sheath and core components increases; hence stretching troubles such as stretching breakage, curling of stretched MF, etc. are liable to occur.

The low melting polyolefin resin used as the sheath component constitutes a component by which adhesive properties due to heat-melt adhesion are imparted to composite MF, and the effectiveness is fully exhibited by single use of HDPE, LLDPE or a low melting PP, but even when two or more kinds thereof are used in admixture, the same effectiveness as in the single use is exhibited. In this case, as for the combination of the components, combinations of polymers having similar fluidities are preferred. When a low melting PP is used as the sheath component, its melting point is necessary to be 135°C or lower. If it is higher than 135°C, when the resulting net is subjected to heat set, this is necessarily carried out at a high temperature and for a long time; hence even if heat adhesion is effected, the orientation of the core component of the composite MF is lost by the heat at the time of the heat set, to reduce its strength and thereby damage the strength-retaining characteristic of the core component.

The melting point of the low melting polyolefin resin is preferably 80°C or higher and more preferably 100°C or higher.

The composite ratio of the sheath component to the core component is preferably in the range of 30 : 70 to 60 : 40. If the sheath component is less than 30%, spinnability and stretchability are liable to be inferior, and also since the amount of the heat-adhesive component of the composite MF is reduced, the bonding force at the adhesion part of the mesh of the net becomes weak. On the other hand, if the core component is less than 40%, the strength of the core component as a basic element of the role thereof is reduced.

As to the stretching in the present invention, general apparatus and process for stretching may be employed which have been employed for ordinary MF. The stretch ratio is suitably in the range of 6 to 9 times the original length. In the case of composite MF, since its strength is structurally somewhat lower than that of ordinary MF, if the ratio is lower than 6 times, its strength is low, while if it exceeds 9 times, its strength is sufficient, but due to the fact that composite MF is poor in the compatibility of polymers at the boundary surface thereof, the difference in stretchability between the sheath component and the core component becomes remarkable so that troubles such as turnover or peel of the sheath component occur during the stretching step and also it is liable to curl after stretching, which causes troubles of bad take-up during the take-up step such as bad take-up shape or getting out of take-up shape. In order to improve the shrinkability of stretched filament after the stretching step, it may be also preferred to apply annealing for relaxation thereto employing a general apparatus and process.

The composite MF of the present invention may usually be preferably used in a thickness of 100 to 1,000 d.

The composite MF obtained according to the present invention retains strength characteristics similar to those of ordinary MF and is at the same time provided with heat-adhesive properties. Further, the net-form product having its mesh part bonded together by heat-adhesion, obtained by subjecting a net-form material prepared by knitting or weaving the above composite MF, to heat treatment by way of a general means such as heating roll, heating calender, hot air, steam treatment, etc., retains strengths similar to those of net-form products consisting of ordinary MF and hardly causes mesh deformation.

The present invention will be described below by way of Examples and Comparative examples. The standards based on which the evaluations of composite MF and nets obtained therefrom were made and the definitions of symbols in Tables listed later are as follows:

1) MI --- Melt flow index of polyethylene resin (a value according to ASTM D-1238 (E); i.e. a weight by gram of a sample obtained by extruding it for 10 minutes under conditions of an orifice hole diameter of 2.092 ± 0.002 mm, 190°C, and a load of 2.160 g).

2) MFR --- Melt flow index of polypropylene resin (this is the same as above except that the temperature is 230°C); according to ASTM D-1238(L).

3) FR ratio --- Ratio of the melt flow index of the sheath component to that of the core component (i.e. ratio of MI (or MFR in case of low melting PP) to MFR, each measured in the items 1) (or 2)) and 2)).

4) Composite ratio --- Ratio by weight of the sheath component to the core component, each obtained by singly extruding the corresponding component followed by measuring the weight of the resulting unstretched filament per unit time.

5) Spinnability --- State of extruded unstretched filament.

o: Normal.

Δ: Unstretched filament bends at the exit of nozzle.

×: Unstretched filament bends at the exit of nozzle to make spinning impossible.

6) Stretchability --- Evaluated by the state of stretching. Symbol * represents impossibility of stretching.

o: Normal both for stretched filament and for stretching process.

Δ: Stretched filament whitens.

×: Stretching break occurs or filament curls and take-up troubles are liable to occur.

