lacquer layer applied to the substrate and a second upper lacquer layer which protects the substrate from physical and chemical influences.

[010] WO 2006/021856 discloses a method for protecting banknotes and security papers from premature wear due to the handling that they undergo, and thus prolonging their lifetime. The disclosed method comprises a lacquering step which consists in depositing a protective layer on the surface of the security document.

[011] WO 2008/054581 discloses a soil and/or moisture resistant secure document and a method for producing such a secure document. The disclosed method employs a size press or other similar device to force a soil and/or moisture resistant formulation into the pores of the substrate and to remove excess formulation from opposing surfaces thereof.

[012] EP-B 1 932 678 discloses a method for applying a protecting layer of parylene on security documents, in particular banknotes so as to increase their resistance to soiling, wetting and mechanical damage.

EP739923 discloses a curable protective formulation comprising a fluorinated polymer and a urethane polymer. Said fluorinated polymer is a reaction product of a di-hydroxyl-terminated fluoropolyether with a reactant which may be an anhydride or an isocyanate or a halohydrin.

[013] Whereas protective varnishes may comprise surface additives such as for example polymerizable compounds or polymeric additives consisting of siloxane or silicone-containing compounds to further increase anti-soiling properties of security documents, in particular banknotes, comprising said varnishes, the protective varnishes that are commonly used may suffer from a poor oil, fat or grease and water repellency thus reducing the durability and circulation lifetime of the security document.

[014] A need remains for providing a high quality protective varnish exhibiting, when applied to a security document, in particular a banknote, an increased performance in circulation, in particular increased soil release characteristics and an increased resistance against premature detrimental influence of soil upon use and time by increasing oil, fat or grease and moisture/water repellency.

SUMMARY

[015] It has been surprisingly found that the above mentioned problems can be overcome by radiation curable protective varnishes comprising one or more cationically curable compounds and one or more di-hydroxyl-terminated perfluoropolyether compounds of the general formula $HO-(CH_2CH_2O)_c-CH_2-CF_2O-(CF_2-CF_2-O)_a-(CF_2O)_b-CF_2-CH_2-(OCH_2CH_2)_d-OH$

amount from about 0.5 to about 4 wt-%, the weight percent being based on the total weight of the radiation curable protective varnish.

According to a preferred embodiment of the present invention, the one or more di-hydroxyl-terminated perfluoropolyether compounds are selected from the group of compounds of the above formula, wherein a + b ≥ 2, and independently are integers in a range between 1 and 50, and wherein and d may be the same or different and are in the range of 1-20, preferably 1-10, and more preferably 1-6. Those di-hydroxyl-terminated perfluoropolyether compounds are commercially available under the trademark Fluorolink® E10 or E10-H from SOLVAY Solexis, Italy. The di-hydroxyl-terminated perfluoropolyether compounds used in the present invention may be prepared from a perfluoropolyether dimethylester precursor, which may be obtained by methods known in the art, e.g. as described in US-3,847,978, in particular col. 11, example D, and col. 17, example 11. Said perfluoropolyether dimethylester precursor may be reduced to the corresponding dimethylol precursor by methods known in the art, e.g. as described in US-3,972,856, col. 4. The thus obtainable dimethylol precursor may be alkoxylated by methods known in the art, e.g. as described in US-4,775,653, and US-5,057,628. According to the scheme described in e.g. those documents, ~~which are explicitly incorporated by reference,~~ the compounds suitable for the present invention may be prepared.

[043] The one or more dihydroxyl-terminated perfluoropolyether compounds described herein, have a weight average molecular weight (Mw) between about 100 and about 5000, more preferably between about 500 and about 3000. Unless stated otherwise, "weight average molecular weight" is determined by gel permeation chromatography (GPC).

[044] The one or more di-hydroxyl-terminated perfluoropolyether compounds described herein have preferably a fluorine content in a range from about 50 to about 70 wt-%, more preferably from about 55 to about 65 wt-%, the weight percent being based on the total weight of the one or more dihydroxyl-terminated perfluoropolyether compounds.

