(54) Title: THERMOPLASTIC POLYURETHANE FILM

(57) Abstract: The present invention is to collect TPU film scrap remaining after use during a shoe manufacturing process and again process the TPU film scrap into a high frequency welding Thermoplastic PolyUrethane (TPU) film for reuse. In detail, during a shoe manufacturing process, a process of printing and attaching a TPU film to a shoe fabric in various forms in a high frequency welding method is frequently performed. In this process, only part of a TPU film of a desired shape is attached to the shoe fabric and unnecessary other parts are scrapped. Such TPU scrap are collected and processed through scrap sorting, compounding, filtering, film extrusion, etc. to have a similar physical property with an original TPU film and then are reused in the same high frequency welding process, thus realizing a method for manufacturing a TPU film.
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THERMOPLASTIC POLYURETHANE FILM

Technical Field

The present invention relates to a Thermoplastic PolyUrethane (TPU) film for high frequency welding. More particularly, the present invention relates to a method for manufacturing a high frequency welding TPU film continuously reusable without a great deterioration of physical property or a change of high frequency workability even under severally repeated recycling conditions by recycling TPU film scrap that have been scrapped or recycled for low-grade use, and a TPU film manufactured by the method.

Background Art

As well known in the art, high frequency welding refers to a process of temporarily melting materials using a heat generated for a moment when high frequency is applied to the materials and adhering the molten materials to a base in a desired form. The high frequency welding is a general technology used in several industrial fields. Such a high frequency welding technology has been applied even to the shoe manufacturing industry over a few years. The high frequency welding technology is a simple method for welding polymer film materials (e.g., Thermoplastic PolyUrethane (TPU), Polyvinyl Chloride (PVC), etc.) printed in various forms and colors, to a surface of a shoe fabric in a desired form so as to ornament an outward appearance of a shoe.

In the shoe industries, polymer film material is called a high frequency film, and TPU, PVC, etc. are used as principal materials. The PVC is in the trend of being regulated in use because of an environmental problem and thus, a TPU film is used in most of the shoe manufacturing fields.

Also, TPU is very diverse in kind depending on its physical property. Of them, TPU having a shore hardness of 80A to 90A suitable for a high frequency film is mainly used.
If having lower shore hardness, a TPU film is so soft that its process is difficult and formability is poor. If having higher shore hardness, a TPU film has an excellent physical property and thus, its high frequency cutting or welding of a desired form is difficult and use is difficult. Thus, a high frequency welding TPU film is mostly manufactured to have a shore hardness of 80A to 90A.

A process of using a high frequency film in a shoe manufacturing process is described below. First, the high frequency film is screen printed in a desired form and color. Then, the high frequency film is coated with water or oil based ink a few times such that it is printed in a specific shape and color. After that, if the ink is completely dried, high frequency welding is performed. Then, a high frequency mold is attached to a high frequency machine and then, a base to which the high frequency film is to be adhered is placed at the bottom and the printed high frequency film is put on the base. Then, if the high frequency machine is operated, the high frequency mold presses the high frequency film at a set pressure and simultaneously, applies high frequency to the high frequency film. The high frequency film heated by high frequency is cut by a pressure of the high frequency mold while being welded to the base. Except for a portion of the high frequency film pressed and cut by the high frequency mold and welded to the base, remaining portions are removed as becoming unnecessary. These are generally called high frequency scrap.

High frequency scrap generated in a high frequency process as above can be no longer used for a shoe manufacturing process and thus, are scrapped as waste materials. Most factories hand over the scrap to a waste collection and disposal company. The waste collection and disposal company sorts and reuses the scrap when manufacturing a polyurethane resin product for a simple and low-grade use or uses the scrap as general plastic mixing materials.
However, TPU used in a shoe manufacturing process is very expensive and is very excellent in physical property. Thus, TPU reused for a low-grade use after a single use is a very big economic loss and results in a waste of resources.

Disclosure

Technical Problem

Accordingly, the present invention is directed to a Thermoplastic PolyUrethane (TPU) film that substantially obviates one or more of the problems due to limitations and disadvantages of the related art.

