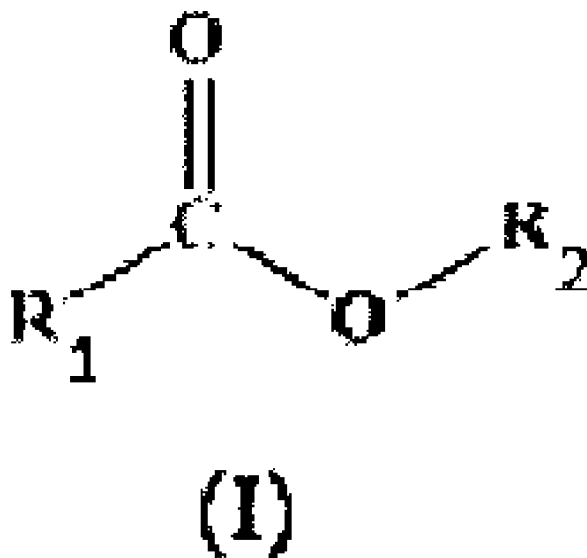




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(54) Title: PLASTICIZER COMPOSITION



(57) Abstract: The invention relates to a plasticizer composition comprising a terephthalic acid di-ester and an ester having the following formula (I): wherein R<sub>1</sub> and R<sub>2</sub> are the same or different and represent a straight chain, branched or cyclic hydrocarbyl group. R<sub>1</sub> and R<sub>2</sub> in formula (I) have from 1 to 15 carbon atoms. The invention further relates to a polymer composition comprising a plasticizer composition comprising a terephthalic acid di-ester and an ester having the following formula (I).

**Title of Invention**

PLASTICIZER COMPOSITION

**Field of the invention**

5 The present invention relates to a plasticizer composition comprising a terephthalic acid di- ester and a mono-ester that are suitable for plasticizing polymers such as vinyl polymer, halogen-containing polymer, chlorosulfonated polyethylene, cellulose ester, acrylic polymer, polyacetal or the mixture thereof.

**Background of the invention**

10 Plasticizers are compounds or mixtures of compounds that are incorporated into a polymer resin to increase the softness, flexibility, workability, or distensibility of the polymer resin. Common plasticizer includes phthalates, in particular, ortho-phthalates. In recent years, di-2-ethylhexyl phthalate (DEHP or DOP) and shorter alkyl chain length phthalate esters have been restricted in certain applications or are the subject of increased scrutiny due to their toxicological properties and the world wide environmental regularity. Thus, it must be at least considered that alternative plasticizers will be required. For these and most other uses of plasticized polymer systems, high molecular weight phthalates like diisodecyl phthalate (DIDP) and also the plasticizer free of ortho-phthalate such as terephthalic esters like dioctyl terephthalate (DOTP),  
15 cyclohexane acid ester like diisononyl 1,2-cyclohexanedicarboxylate (DINCH) have been developed.

20 US2628207 discloses a composition comprising 100 parts of a resinous copolymer of about 95% vinyl chloride and about 5% vinyl acetate, and 5-100 parts of a DOTP.

US2010/0305250 discloses C7-C12 secondary alcohol esters of cyclohexanecarboxylic acids as plasticizers for polyvinyl chloride (PVC) and other plasticizable polymers.

30 WO2008/140177 discloses a plasticizer composition comprising at least three different terephthalic acid compounds.

US2013/0310472A1 discloses a foamable composition containing a polymer selected from the group consisting of polyvinyl chloride, polyvinylidene

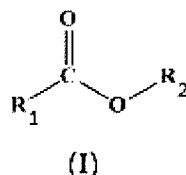
chloride, polyvinyl butyrate, polyalkyl(meth)acrylate and copolymers thereof, a foam former and/or foam stabilizer and di-2-ethylhexyl terephthalate as plasticizer.

US2003/0014948A1 describes the plasticized polyvinyl chloride (PVC) wherein plasticizers comprising dioctyl terephthalate and dioctyl adipate.