7) Peeling properties of composite MF --- Separation properties of the sheath component layer from the core component layer.

o: Sheath layer does not peel even when forcible peel is tried.

Δ: Sheath layer peels when it is forcibly peeled, but usually no problem is raised.

×: Sheath layer is liable to peel at the stretching and take-up steps.

8) Heat set (heat adhesion) process of net-form product --- Net-form product obtained from composite MF in a conventional manner is allowed to stand in a hot air-heating vessel at 140 ~ 150°C for 1.5 minute.

9) Strength of composite MF after heat adhesion processing --- Composite MF is collected from net-form product heat-adhered at the mesh part, followed by measuring and evaluating its tensile strength.

o: Greater than 4.0 g/d

Δ: 3.0 ~ 4.0 g/d

×: Less than 3.0 g/d

(Note) Measurement conditions for the tensile strength:

① Tensile tester: Tensilon IV type manufactured by Toyo Baldwin Company

② Distance between chucks: 200 mm

③ Tensile rate: 200 mm/min.

④ Room temperature: 23°C

⑤ Humidity: 50%

10) Adhesive properties of net-form product at the mesh part --- Bond strength at the mesh part is measured.

o: Bond strength, greater than 300 g

Δ: Bond strength, 100 ~ 300 g

×: Bond strength, less than 100 g (the mesh parts have been adhered for the present, but a portion thereof is slight in adhesion).

Example 1 and Comparative example 1

Using as a core component, various kinds of PP having a melting point of 161°C and various MFR values and as a sheath component, HDPE or LLDPE having various MI values or PP having a melting point of 128°C, and employing two extruders each having a bore diameter of 40 mm and a composite spinneret of sheath-and-core type having a nozzle diameter of 1.5 mm, melt-extrusion was carried out at an extrusion temperature on the core side of 260°C, at an extrusion temperature on the sheath side of 240°C and at a composite spinneret temperature of 260°C, followed by spinning through cooling to obtain an unstretched composite filament of sheath-and-core type having a composite ratio of 50 : 50, which was then stretched to 5 to 10 times by means of a wet type, heat stretching apparatus to obtain various kinds of composite MF of 450 d. The results as to the spinnability and stretchability of the extruded, unstretched filament and the peeling properties of the sheath layer from the core layer are shown in Table 1. Further, various kinds of composite MF prepared according to the above process were each woven into a net-form product having a woven density of 5 warps/ 25 mm × 5 wefts/25 mm, which was then heat-set in a hot air-heating vessel at 140°C for 1.5 minute, taken out and subjected to evaluations of the heat-adhesive properties at the mesh parts and the residual strength of the composite MF. The results are shown in Table 2.

From these Tables it is seen that when a high melting PP of m.p. 161°C is used as a core component and either one of HDPE or LLDPE or a low melting PP of m.p. 128°C is used as a sheath component, if the FR ratio is in the range of 1.5 to 7.0 and the stretch ratio is in the range of 6 to 9 times, it is possible to obtain a stretched MF having a stabilized composite structure without any peel, and also that among the above cases, when a low melting PP is used as a sheath component, a composite MF which is particularly difficult to peel is obtained. Further it is also seen that net-form products obtained by heat-setting net-form materials prepared from the above composite MF have the mesh parts bonded together by heat adhesion and have a sufficiently retained strength.

Example 2 and Comparative example 2

Using as a core component, PP having a m.p. of 161°C and a MFR of 3.1, and as a sheath component, either one of HDPE, LLDPE or PP of m.p. 128°, spinning was carried out under the same conditions as in Example 1 to obtain various unstretched composite filaments of sheath-and-core type, which were then stretched by means of a wet type, heat stretching apparatus to obtain composite MFs of 450 d. The spinnability and stretchability of the resulting composite MFs and evaluations of the heat-adhesive properties and the residual strength of net-form products prepared from the above composite MFs in the same manner as in Example 1 are shown in Table 3.

From Table 3 it is seen that when the composite ratio of the sheath and core components is in the range of 30 : 70 to 60 : 40, the spinning and stretching stabilities of composite MF and the heat-adhesive properties and the residual strength of net-form products prepared from composite MF are superior.