An object of the present invention is to provide a method for reprocessing high frequency TPU film scrap generated during a high frequency welding process that is one of shoe manufacturing processes and manufacturing the scrap as a high frequency welding TPU film, and a TPU film manufactured by the method.

Another object of the present invention is to provide a method for manufacturing a high frequency welding TPU film by recycling TPU film scrap, for reprocessing TPU film scrap generated during a high frequency shoe welding process and, by physical property adjustment, allowing the TPU film scrap to be used as a high frequency film, and a TPU film manufactured by the method.

A further object of the present invention is to provide a method for manufacturing a high frequency welding TPU film by recycling TPU film scrap, for preventing a failure to keep excellent characteristics of TPU materials from occurring because an expensive TPU film is used only in part and remaining most parts scrap are wasted or diverted to low-grade use, thus reducing a cost of a shoe manufacturing process and saving resources, and a TPU film manufactured by the method.

Technical Solution

To achieve these and other advantages and in accordance
with the purpose of the present invention, as embodied and broadly described, there is provided a method for manufacturing a high frequency welding Thermoplastic PolyUrethane (TPU) film by recycling TPU film scrap. The method includes a first step of pulverizing high frequency scrap generated in a high frequency process, a second step of mixing the pulverized high frequency scrap with TPU, adjusting the physical property of the scrap, extruding the resultant, and manufacturing recycling TPU, and a third step of extruding the recycling TPU and manufacturing a high frequency welding TPU film.

The extruding step includes eliminating foreign materials by installing a screen metal network.

The second step includes extruding the pulverized high frequency scrap of the first step, eliminating foreign materials, and manufacturing the high frequency scrap in a pellet form, blending the high frequency scrap pellet with TPU that is raw material, and extruding the resultant, eliminating foreign materials, and manufacturing a recycling TPU pellet.

**Advantageous Effects**

An exemplary embodiment of the present invention can manufacture a Thermoplastic PolyUrethane (TPU) film reusable as a high frequency film of the same use by reprocessing TPU film scrap generated in a high frequency welding process. In addition, an exemplary embodiment of the present invention can also use a recycling film going through a repeated process of several times with no great difference of initial recycling state and appearance, physical property, and high frequency workability. Due to this, an exemplary embodiment of the present invention recycles high frequency film scrap scrapped or recycled for low-grade use, thus being able to achieve an economical effect and an environment-friendly effect.
Description of Drawings

FIG. 1 is a diagram illustrating a manufacturing process of a first step of collecting, sorting, washing, and pulverizing high frequency Thermoplastic PolyUrethane (TPU) film scrap when recycling the TPU film scrap and manufacturing a high frequency welding TPU film according to an exemplary embodiment of the present invention;

FIG. 2 is a diagram illustrating a manufacturing process of a second step of performing compounding to adjust the physical properties of the high frequency scrap pulverized through the manufacturing process of the first step of FIG. 1; and

FIG. 3 is a diagram illustrating a manufacturing process of a third step of extruding a high frequency welding TPU film using a recycling TPU pellet going through the manufacturing process of the second step of FIG. 2.

Best Mode for Carrying out the Invention

Hereinafter, exemplary embodiments of the present invention will be described in detail with reference to accompanying drawings. In a detailed description below, a typical exemplary embodiment of the present invention will be provided to achieve the aforementioned technical solution. Other possible exemplary embodiments of the present invention are substituted with a description of a construction of the present invention.

An exemplary embodiment of the present invention provides a technical construction for collecting TPU film scrap remaining after use during a shoe manufacturing process and again processing the TPU film scrap into a high frequency welding Thermoplastic PolyUrethane (TPU) film for reuse.

In detail, during a shoe manufacturing process, a process of printing and attaching a TPU film to a shoe fabric in various forms in a high frequency welding method is frequently performed. In this process, only part of a TPU film of a desired shape is attached to the shoe fabric and
unnecessary other parts are scrapped. Such TPU scrap are collected and processed through scrap sorting, compounding, filtering, film extrusion, etc. to have a similar physical property with an original TPU film and then are reused in the same high frequency welding process, thus realizing a method for manufacturing a TPU film according to an exemplary embodiment of the present invention.