US2014/0162045A1 describes a polyvinyl chloride (PVC) article, comprising a PVC resin, a primary plasticizer and a metal-carboxylate acid scavenger. The PVC article further comprises a secondary plasticizer. The primary and secondary plasticizer are selected from the group consisting of phthalates, terephthalate, epoxidized vegetable oils, trimellitates, polyesters, phosphates, citrates, benzoates, sulphonates, and adipates.

Despite all the above-mentioned work, an efficient plasticizer, which can enhance processability, plasticizer absorption speed, weight stability at high temperature, electrical volume resistivity and also reduce defect point of the plasticized polymer at comparable strength, migration and heat stability properties, is still being sought.

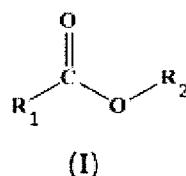
It has surprisingly been found that this object can be achieved by a plasticizer composition comprising a terephthalic acid di-ester and an ester having the following formula (I):



wherein R<sub>1</sub> and R<sub>2</sub> are the same or different and represent a straight chain, branched or cyclic hydrocarbyl group.

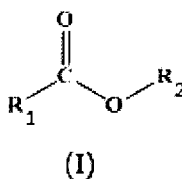
## SUMMARY

A first embodiment of the present invention relates to a plasticizer composition comprising a terephthalic acid di-ester and an ester having the following formula (I):



wherein R<sub>1</sub> and R<sub>2</sub> are the same or different and represent a straight chain, branched or cyclic hydrocarbyl group.

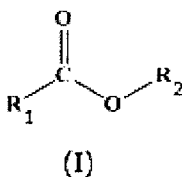
Another embodiment of the present invention relates to a polymer composition comprising at least one polymer selected from the group consisting of vinyl polymer, halogen-containing polymer, chlorosulfonated polyethylene, cellulose ester, acrylic polymer, polyacetal or the mixture thereof, and a plasticizer composition comprising a terephthalic acid di-ester and an ester having the following formula (I)



wherein R<sub>1</sub> and R<sub>2</sub> are the same or different and represent a straight chain, branched or cyclic hydrocarbyl group.

#### 10 DETAILED DESCRIPTION

A plasticizer composition comprising a terephthalic acid di-ester and an ester having the following formula (I):

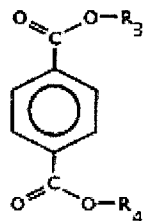


wherein R<sub>1</sub> and R<sub>2</sub> are the same or different and represent a straight chain, branched or cyclic hydrocarbyl group, preferably alkyl group. R<sub>1</sub> and R<sub>2</sub> may have from 1 to 15 carbon atoms. Preferably, R<sub>1</sub> is an alkyl group having from 1 to 12 carbon atoms, more preferably from 2 to 8 carbon atoms, and most preferably from 2 to 7 carbon atoms. R<sub>2</sub> is preferably an alkyl group having from 7 to 15 carbon atoms, more preferably from 7 to 14 carbon atoms, most preferably from 7 to 9 carbon atoms. In yet another preferred embodiment, R<sub>2</sub> is an alkyl group having from 7 to 8 carbon atoms.

Most preferably, the ester of formula (I) has 11 to 23 carbon atoms. If the ester of formula (I) has less than 11 carbon atoms, it will be more volatile at room temperature. On the contrary, if the ester of formula (I) has a number of carbon atoms greater than 23, it will be in solid form at room temperature resulting in poorer processability of and compatibility with the polymer resin.

The terephthalic acid di-ester has preferably the following formula (II):

4



(II)

wherein R<sub>3</sub> and R<sub>4</sub> are the same or different and represent a straight chain or branched alkyl group having from 6 to 15 carbon atoms, preferably from 8 to 10 carbon atoms. If an alkyl group having a low number of carbon atoms is used, migration will be increased. On the contrary, if an alkyl group having a larger number of carbon atoms is used, compatibility with the polymer resin will decrease due to its high viscosity. The processability of plasticized polymer composite will also be poorer.