Example 3 and Comparative example 3

Using as a core component, PP having a m.p. of 161°C and a MFR of 3.1 and as a sheath component, various low melting PPs having a MFR of 15.5 and various melting points, composite MFs were prepared under the same conditions as in Example 1. The heat-adhesive properties and the residual strength of net-form products prepared from the above composite MFs were evaluated. The results are shown in Table 4.

From Table 4 it is seen that in the case where a low melting PP is used as the sheath component, if its melting point exceeds 135°C, the contrary properties to each other of the heat-adhesive properties and the residual strength become greater depending on the heat setting conditions of net-form products, and as the melting point becomes higher, the heat-adhesive properties become inferior, and if the heat setting temperature is raised in order to improve heat-adhesive properties, the strength of composite MF after heat adhesion processing contrarily becomes too low.

Example 4

A PP having a m.p. of 161°C and a MFR of 3.1 was used as a core component, and three kinds of mixed resins obtained by mixing the respective two of HDPE, LLDPE or a PP of m.p. 128°C in a ratio of 1 : 1 by means of a Henschel mixer, followed by extruding and granulating the mixtures by means of an extruder having a bore diameter of 40 mm were used as a sheath component, respectively. Evaluation was made as in Example 1. The results are shown in Table 5.

From Table 5 it is seen that even when mixed resins of HDPE, LLDPE or a low melting PP are used as a sheath component, the same effectiveness as in the case of single use thereof is obtained.

Example 5 and Comparative example 4

PPs having similar MFRs and various melting points were used as a core component, and HDPE, LLDPE or a PP of m.p. 128°C was singly used as a sheath component. Evaluation was made as in Example 1. The results are shown in Table 6.

From Table 6 it is seen that when the melting point of core component is lower than 150°C, reduction in the residual strength is remarkable although no problem is raised as to heat-adhesive properties.

Table 1

(Composite ratio 50 : 50)

[\ ] → Stretchability \ Peeling properties of composite MF

Core component \ Sheath component		Kind	HDPE					LLDPE				Low melting PP (m.p.: 128°C)				
		MI or MFR	3.1	4.7	16.1	21.1	24.8	2.5	6.0	10.5	26.2	3.41	4.7	17.3	21.4	25.7
MFR: 3.1 M.P.: 163°C	FR ratio		1.0	1.52	5.19	6.81	8.0	0.81	1.94	3.39	8.45	1.10	1.52	5.58	6.90	8.29
	Spinnability		△	○	○	○	×	△	○	○	×	△	○	○	○	×
	Stretch ratio	5	△\○	△\○	△\○	△\○	*	△\○	△\○	△\○	*	○\○	○\○	○\○	○\○	*
		6	△\○	△\○	△\○	△\○	*	△\○	△\○	△\○	*	○\○	○\○	○\○	○\○	*
		7.5	△\○	△\○	△\○	△\○	*	△\○	△\○	△\○	*	○\○	○\○	○\○	○\○	*
		9	×\×	△\△	△\△	△\△	*	×\×	△\△	△\△	*	○\△	○\○	○\○	○\○	*
		10	×\×	×\×	×\×	×\×	*	×\×	×\×	×\×	*	○\△	○\△	○\△	○\△	*
MFR: 5.9 M.P.: 163°C	FR ratio		0.53	0.80	2.73	3.58	4.20	0.42	1.01	1.78	4.44	0.58	0.80	2.93	3.63	4.36
	Spinnability		×	△	○	○	○	×	△	○	○	×	△	○	○	○
	Stretch ratio	5	*	*	△\○	△\○	△\○	*	△\○	△\○	△\○	*	○\○	○\○	○\○	○\○
		6	*	*	△\○	△\○	△\○	*	△\○	△\○	△\○	*	○\○	○\○	○\○	○\○
		7.5	*	*	△\○	△\○	△\○	*	△\○	△\○	△\○	*	○\○	○\○	○\○	○\○
		9	*	*	△\△	△\△	△\△	*	×\×	△\△	△\△	*	○\△	○\△	○\△	○\△
		10	*	*	×\×	×\×	×\△	*	×\×	×\×	×\×	*	○\△	○\△	○\△	○\△
MFR: 3.1 M.P.: 163°C	FR ratio		0.30	0.45	1.55	2.03	2.38	0.24	0.58	1.01	2.52	0.33	0.45	1.66	2.06	2.47
	Spinnability		×	×	○	○	○	×	×	△	○	×	×	○	○	○
	Stretch ratio	5	*	*	△\○	△\○	△\○	*	*	△\○	△\○	*	*	○\○	○\○	○\○
		6	*	*	△\○	△\○	△\○	*	*	△\○	△\○	*	*	○\○	○\○	○\○
		7.5	*	*	△\○	△\○	△\○	*	*	△\○	△\○	*	*	○\○	○\○	○\○
		9	*	*	△\△	△\△	△\△	*	*	×\△	△\△	*	*	○\○	○\○	○\○
		10	*	*	×\×	×\×	×\△	*	*	×\×	×\×	*	*	○\△	○\△	○\△

