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(54) Cordage.

(57) The invention relates to cordage which has been produced predominantly or exclusively from meltable polymer filaments, fibers and/or yarns and has been subjected to a heat treatment, to bring about partial melting of the polymer constituents without significant loss in molecular orientation, in those areas at its ends where, in use, stresses occur in a direction other than the longitudinal direction.

The cordage according to the invention has in those areas where knotting, splicing, thimbling or similar measures for forming eyes or for joining with other cordage have been carried out substantially higher tensile strengths and moduli than existing cordage in directions other than the longitudinal direction of the cordage.

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Cordage

The present invention relates to cordage, i.e. lines, ropes, hawsers etc., which has been produced predominantly or exclusively from meltable polymer filaments, fibers and/or yarns.

Cordage of this type has high tensile strengths and moduli in its longitudinal direction, while these properties decrease in directions other than the longitudinal direction and are at their minimum in the direction perpendicular to the longitudinal direction. This decrease in strengths and moduli is adversely apparent for example when, for fastening purposes, cordage is provided at one end with an eye by knotting, splicing or thimbling or, for joining to other cordage, is joined with the aid of the same measures. In the contact areas, where tensile forces occur in a direction other than the longitudinal direction of the cordage to an appreciable extent, the tensile strengths and moduli of the cordage are then appreciably reduced (down to about 55% of the strength/modulus values of the longitudinal direction). Accordingly, cordage which features knots, splices and thimbles cannot be stressed to the full values of the tensile strengths and moduli in the longitudinal direction.

It is an object of the present invention to eliminate the disadvantages described above by providing cordage which, in the event of knottings, splicings, thimblings and similar measures, has in the particular contact areas tensile strengths and moduli which are no longer reduced by as much as with prior art cordage.

This object is achieved according to the invention with cordage which has been produced predominantly or exclusively from meltable polymer filaments, fibers and/or yarns and which has been subjected to a heat treatment, to bring about partial melting of the copolymer constituents without significant loss in molecular orientation, in those areas at its ends where, in use, stresses occur in a direction other than the longitudinal direction. These areas at the ends are in particular those areas where, to form eyes or to join together with other cordage, cordage parts are brought into contact, in particular by knotting, splicing or thimbling or similar measures which have the effect that tensile stresses exerted on the cordage in the longitudinal direction result in those areas in stresses which no longer act in the longitudinal direction of the cordage but in the least favorable case act in a direction perpendicular to the longitudinal direction, as a consequence of which the cordage can no longer be loaded with the maximum tensile stress possible in the longitudinal direction.

The heat treatment is carried out by partially melting, in particular at the surface, of the polymer constituents of which the cordage is made without significant loss in molecular orientation, thereby enhancing the tensile strength and modulus values.

The term "partial melting" as used herein is to be understood as meaning that the polymer filaments, fibers and/or yarns which predominantly or exclusively form the cordage become converted at the surface into a softened or melted state without at the same time incurring a significant loss in molecular orientation.

The heat treatment can be carried out by heating the cordage in the areas where cordage parts come into contact in the course of knotting, splicing or thimbling to a temperature above the melting point of polymers of which the cordage is made, with or without pressure being employed, prior to the step of knotting, splicing or thimbling. The heating can also be carried out after knotting, splicing or thimbling has been carried out and advantageously should be carried out only for such a length of time, and to such an extent, as to maintain a good balance between strength enhancement and adequate flexibility of cordage.

As regards thimbling, which can be done for example using metal rings or resin sheaths, a possible procedure comprises heating the metal rings or the resin before the step of thimbling to a temperature above the melting point of the polymer constituents of the cordage, so that in the course of and after the application of the thimble, the metal rings or the resin transfer their heat to the polymer constituents to effect partial melting of the latter.

The cordage according to the invention can be produced in any desired conventional manner from polymer filaments, fibers and/or yarns or from mixtures of such polymer components with natural fibers such as hemp, manilla, sisal, coconut or cotton, including, if desired, metal wires. However, the important thing is that polymer components suitable for partial melting are present at the surface of the cordage.

The polymer filaments, fibers and yarns used for producing the cordage according to the invention can consist of any desired polymer material suitable for cordage production, although particular preference is given to polyolefins and polyamides of, in particular, high molecular weight, particularly preferably of ultra-high molecular weight of more than 600,000 g/mol (weight average of molecular weight). To enhance the orientation and hence the strength properties, these filaments and fibers have preferably been highly drawn, in particular to draw ratios of more than 20, in particular more than 30.