Mixtures of the terephthalic acid di-ester and an ester of formula (I) can comprise any ratio of the terephthalic acid di-ester and an ester of formula (I). A suitable mixture could include the terephthalic acid di-ester in an amount of from 80% to 99.7% by weight, preferably 85% to 99.5% by weight, more preferably in an amount of from 92% to 98.5%, and most preferably in an amount of from 92% to 97% by weight with respect to the total amount of the plasticizer composition. Likewise, a suitable mixture could include the ester of formula (I) in an amount of from 0.3% to 20% by weight, preferably 0.5% to 15% by weight, more preferably in an amount of from 1.5% to 8%, and most preferably in an amount of from 3% to 8% by weight with respect to the total amount of the plasticizer composition. In an embodiment, the plasticizer composition consists of a mixture of the terephthalic acid di-ester and an ester of formula (I) in any of the above described embodiments.

The potential use of the plasticizer composition of the present invention is the use as plasticizer for various polymer resins such as vinyl polymer, halogen-containing polymer, chlorosulfonated polyethylene, cellulose ester, acrylic polymer, polyacetal or the mixture thereof, preferably acrylate elastomer, polyvinyl butyral, polyvinyl chloride, epichlorohydrin, chlorosulfonated polyethylene, cellulose-acetate butyrate, most preferably polyvinyl chloride.

The plasticizer composition of the present invention has excellent compatibility with the polymer, especially polyvinyl chloride. This is due to a low viscosity of the said plasticizer composition where the ester of formula (I) acts as a viscosity reducer and an absorption speed improver for the terephthalic acid di-ester.

Another embodiment of the present invention relates to a polymer composition comprising at least one polymer and a plasticizer composition comprising a terephthalic acid di-ester and an ester of formula (I).

The polymer of this embodiment is selected from the group consisting of vinyl polymer, halogen-containing polymer, chlorosulfonated polyethylene, cellulose ester, acrylic polymer, polyacetal or mixtures thereof, preferably acrylate elastomer, polyvinyl butyral, polyvinyl chloride, epichlorohydrin, chlorosulfonated polyethylene, cellulose-acetate butyrate, most preferably polyvinyl chloride.

In the polymer composition of this embodiment, the plasticizer composition comprising terephthalic acid di-ester and an ester of formula (I) may be used in any of the embodiments as described herein before.

The polymer composition of this invention preferably comprises 10 to 100 parts by weight of the plasticizer composition per 100 parts by weight of polymer, more preferably comprises 40 to 60 parts by weight per 100 parts by weight of the polymer.

The polymer composition of this invention is easily processed, mixed or formed due to the fact that said plasticizer composition has a low viscosity and a good compatibility with the polymer and, thus, helps to reduce the polymer viscosity while processing, mixing or forming the said polymer composition. Then, the mixing time and cooling time can also be reduced, in which a homogeneous distribution still is obtained, resulting in improved energy saving and higher productivity. Moreover, this polymer composition has a lower decomposition weight, defect point, and higher electrical volume resistivity.

The polymer composition of this present invention further comprises at least one additive selected from the group consisting of fillers, extenders, pigments, thermal stabilizers, UV stabilizers, viscosity regulators, rheological additives, foam formers, foam stabilizers, antistatic agent, impact modifiers and lubricants.

The polymer composition of the invention can be used for the production of compounds, electric wire/cable compounds, wiring harness, sheets, tapes, films, food packages, hoses, auto parts, seal liners, gasket, medical supplies, construction materials, household items, shoes, floor materials, synthetic leathers, tarpaulins, wallpapers, toys, etc.

In the following, the invention is further illustrated by way of examples.

## Methods and definitions

### 1. Determination of plasticizer composition viscosity

The viscosity of the plasticizer composition is determined according to ASTM D2196 (Brookfield viscometer), testing at 25°C and using spindle no. 0.

### 2. Determination of plasticizer absorption time

Plasticizer absorption time is determined by the procedure of ASTM D2396-88. The time taken from the addition of the plasticizer until the kneading torque of the planetary mixer reached a minimum is measured as plasticizer absorption time.