An exemplary embodiment of the present invention mainly includes three steps so as to reprocess high frequency film scrap, etc. and then blend the high frequency film scrap with TPU that are raw materials, thus manufacturing a high frequency welding TPU film. In detail, an exemplary embodiment of the present invention includes a first step of washing and pulverizing high frequency scrap, a second step of compounding the high frequency scrap to adjust the physical properties of the high frequency scrap, and a third step of extruding the high frequency scrap as a high frequency welding TPU film. This is described in detail with reference to FIGS. 1 to 3.

FIG. 1 is a diagram illustrating a manufacturing process of a first step of collecting, sorting, washing, and pulverizing high frequency TPU film scrap when recycling and manufacturing the TPU film scrap as a high frequency welding TPU film according to an exemplary embodiment of the present invention. The first step is comprised of a series of processes of collecting high frequency welding film scrap among a diversity of kinds of scrap generated upon execution of a high frequency welding process in a shoe factory and then sorting, washing, and pulverizing the scrap.

As such, an exemplary embodiment of the present invention collects and recycles only high frequency welding film scrap among a variety of kinds of scrap generated during a high frequency process. This is because of the following reasons.

The high frequency process uses a different kind of several materials in addition to a high frequency film. These
materials are equal to a molding processing TPU film, synthetic leather, natural leather, a polyester film, etc. It is important that these materials are completely collected and separated from high frequency film scrap. If these components are film extruded in a state of being mixed with high frequency scrap, the components appear as foreign materials on a surface of the final film, thus being able to cause surface defects, reducing production speed, and reducing productivity.

A detailed description is made with reference to FIG. 1. After a variety of kinds of foreign materials are sorted from TPU film scrap (hereinafter, referred to as "high frequency scrap"), the sorting-completed high frequency scrap are washed with water in a large size washing machine to eliminate stuck contaminants from surfaces of the scrap. After washing, the high frequency scrap are dried (i.e., are oven dried) during 20 minutes at a temperature of about 30 °C to 60 °C (desirably, 50 °C) to eliminate remaining moisture from the high frequency scrap.

It is essential that the dried high frequency scrap are pulverized in a predetermined form such that they are used in an extrusion work to be performed in a second step. A pulverizer is manufactured to have a punching plate of a diameter of 8 mm to 12 mm and pulverizes high frequency scrap. It is desirable that the pulverized high frequency scrap has a diameter of 5 mm or less.

A large amount of pulverized powder is generated during a pulverization process. In order to eliminate the pulverized powder, a centrifugal separator is used. That is, if the pulverized high frequency scrap are input together with water to the centrifugal separator, heavy normal pulverized high frequency scrap go to the bottom and other light pulverized powder is separated together with water.

The pulverized high frequency scrap passing through the centrifugal separator contain a large amount of moisture and thus, the scrap are dried in a hopper drier for moisture
elimination. It is desirable that drying is performed at 50 °C for 20 minutes.

A process of mixing the dried high frequency scrap with each other in a mixer is performed. In detail, print ink of various colors remains on surfaces of the high frequency scrap and thus, the scrap should be mixed with each other to the maximum to produce a final film of a uniform color (i.e., a high frequency welding TPU film). Thus, the process of mixing the pulverized high frequency scrap of various colors is performed.

The pulverized high frequency scrap going through the mixing process is dried in the hopper drier and, if so, is produced as pulverized high frequency scrap of a uniform color. After the first step, the pulverized high frequency scrap of a uniform color goes through a compounding step. This is described in detail in FIG. 2. The resultant of the first step is named as "pulverized high frequency scrap" below.

FIG. 2 is a diagram illustrating a manufacturing process of a second step of performing compounding to adjust the physical properties of pulverized high frequency scrap going through the manufacturing process of the first step of FIG. 1. The second step is a process of adjusting the physical properties of pulverized high frequency scrap. In detail, the second step includes blending pulverized high frequency scrap with antioxidant, manufacturing the resultant in a pellet form, blending the resultant with TPU that is raw material, and producing a recycling TPU pellet.