Table 2

(Composite ratio 50 : 50)

\ → Strength of composite MF after heat-adhesion processing
→ Adhesive properties of net

Core component \ Sheath component		Kind	HDPE					LLDPE				Low melting PP (m.p.: 128°C)				
		MI or MFR	3.1	4.7	16.1	21.1	24.8	2.5	6.0	10.5	26.2	3.41	4.7	17.3	21.4	25.7
MFR: 3.1 M.P.: 163°C	FR ratio		1.0	1.52	5.19	6.81	8.00	0.81	1.94	3.38	8.45	1.10	1.52	5.58	6.90	8.29
	Stretch ratio	5	△\×	△\×	○\×	○\×	*	×\×	△\×	△\×	*	△\△	△\△	○\△	○\△	*
		6	△\△	△\△	○\△	○\△	*	×\△	△\△	△\△	*	△\△	△\△	○\△	○\△	*
		7.5	△\△	△\△	○\△	○\△	*	×\△	△\△	△\△	*	△\○	△\○	○\○	○\○	*
		9	△\△	△\△	△\○	△\○	*	×\△	△\△	△\△	*	△\○	△\○	○\○	○\○	*
		10	×\×	×\×	×\×	×\×	*	×\×	×\×	×\×	*	△\△	△\○	△\○	△\○	*
MFR: 5.9 M.P.: 163°C	FR ratio		0.53	0.80	2.73	3.58	4.20	0.42	1.02	1.78	4.44	0.58	0.80	2.93	3.63	4.36
	Stretch ratio	5	*	*	△\×	○\×	○\×	*	×\×	△\×	○\×	*	△\△	△\△	△\△	△\△
		6	*	*	△\△	○\△	○\△	*	×\△	△\△	○\△	*	△\△	△\△	○\△	○\△
		7.5	*	*	△\△	○\△	○\△	*	×\△	△\△	○\△	*	△\○	○\○	○\○	○\○
		9	*	*	△\△	△\○	△\○	*	×\△	△\△	○\△	*	△\○	○\○	○\○	○\○
		10	*	*	×\×	×\×	×\×	*	×\×	×\×	×\×	*	△\△	○\△	△\○	△\○
MFR: 10.4 M.P.: 163°C	FR ratio		0.30	0.45	1.55	2.03	2.38	0.24	0.58	1.01	2.52	0.33	0.45	1.66	2.06	2.47
	Stretch ratio	5	*	*	△\×	△\×	△\×	*	*	×\×	△\×	*	*	△\×	△\×	△\×
		6	*	*	△\△	△\△	△\△	*	*	×\△	△\△	*	*	△\△	○\△	○\△
		7.5	*	*	△\△	△\△	△\△	*	*	×\△	△\△	*	*	△\△	○\△	○\△
		9	*	*	△\△	△\△	△\△	*	*	×\△	△\△	*	*	△\○	○\○	○\○
		10	*	*	×\×	×\×	×\×	*	*	×\×	×\×	*	*	△\○	△\○	△\○

Table 3

□\□ → Strength of composite MF after heat-adhesion processing
→ Adhesive properties of net