### 3. Determination of physical properties of the polymer composites

#### a) *Hardness*

The specimen with thickness of 3 mm is measured according to ASTM D2240 with a hardness tester or durometer (Type A) at five different positions on the specimen and the average value was reported.

#### b) *Migration* is a measure of the plasticizer migration content.

The specimen with thickness of 1 mm is heated in an oven at 70°C for 10 days and % migration was calculated by the following formula:

$$\% \text{ Migration} = \frac{\text{Weight before oven} - \text{Weight after oven}}{\text{Weight before oven}} \times 100$$

#### c) *Volume resistivity (VR)* is a measure of the electrical volume resistance of the polymer compositions.

Volume resistivity is determined according to ASTM D257. The specimen with thickness of 2 mm is placed between two electrodes. For sixty seconds, a voltage is applied and the resistance is measured. Surface or volume resistivity is calculated, and apparent value is given (60 seconds electrification time).

#### d) *Heat stability* is a measure of the endurance of the polymer composite to the heat.

Heat stability is determined by Metastat machine at 200°C and 200 minutes. The specimen thickness of 1 mm is visually inspected for discoloration and other signs of degradation. The time of the specimen start to change the color (initial discoloration) and the time of the specimen start to burn (burnt discoloration) are recorded.

e) *Weight stability* (%Weight loss) is a measure of the decomposition of polymer compositions after heating.

The specimen with thickness of 1 mm is punched into dumbbell shape and then heated at 100°C for 168 hours and the %weight loss was calculated as below.

5

Weight loss (%)

$$= \frac{(\text{Weight of specimen before aging} - \text{Weight of specimen after aging}) \times 100}{\text{Weight of specimen before aging}}$$

f) *The yellowness index* is a measure of yellow discoloration of a specimen.

The specimen with thickness of 1 mm is measured by the Data color machine 600TM according to ASTM D9125.

g) *Tensile strength and %Elongation*

10

Tensile strength and Elongation is measured by JIS K6723. The specimen in dumbbell shape is extended at the cross head speed of 200 mm/min by using the test machine U.T.M. The breaking point is measured. Tensile strength and Elongation are calculated by the following formula.

$$\text{Tensile strength } \left( \frac{\text{kgf}}{\text{mm}^2} \right) = \frac{\text{Load value (kgf)}}{\text{Width (mm)} \times \text{Thickness (mm)}}$$

15

$$\% \text{ Elongation} = \frac{\text{Extension}}{\text{Primary length}} \times 100$$

h) *Brittleness temperature* is a measure of the temperature where the polymer composition endures low temperatures before the brittleness is found. The lower the brittleness temperature, the higher the endurance of the polymer composite regards low temperatures.

20

The specimen with thickness of 2 mm is measured using the Clash and Berg test (ASTM D746 brittleness test) during the temperature range from -30 to -50 °C by temperature rate 2 °C /min.

i) *Fish eyes* are a surface defect that results from unmelted material appearing on the surface of a molded part.

25

Fish eye is measured according to ASTM D3596-09. PVC resin, plasticizer, heat stabilizer and carbon black is hand mixed separately and the compound is milled

at 145 °C for 5 minutes, folding edges only once at one minute intervals. The milled sheet with thickness of 1 mm is removed, allowed to cool and placed on a black lighted surface. Gel or hard particle per unit area is counted under magnification.

5 The abbreviations used in the below tables have the following meanings:

PVC : polyvinyl chloride resin

DOTP : di(2-ethylhexyl) terephthalate

DIDP : di-isodecyl phthalate

DINCH : di-isononyl 1,2-cyclohexanedicarboxylate

10 2EHP : 2-ethylhexyl propionate

2EHNN : 2-ethylhexyl isononanoate

DOA : di(2ethylhexyl) adipate

ATBC : acetyl tri-butyl citrate

EPO : epoxidize soyabean oil

15 Hereinafter, the present invention is described in more detail through the following examples and comparative examples. However, the following examples are only for the understanding of the present invention, and the present invention is not limited to the following examples.