A ratio of blending pulverized high frequency scrap with antioxidant is shown in Table 1 in detail. Table 2 shows a ratio of blending molding scrap, which are to be referred below, with antioxidant.

| Table 1 |
|-----------------|--------|
| High frequency film scrap (Shore hardness of 80 to 86A) | 100 weight parts |
Referring to FIG. 2, the pulverized high frequency scrap is blended with antioxidant as shown in Table 1 and then, the resultant is extruded by a single-screw extruder and is manufactured to be in a pellet state convenient for use. That is, the pulverized high frequency scrap is manufactured to have a pellet shape using the single-screw extruder constructed by a single screw and then, is dried in the hopper drier. The pulverized high frequency scrap can be used in a pulverized state as it is without being processed in a pellet form. However, it is desirable that, for blended materials to be uniformly input to the extruder, the pulverized high frequency scrap is processed in a pellet form and then is mixed with real TPU that is raw material for use.

Meantime, although a process of separating remaining foreign materials from the high frequency scrap pulverized in the first step is performed, the foreign materials cannot be completely eliminated. Thus, in an exemplary embodiment of the present invention, a screen filter (or a metal net filter) is installed in a single-screw extruder to once more eliminate various kinds of foreign materials. Thus, remaining foreign materials are eliminated from the pulverized high frequency scrap during an extrusion process. That is, just before molten and pulverized high frequency scrap are discharged from the single-screw extruder through a general dice, foreign materials are eliminated through an installed dual screen filter. As such, foreign materials elimination is a factor of much importance to an appearance of a final product. Thus, in an exemplary embodiment of the present
invention, a multiple screen filter is installed in the single-screw extruder to eliminate foreign materials to the maximum.

Also, among scrap generated in a shoe manufacturing process, even a TPU film of a high shore hardness of 95A for molding processing not for high frequency is mixed in great quantities. These are separately sorted, are then blended with antioxidant as given in Table 2 below, and then are processed in a pellet form (hereinafter, referred to as "molding scrap pellet") using a single-screw extruder. Then, the resultant is added and used to adjust physical property.

Meantime, TPU resin can easily absorb moisture because of its chemical structural characteristic. Although the moisture-absorbing resin is extruded after dried, a considerable reduction of its molecular weight takes place because extrusion is performed at high temperature. The reduction of the molecular weight appears as a deterioration of the physical property of the resin and thus, the repeatedly extruded resin is greatly deteriorated in physical property compared to original resin and suffers even a yellowing phenomenon caused by oxidation.

Accordingly, an exemplary embodiment of the present invention compensates for a deterioration of physical property caused by a repeated extrusion work by appropriately mixing the pellet type high frequency scrap (hereinafter, referred to as "high frequency scrap pellet") with real TPU of a fresh state. In order to mix the high frequency scrap pellet with the real TPU that is raw material, an extrusion work is performed using a dual-screw extruder (generally, an extruder with two screws) having good mixture efficiency. Similarly even at this time, a screen filter is installed in a dual-screw extruder to eliminate each variety of kinds of foreign materials, thus preventing the foreign materials from being mixed in.

Tables 3 to 5 below show the conditions for blending between a high frequency scrap pellet and real TPU that is
raw material in each exemplary embodiment of the present invention. A blending ratio of resin below is to realize a best mode of an exemplary embodiment of the present invention and thus, can be variously modified without limiting the scope of the invention.

Table 3

<table>
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<tr>
<th>First exemplary embodiment (unit: weight part)</th>
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<tr>
<td>High frequency scrap pellet</td>
<td>100</td>
</tr>
<tr>
<td>Molding scrap pellet</td>
<td>20 to 30</td>
</tr>
<tr>
<td>Real TPU with shore hardness of 85 to 87A</td>
<td>2 to 6</td>
</tr>
<tr>
<td>Real TPU with shore hardness of 90 to 93A</td>
<td>70 to 80</td>
</tr>
<tr>
<td>Ultraviolet (UV) anti-yellowing agent</td>
<td>0.3 to 0.6</td>
</tr>
<tr>
<td>Antioxidant</td>
<td>0.1 to 0.3</td>
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Table 4