[045] Although most of the above di-hydroxyl-terminated perfluoropolyether compounds described herein are in liquid form, one or more solvents may be added to the radiation curable protective varnishes to facilitate the mixing or dispersing of said compounds in the varnish. Suitable solvents include without limitation ethanol, propanol, isopropanol, butanol, isobutanol, glycols, glycol ether (such as for example 1-methoxy-2-propanol (propylene glycol methyl ether) or

CLAIMS

1. A radiation curable protective varnish comprising one or more cationically curable compounds and one or more di-hydroxyl-terminated perfluoropolyether compounds of the general formula $HO-(CH_2CH_2O)_c-CH_2-CF_2O-(CF_2-CF_2-O)_a-(CF_2O)_b-CF_2-CH_2-(OCH_2CH_2)_d-OH$

   wherein a and b independently are integers in a range between 0 and 50 and wherein a + b ≥ 1, and

   wherein c and d may be the same or different and are in the range of 1-20.
2. The radiation curable protective varnish according to claim ~~1being~~ 1 being UV-Vis-curable protective varnishes.
3. The radiation curable protective varnish according to any preceding claim, wherein the one or more cationically curable compounds are selected from the group consisting of vinyl ethers, propenyl ethers, cyclic ethers and mixtures thereof.
4. The radiation curable protective varnish according to any preceding claim, further comprising one or more cationic photoinitiators selected from the group consisting of onium salts, oxonium salts, sulphonium salts and mixtures thereof, preferably in an amount from about 0.1 to about 20 wt-%, the weight percents being based on the total weight of the radiation curable protective varnish.
5. The radiation curable protective varnish according to any preceding claim, wherein the one or more di-hydroxyl-terminated perfluoropolyether compounds are present in an amount from about 0.1 to about 5.0 wt-%, the weight percents being based on the total weight of the radiation curable protective varnish.
6. The radiation curable protective varnish according to any preceding claim, wherein the one or more di-hydroxyl-terminated perfluoropolyether compounds have weight average molecular weight (Mw) between about 500 and about 3000.
7. The radiation curable protective varnish according to any preceding claim further comprising one or more radically curable compounds.
8. The radiation curable protective varnish according to claim 7, wherein the one or more cationically curable compounds are present in an amount from about 85 to about 95 wt-% and the one or more radically curable compounds are present in an amount from about 5 to about 15 wt-%, the weight percent being based on the total weight of the mixture of the one or more cationically curable compounds and the one or more radically curable compounds.
9. The radiation curable protective varnish according to claim 7 or 8 further comprising one or more free radical photoinitiators.

10. A security document comprising a substrate and a radiation cured coating obtained by radiation curing of a radiation curable protective varnish recited in any one of claims 1 to 9.
11. The security document according to claim 10, wherein the substrate is selected from the group consisting papers or other fibrous materials, paper-containing materials, plastics and polymers, composite materials and mixtures or combinations thereof.
12. The security document according to claim 10 or 11, wherein the radiation cured coating made of the radiation curable protective varnish has a surface energy less than or equal to about 25 mN/m and a dispersive surface energy less than or equal to about 18 mN/m.
13. A process for making a security document comprising a) a step of applying on a substrate the radiation curable protective varnish recited in any one of claims 1 to 9 so as to form a wet coating and b) a step of radiation curing said radiation curable protective varnish so as to form a radiation cured coating.
14. A use of the radiation curable protective varnish recited in any one of claims 1 to 9 for providing a protective coating or layer on a security document.
15. A method for imparting soil resistance to a security document comprising a substrate, said method comprising a step of applying the radiation curable protective varnish recited in any one of claims 1 to 9 onto said substrate and radiation curing said radiation curable protective varnish.
16. A use of the one or more di-hydroxyl-terminated perfluoropolyether compounds recited in any one of claims 1 to ~~10~~ 9 for the manufacture of a radiation curable protective varnish according to any one of claims 1 to 9.