## 20 **First embodiment**

Plasticizer compositions of this invention and the comparative plasticizers were prepared by stirring the mixtures at 40 rpm and ambient temperature for 5 minutes. Then, the properties were evaluated as presented in Table 1.

Table 1

	Example (%weight of total plasticizer composition weight)										
	IE1	IE2	IE3	IE4	IE5	IE6	CE1	CE2	CE3	CE4	CE5
DOTP	98.1	96.2	94.4	92.7	89.5	96.2	100.0	-	-	96.2	96.2
2EHP	1.9	3.8	5.6	7.3	10.5	-	-	-	-	-	-
2EHNN	-	-	-	-	-	3.8	-	-	-	-	-
DIDP	-	-	-	-	-	-	-	100.0	-	-	-
DINCH	-	-	-	-	-	-	-	-	100.0	-	-
DOA										3.8	-
ATBC										-	3.8
Viscosity (cP)	59	44	42	40	40	50	62	93	55	55	54

Plasticizer absorption time (second)	260	235	233	218	209	286	290	302	371	264	309
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As apparent from Table 1, the presence of ester of formula (I) with DOTP (IE1-6) results in lower viscosity than DOTP solely (CE1), higher molecular weight phthalate plasticizer DIDP (CE2) and DINCH (CE3). The higher the amounts of ester of formula (I), the lower viscosities of the plasticizer compositions are found. At the same amount of second plasticizer, the plasticizer composition comprising DOTP and an ester of formula (I) (IE2 and IE6) has lower viscosity than the plasticizer composition comprising DOTP and DOA (CE4) and the plasticizer composition comprising DOTP and ATBC (CE5). These will lead to easier processing of plasticized polymer based on the plasticizer composition of this invention compared to the comparative plasticizers, in addition the lower molecular weight of the ester of formula (I) promotes this effect.

Table 1 also shows that the plasticizer absorption time of plasticizer composition comprising DOTP and ester of formula (I) (IE1-6), especially as regards the lower molecular weight ester of formula (I), are significantly shorter than plasticizer absorption time of DOTP (CE1), higher molecular weight phthalate plasticizer DIDP (CE2) and DINCH (CE3). The plasticizer compositions comprising DOTP and 2EHP (IE1-IE5) also show shorter plasticizer absorption time than the plasticizer composition comprising DOTP and DOA (CE4) and than the plasticizer composition comprising DOTP and ATBC (CE5).

Lower viscosity and shorter plasticizer absorption time using plasticizers composition comprising DOTP and the ester of formula (I), especially the lower molecular weight ester of formula (I), lead to faster processing time.

**Second embodiment**

Polymer compositions for cable compounds were prepared according to the materials and amounts as shown in Table 2. The components were dry blended and then mixed by a mixing roll at 160°C for 4 minutes to prepare a polyvinyl chloride composition sheet for testing heat stability. For testing the properties of hardness, tensile strength, elongation, plasticizer migration content, electrical volume resistance and

weight stability, the composition sheets were compressed by compression molding at 180°C for 5 minutes to a predetermined size. The results were shown in Table 2.

Table 2

	Polymer composition no.								
	1	2	3	4	5	6	7	8	9
Ingredients (phr)									
PVC	100	100	100	100	100	100	100	100	100
Calcium carbonate	30	30	30	30	30	30	30	30	30
Calcium zinc stabilizer	4	4	4	4	4	4	4	4	4
IE1	52								
IE2		53				-	-	-	
IE3			54						
IE4				55					
IE5					57				
CE1		-				54	-	-	
CE3		-				-	54	-	
CE4		-				-	-	53	
CE5									53
Properties									
Hardness <sup>1</sup>	86	85	85	85	85	85	85	84	84
Tensile strength (kgf/cm <sup>2</sup> )**	220	227	225	227	222	225	175	228	231
Elongation (%)**	312	308	310	315	304	316	317	328	343
Migration (%)*	8.0	7.6	8.2	8.2	8.1	9.4	13.5	9.1	7.4
Volume resistivity ** (x 10 <sup>13</sup> ohm.cm)	4	4	4	4	3	3	1	2	3
Heat stability**									
-Initial color (min)	45	48	45	45	45	45	36	46	50
-Burnt color (min)	140	140	140	140	140	140	120	150	150
Weight loss (%)*	1.2	1.6	2.0	2.0	2.0	2.8	3.1	2.9	3.8

5 <sup>1</sup>The hardness is the control parameter at value  $85 \pm 2$ .