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<th>Second exemplary embodiment (unit: weight part)</th>
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<tr>
<td>High frequency scrap pellet</td>
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<tr>
<td>Molding scrap pellet</td>
<td>20 to 30</td>
</tr>
<tr>
<td>Real TPU with shore hardness of 85 to 87A</td>
<td>2 to 6</td>
</tr>
<tr>
<td>Real TPU with shore hardness of 95 to 97A</td>
<td>20 to 40</td>
</tr>
<tr>
<td>UV anti-yellowing agent</td>
<td>0.3 to 0.6</td>
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<tr>
<td>Antioxidant</td>
<td>0.1 to 0.3</td>
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Table 5

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<th>Third exemplary embodiment (unit: weight part)</th>
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<tr>
<td>High frequency scrap pellet</td>
<td>20</td>
</tr>
<tr>
<td>Molding scrap pellet</td>
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</tr>
<tr>
<td>Real TPU with shore hardness of 85 to 87A</td>
<td>60 to 80</td>
</tr>
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As above, while a mixture blended with components provided in each exemplary embodiment of the present invention depending on a component ratio is extruded, foreign materials are eliminated through a dual-screw extruder. After that, the mixture is dried in a hopper drier and produced as a recycling TPU pellet.

Meantime, recycling TPU pellets going through the first and second steps have physical properties shown in Table 6. The results of these physical properties are not problematic in use for high frequency welding. The results are not greatly different from those of a non-recycling high frequency film because an actual high frequency work result shows good high frequency welding, cutting, and stickiness.

| Table 6 |
|---------------------------------|---------|---------|---------|----------------|
| 1st exemplary embodiment       | 2nd exemplary embodiment | 3rd exemplary embodiment | Reference physical property |
| 300% modulus (kgf/cm²)         | 100     | 90      | 110     | > 80           |
| Breaking strength (kgf/cm²)    | 280     | 250     | 290     | > 200          |
| Elongation (%)                 | 550     | 500     | 600     | 450            |
| High frequency stickiness strength (kgf/cm²) | > 3.0   | > 3.0   | > 3.0   | > 2.5          |

After the second step, the recycling TPU pellet goes through a film extrusion step that is the last step. This is described in detail with reference to FIG. 3. The resultant
going through the second step is named as "recycling TPU pellet" below.

FIG. 3 is a diagram illustrating a manufacturing process of a third step of extruding a high frequency welding TPU film using a recycling TPU pellet according to an exemplary embodiment of the present invention. Referring to FIG. 3, the third step is a step of extruding and processing a high frequency welding film using a recycling TPU pellet whose physical property is adjusted. Like the second step, in the third step, before molten resin (desirably, a recycling TPU pellet) is extruded through a T-dice, the resin is once more filtered passing through a screen filter, thus maximally eliminating possible foreign materials remaining up to the last step. In order to eliminate foreign materials to the maximum, a total of three times of screen filtering is performed.

Subsequent steps are the same as those of a general TPU film extrusion process and thus, are omitted in a detailed description of the present invention.

As described above, a high frequency welding TPU film manufactured through the first to third steps has an opaque image, has basically a gray color, and changes in color depending on the kind of contained ink of scrap. Also, a high frequency film is manufactured to have black color not gray color by separately sorting and processing scraps much containing almost blackish ink. If a base fabric to be high frequency welded is dark that is almost black color, a work using a black high frequency film gets appearance cleaner than a gray high frequency film.