Sheath component	Sheath/Core Composite ratio		25/75	30/70	50/50	60/40	65/35
HDPE MI: 16.1 Sheath Core FR ratio: 5.19	Spinnability		△	○	○	○	△
	Stretch ratio	6	△\○	△\○	△\△	△\×	△\×
		7.5	△\○	△\○	○\○	△\△	△\×
		9	×\△	△\○	○\○	△\△	△\△
LLDPE MI: 10.5 Sheath Core FR ratio: 3.39	Spinnability		△	○	○	○	△
	Stretch ratio	6	×\○	△\○	△\△	△\×	△\×
		7.5	×\○	△\○	△\△	△\×	△\×
		9	×\△	△\○	△\△	△\△	△\×
Low melting PP (M.P.: 128°C) MFR: 17.3 Sheath Core FR ratio: 5.58	Spinnability		△	○	○	○	△
	Stretch ratio	6	○\○	○\○	○\△	○\×	○\×
		7.5	△\○	○\○	○\○	○\△	○\×
		9	×\△	○\○	○\○	○\○	○\△

Table 4

[\ ] → Strength of composite MF after heat-adhesion processing (right-hand symbol)
→ Adhesive properties of net (left-hand symbol)

(Composite ratio 50 : 50)

Heat setting conditions of net-form product \ M.p. of low melting PP as core component			128°C	134°C	141°C
Hot air-heating vessel Heat treatment 140°C 1.5 min.	Spinnability		○	○	○
	Stretch ratio	6	○\△	△\△	×\△
		7.5	○\○	△\○	×\○
		9	○\○	△\○	×\○
Hot air-heating vessel Heat treatment 150°C 1.5 min.	Spinnability		○	○	○
	Stretch ratio	6	○\×	○\×	△\×
		7.5	○\△	○\△	△\△
		9	○\○	○\○	△\○

Note: MFR of PP as core component: 3.1,

M.P.: 161°C,

FR ratio: 5.0

Table 5

□ \ → Strength of composite MF after heat-adhesion processing
→ Adhesive properties of net

(Composite ratio 50 : 50)

PP as core component \ Combination of sheath component (blending ratio 1 : 1)			HDPE/LLDPE	HDPE/Low melting PP (128°C)	LLDPE/Low melting PP (128°C)
MFR 3.1 M.P. 163°C	FR ratio		4.22	5.35	3.94
	Spinnability		o	o	o
	Stretch ratio	6	Δ\Δ	o\Δ	o\Δ
		7.5	o\Δ	o\Δ	o\Δ
		9	Δ\Δ	Δ\o	Δ\o

Table 6

(Composite ratio 50 : 50)

□ (upper left of diagonal) → Strength of composite MF after heat-adhesion processing

□ (lower right of diagonal) → Adhesive properties of net

Sheath component \ PP as Core component			M.P.	141℃	150℃	161℃
			MFR	3.02	3.17	2.89
HDPE MI 16.1	FR ratio			5.33	5.08	5.57
	Spinnability			○	○	○
	Stretch ratio	6		△\×	△\△	○\△
		7.5		△\×	△\△	○\○
		9		△\△	△\○	△\○
Low melting PP (M.P. 128°C) MFR 17.3	FR ratio			5.73	5.46	5.99
	Spinnability			○	○	○
	Stretch ratio	6		○\×	○\△	○\△
		7.5		○\×	○\△	○\○
		9		○\×	○\○	○\○

WHAT WE CLAIM IS:

1. A process for producing a composite monofilament having heat-adhesive properties and suprior strengths which comprises

subjecting a low melting polyolefin resin selected from the group consisting of high density polyethylene, linear chain, low density polyethylene, polypropylene having a melting point of 135°C or lower and mixtures of the foregoing, and a high melting polypropylene having a melting point of 150°C or higher, to a sheath-and-core type composite spinning using the former low melting polyolefin resin as the sheath component and the latter high melting polypropylene as the core component, into an unstretched monofilament,

the melt flow index ratio of the former low melting polyolefin resin component to the latter high melting polypropylene component being in the range of 1.5 to 7, and the composite ratio being in the range of 30 : 70 to 60 : 40; and

stretching the unstretched composite monofilament to 6 to 9 times the original length.

2. A process according to claim 1, wherein the low melting polyolefin resin and/or the high melting polypropylene is a homopolymer.

3. A process according to claim 1 or 2, wherein the melting point of the low melting polyolefin resin is 80°C or higher.

4. A composite monofilament produced by a method according to any proceeding claim and having a thickness of 100 to 1000d.

5. A net made from composite monofilament according to claim 4.