\*The lower value, the more favorable the resulting composition

\*\* The higher value, the more favorable the resulting composition

10 Table 2 shows that the volume resistance and weight stability properties of the polymer compositions containing DOTP and 2EHP (polymer compositions 1 to 5) are better than the polymer compositions containing the comparative DOTP based plasticizer compositions (polymer compositions 6, 8 and 9) whereas properties such as plasticizer migration, tensile strength, %elongation, stay at comparable levels. Moreover, the polymer composition containing DINCH (polymer composition

7) shows most properties worse than the polymer compositions containing DOTP and 2EHP.

### Third embodiment

5 Polymer compositions for soft sheet and hose compound were prepared using the materials and amounts as shown in Table 3. The components were dry blended and then mixed by a mixing roll at 160 °C, for 4 minutes to prepare a polyvinyl chloride composition sheet for testing heat stability. For testing the properties of hardness, yellowness index, tensile strength, %elongation, plasticizer migration content, and  
10 brittleness, the composition sheets were compressed by compression molding at 180°C for 5 minutes to a predetermined size for testing. The results are shown in Table 3.

Table 3

	Polymer composition no.		
	10	11	12
Ingredients (phr)			
PVC	100	100	100
EPO	5	5	5
Calcium zinc stabilizer	0.75	0.75	0.75
Stearic acid	0.15	0.15	0.15
Paraffin wax	0.2	0.2	0.2
IE2	46	-	-
CE1	-	48	-
CE3	-	-	48
Properties			
Hardness <sup>1</sup>	83	83	83
Yellowness Index*	2.7	2.9	2.8
Tensile strength (kg/cm <sup>2</sup> )**	258	251	237
Elongation (%)**	350	349	356
Migration (%)*	7.9	8.6	14.0
Brittleness temperature (°C)*	-48	-48	-49
Heat stability**			
Initial color (min)	44	42	41
Burnt color (min)	100	90	80
Fish eye (number of points)*	5	15	45

<sup>1</sup>The hardness is the control parameter at value  $83 \pm 2$ .

15 \*The lower value, the more favorable the resulting composition

\*\* The higher value, the more favorable the resulting composition

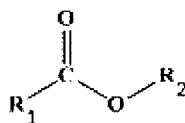
Table 3 shows that comparable hardness can be obtained with plasticizer composition comprising DOTP and 2EHP (polymer composition 10), wherein lower

amounts of plasticizer is present than in polymer compositions merely comprising DOTP or DINCH as plasticizer (polymer compositions 11 and 12). The plasticizer composition comprising DOTP and 2EHP (polymer composition 10) shows less defect point, and longer time before burnt than the plasticizer compositions merely comprising DOTP or DINCH as plasticizer (polymer compositions 11 and 12).

Moreover, the plasticizer composition comprising DOTP and 2EHP (polymer composition 10) has significantly lower migration than DINCH as plasticizer (polymer composition 12).

**Claims**

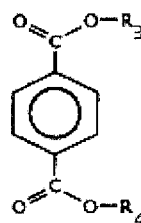
1. A plasticizer composition comprising a terephthalic acid di-ester and an ester having the following formula (I):



(I)

wherein R<sub>1</sub> and R<sub>2</sub> are the same or different and represent a straight chain, branched or cyclic hydrocarbyl group.