A finally manufactured high frequency film has a similar physical property with a high frequency film used as raw material scrap. Although the high frequency film manufactured through the process of each of the steps is repeatedly recycled through the same process as the manufacturing method of the present invention, the physical property is not deteriorated.
While the present invention has been described and illustrated herein with reference to the preferred embodiments thereof, it will be apparent to those skilled in the art that various modifications and variations can be made therein without departing from the spirit and scope of the invention. Thus, it is intended that the present invention covers the modifications and variations of this invention that come within the scope of the appended claims and their equivalents.
**Claims**

1. A method for manufacturing a high frequency welding Thermoplastic PolyUrethane (TPU) film by recycling TPU film scrap, the method comprising:
   - a first step of pulverizing high frequency scrap generated in a high frequency process;
   - a second step of mixing the pulverized high frequency scrap with TPU, adjusting the physical property of the scrap, extruding the resultant, and manufacturing recycling TPU; and
   - a third step of extruding the recycling TPU and manufacturing a high frequency welding TPU film.

2. The method of claim 1, wherein the extruding step comprises eliminating foreign materials by installing a screen metal network.

3. The method of claim 1, wherein the second step comprises:
   - extruding the pulverized high frequency scrap of the first step, eliminating foreign materials, and manufacturing the high frequency scrap in a pellet form;
   - blending the high frequency scrap pellet with TPU that is raw material; and
   - extruding the resultant, eliminating foreign materials, and manufacturing a recycling TPU pellet.

4. The method of claim 3, wherein the pulverized high frequency scrap is blended with antioxidant and then, is manufactured in a pellet form.

5. The method of claim 3, wherein a molding scrap pellet, TPU having a shore hardness of 85A to 87A, TPU having a shore hardness of 90A to 93A, a Ultraviolet (UV) anti-yellowing agent, and an antioxidant are further added and blended at a time the high frequency scrap pellet is blended.
with TPU that is raw material.

6. The method of claim 3, wherein a molding scrap pellet, TPU having a shore hardness of 85A to 87A, TPU having a shore hardness of 95A to 97A, a UV anti-yellowing agent, and an antioxidant are further added and blended at a time the high frequency scrap pellet is blended with TPU that is raw material.

7. A high frequency welding TPU film manufactured by a method claimed in any one of claims 1 to 6.
INPUT HIGH FREQUENCY SCRAP

SORT FOREIGN MATERIALS

PRIMARY WASH AND DEHYDRATION

OVEN DRY

PULVERIZE HIGH FREQUENCY SCRAP

SECONDARY WASH AND CENTRIFUGAL DEHYDRATION

DRY IN HOPPER DRIER

MIX PULVERIZED HIGH FREQUENCY SCRAP

DRY AND STORE

PRODUCE DECOMPOSED HIGH FREQUENCY SCRAP OF UNIFORM COLOR
Fig. 2

- Blend pulverized high frequency scrap of uniform color
- Extrusion with single-screw extruder
- Primary filtering through screen filter
- Generate scrap in pellet type
- Dry in hopper drier
- Blend high frequency scrap pellet with TPU that is raw material
- Extrusion with dual-screw extruder
- Secondary filtering through screen filter
- Dry in hopper drier
- Produce recycling TPU pellet
A. CLASSIFICATION OF SUBJECT MATTER

**B29D 7/01(2006.01)1**

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 8 B29D 7/01, B29B 1700

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

Korean Utility models and applications for Utility models since 1975

Japanese Utility models and applications for Utility models since 1975

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

eKIPASS(KIPO internal), PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
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<td>KR 10200601 15567 A(Park, Hee Dae) 09 November 2006</td>
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<td>1-7</td>
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<tr>
<td>A</td>
<td>KR 102002094225 A(Park, Ju Hysun) 18 December 2002</td>
<td>1-7</td>
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<td>A</td>
<td>JP 2000336264 A(Nippon Steel Chem CO LTD) 05 December 2000</td>
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Further documents are listed in the continuation of Box C

See patent family annex

* "A" document defining the general state of the art which is not considered to be of particular relevance

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* "P" document published prior to the international filing date but later than the priority date claimed

"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

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"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

"&" document member of the same patent family

Date of the actual completion of the international search

06 AUGUST 2009 (06 08 2009)

Date of mailing of the international search report

07 AUGUST 2009 (07.08.2009)

Name and mailing address of the ISA/KR

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Facsimile No 82-42-472-7140

Authorized officer

KIM, Sung Sik

Telephone No 82-42-481-8159

Form PCT/ISA/210 (second sheet) (July 2008)
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