Suitable filaments and fibers are made in particular of polyethylene, in particular linear

polyethylenes of ultrahigh molecular weight. These polyethylenes may contain minor amounts, preferably not more than 5 mol % of one or more other alkenes copolymerizable therewith, such as propylene, butylene, pentene, hexene, 4-methylpentene, octene etc. and have 1 to 10, in particular 2 to 6, methyl or ethyl groups per 1,000 carbon atoms. It is of course also possible to use other polyolefins, for example polypropylene homopolymers and copolymers; furthermore, the polyolefins used may also contain minor amounts of one or more other polymers, in particular alkene-1 polymers.

Of the polyamides, preference is given in particular to the polyaramids and the nylons, such as nylon-6 and nylon-6.6.

The filaments or fibers are preferably produced by the gel process, which is described for example in GB-A-2,042,414 and -2,051,667 and also in DE Offenlegungsschrift 3,724,434, and comprises essentially dissolving the particular polymer used for filament production in a solvent, molding the solution into a filament at a temperature above the dissolving temperature of the polymer, cooling the filament, for gelling, down to a temperature below the dissolving temperature, and drawing the filament with solvent removal.

In an embodiment of the invention it is also possible to provide one or more polymers which have lower melting points than the polymer filaments, fibers and/or yarns which predominantly or exclusively form the cordage, in particular in the areas subject to a stress on the cordage, in which case the heat treatment is carried out at a temperature which is above the melting point of the low-melting polymers and below the melting point of polymer filaments, fibers and/or yarns. These low-melting polymers, which preferably have melting points of less than 135 °C can be present in the form of filaments, fibers and/or yarns and be incorporated in the cordage from the start of the production of the cordage or, however, be introduced into the cordage, preferably in the stressed areas, for example by splicing, only before the heat treatment. It is also possible to introduce these polymers into the cordage by dipping the stressed areas of the cordage into a melt of the low-melting polymers. Preferably, the low-melting polymers used are polyolefins, in particular polyethylenes, in particular (L)LDPE.

Claims

1. Cordage produced predominantly or exclusively from meltable polymer filaments, fibres and/or yarns, which has been subjected to a heat treatment, to bring about partial melting of the polymer constituents without significant loss in molecular orientation, in those areas at its ends where, in use, stresses occur in a direction other than the longitudinal direction.

2. Cordage as claimed in claim 1, wherein the heat treatment has been carried out in those areas where, to form eyes or to join together with other cordage, cordage parts are brought into contact.

3. Cordage as claimed in either of claims 1 and 2, wherein the contact areas consist of knots, splices or thimbles.

4. Cordage as claimed in any of claims 1 to 3, wherein the meltable filaments, fibers or yarns consist of polyolefins or polyamides.

5. Cordage as claimed in any of claims 1 to 4, wherein the filaments, fibers or yarns consist of polyethylenes, in particular linear polyethylenes, having an ultrahigh molecular weight of more than 600,000 g/mol (weight average of molecular weight).

6. Cordage as claimed in any of claims 1 to 4, wherein there are present, in particular in the stressed areas, one or more polymers which have lower melting points than the polymer filaments, fibers and/or yarns which form the cordage, the heat treatment having been carried out at a temperature above the melting point of the low-melting polymers and below the melting point of the polymer filaments, fibers and/or yarns which form the cordage.

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EUROPEAN SEARCH REPORT

Application Number

EP 88 20 2160

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
A	US-A-4456451 (G W VOSPER) * claims 1, 2; figure 1 * ---	1,4	D07B9/00 D07B1/18 D07B1/00
A	GB-A-1202923 (UNION LIGHTERAGE COMPANY LIMITED) * claims 1-8; figures 1, 2 * ---	1,4	
A	GB-A-552225 (E CHASE; R V PATCHETT) * page 3, line 94 - page 4, line 8 * * page 6, line 96 - line 121 * ---	1	
A	FR-A-1443391 (ETABLISSEMENTS COUSINS FRERES) * page 1, left-hand column, paragraph 1 - 2 * résumé ---	1,6	
A	DE-A-1902850 (TOUGH ROPES LTD) * claim 1 * ---	6	
A	EP-A-029630 (ANZA BV.) -----		

TECHNICAL FIELDS SEARCHED (Int. Cl.4)
D07B
D02J
D02G
D04C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	10 JANUARY 1989	D HULSTER E.W.F.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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