2. The plasticizer composition according to claim 1 wherein R<sub>1</sub> and R<sub>2</sub> in formula (I) are the same or different and represent a straight chain or branched alkyl group.
3. The plasticizer composition according to claims 1 or 2 wherein R<sub>1</sub> and R<sub>2</sub> in formula (I) independently from each other have from 1 to 15 carbon atoms.
4. The plasticizer composition according to any of the preceding claims, wherein R<sub>1</sub> is an alkyl group having from 1 to 12 carbon atoms.
5. The plasticizer composition according to any of the preceding claims, wherein R<sub>2</sub> is an alkyl group having from 7 to 15 carbon atoms.
6. The plasticizer composition according to any of the preceding claims, wherein the terephthalic acid di-ester has the following formula (II):



(II)

wherein R<sub>3</sub> and R<sub>4</sub> are the same or different and represent a straight chain or branched alkyl group having from 6 to 15 carbon atoms.

7. The plasticizer composition of any one of the preceding claims, wherein the terephthalic acid di-ester is present in an amount of from 80% to 99.7% by weight with respect to the total amount of the plasticizer composition.

8. The plasticizer composition according to claim 7, wherein the terephthalic acid di-ester is present in an amount of from 85% to 99.5% by weight with respect to the total amount of the plasticizer composition.
9. The plasticizer composition of any one of the preceding claims, wherein the ester of formula (I) is present in an amount of from 0.3% to 20% by weight with respect to the total amount of the plasticizer composition.
10. The plasticizer composition according to claim 9, wherein the ester of formula (I) is present in an amount of from 0.5% to 15% by weight with respect to the total amount of the plasticizer composition.
11. Use of the plasticizer composition according any one of the preceding claims for vinyl polymer, halogen-containing polymer, chlorosulfonated polyethylene, cellulose ester, acrylic polymer, polyacetal or the mixture thereof, preferably acrylate elastomer, polyvinyl butyral, polyvinyl chloride, epichlorohydrin, chlorosulfonated polyethylene, cellulose-acetate butyrate, most preferably polyvinyl chloride.
12. A polymer composition comprising at least one polymer selected from the group consisting of vinyl polymer, halogen-containing polymer, chlorosulfonated polyethylene, cellulose ester, acrylic polymer, polyacetal or the mixture thereof, and a plasticizer composition according to any one of claims 1 to 10.
13. The polymer composition of claim 12, wherein the polymer is polyvinyl chloride.
14. The polymer composition according to any of claims 12 or 13, wherein the plasticizer composition is present in an amount of 10 to 100 parts per 100 parts by weight of polymer, preferably 40 to 60 parts by weight of polymer.
15. The polymer composition of any of claims 12 to 14, further comprising at least one additive selected from the group consisting of fillers, extenders, pigments, thermal stabilizers, UV stabilizers, viscosity regulators, rheological additives, foam formers, foam stabilizers, antistatic agent, impact modifiers and lubricants.

**INTERNATIONAL SEARCH REPORT**

International application No  
PCT/TH2016/000059

**A. CLASSIFICATION OF SUBJECT MATTER**  
 INV. C08K5/101 C08K5/12  
 ADD.  
 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)  
 C08K C08L  
 Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)  
 EPO-Internal, WPI Data

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 2011/110350 A1 (EMERY OLEOCHEMICALS GMBH [DE]; DAUTE PETER [DE]; SCHAEFER MARTIN [DE];) 15 September 2011 (2011-09-15) claims 1, 2, 4-6 -----	1-15
Y	US 2 628 207 A (SMITH JR PAUL V ET AL) 10 February 1953 (1953-02-10) cited in the application column 1, line 40 - line 45; claims 1-4 -----	1-15

Further documents are listed in the continuation of Box C.

See patent family annex.

\* Special categories of cited documents :

<p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier application or patent but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p>	<p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone</p> <p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art</p> <p>"&amp;" document member of the same patent family</p>
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Date of the actual completion of the international search <b>2 September 2016</b>	Date of mailing of the international search report <b>13/09/2016</b>
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Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Authorized officer <b>Scheid, Günther</b>
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# INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/TH2016/000059

Patent document cited in search report	Publication date	Patent family member(s)	Publication date	
WO 2011110350	A1	15-09-2011	DE 102010010985 A1	15-09-2011
			WO 2011110350 A1	15-09-2011
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US 2628207	A	10-02-1953	NONE	
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