

(19) **DANMARK**

(10) **DK/EP 2622000 T3**



(12) **Oversættelse af  
europæisk patentskrift**

Patent- og  
Varemærkestyrelsen

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- (51) Int.Cl.: *C 08 G 63/48 (2006.01)*      *B 01 F 3/08 (2006.01)*      *B 01 F 7/00 (2006.01)*  
*C 08 J 3/05 (2006.01)*      *C 08 L 67/08 (2006.01)*      *C 09 D 167/08 (2006.01)*
- (45) Oversættelsen bekendtgjort den: **2017-07-31**
- (80) Dato for Den Europæiske Patentmyndigheds bekendtgørelse om meddelelse af patentet: **2017-04-26**
- (86) Europæisk ansøgning nr.: **11773751.0**
- (86) Europæisk indleveringsdag: **2011-09-23**
- (87) Den europæiske ansøgnings publiceringsdag: **2013-08-07**
- (86) International ansøgning nr.: **FR2011052208**
- (87) Internationalt publikationsnr.: **WO2012042153**
- (30) Prioritet: **2010-09-27 FR 1003817**
- (84) Designerede stater: **AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR**
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- (54) Benævnelse: **Polyesterharpiks på basis af fedtsyrer med kort olielængde, vandige dispersioner og coatings deraf**
- (56) Fremdragne publikationer:  
**WO-A2-95/02019**  
**FR-A1- 2 253 057**  
**FR-A1- 2 483 434**  
**US-A- 2 791 568**  
**US-A- 3 440 193**  
**US-A- 4 039 495**  
**US-A1- 2007 167 603**  
**L.G.Zachary et al.: "Tall oil and its Uses", 1 January 1965 (1965-01-01), McGraw-Hill, New York pages 1-33,**



The invention relates to an aqueous dispersion of fatty acid-based polyester resin, in particular of an alkyd resin, with a short or even zero oil length, modified to a high proportion by rosin or derivatives thereof with no presence of organic solvent, and to applications as binder in coatings and in particular in water-based coatings for adhesives, 5 paints, surface coatings, primers or varnishes. The polyester resin, and in particular alkyd resin, of this dispersion, uses a high content of starting materials of renewable origin and has specific performance qualities, in particular concerning the development of hardness over time after application and the reduction of yellowing. In particular, the novel resin dispersion may be used as binder in decorative or industrial water-based coating 10 compositions capable of curing in air with or without siccating agent.

Alkyds in organic solvent medium, also referred to as being solvent-based, are resins that have been known for a long time to those skilled in the art, and are used in general in decorative and industrial paint formulations and coatings. To satisfy questions as regards comfort of use, odor and toxicity, specific alkyd emulsions have been developed 15 and marketed for about 20 years, with advantageous performance levels in terms of gloss, drying, appearance/color, stability and odor. A technical solution for conventional implementation, employed to form alkyd emulsions that are stable over time, consists in using a combination of a nonionic surfactant with an anionic surfactant as described in WO 2008/076360.

20 Despite these improvements, certain parameters and performance levels still remain to be improved, such as the resistance to yellowing, the blocking resistance, the hardness, the water sensitivity and the biodegradability. The tendency toward yellowing is a natural and intrinsic property of alkyd resins, which thus limits their use to quite specific end uses, for instance primers, surface coatings, woods and trims. The first alkyd emulsions 25 described in the literature concern alkyds with large oil lengths of about 65% to 82% as described in *Colloids Surfaces A. Physicochem. Eng. Aspects* 1995, 94, 161-171. The emulsification of resins with a smaller oil length is relatively difficult to perform, due to the lower affinity of surfactants with the resin, as explained in *Prog. Org. Coat.* 1994, 24, 281-97. Nevertheless, nowadays, commercial products have an average oil length of 50%, 30 as described in WO 2009/140192 or even a smaller oil length up to approximately 40% for the lowest oil lengths, as described in *Prog. Org. Coat.* 2000, 40, 253-266 or even more recently in WO 2008/076360. US 4 039 495 already describes coating compositions as a dispersion in water of short alkyd resins as oil with a high acid number, and neutralized

with an amine, and from 20 to 55% by weight, relative to the tris(hydroxymethyl)nitromethane alkyd, for improving the flexibility of the coating without losing hardness. US 2007/0167603 describes alkyd emulsions for varnishes containing a water-insoluble alkyd resin A and a water-soluble alkyd resin B used as emulsifying resin.

5 For a more systematic and universal use, it is necessary to find solutions that guarantee products which develop less yellowing for applications of wider scope such as on walls or ceilings. Nowadays, these applications are almost exclusively reserved for acrylic emulsions, which have been known for a long time for their good resistance to yellowing and to oxidation, but acrylic emulsions have drawbacks such as lower gloss, water  
10 sensitivity (lower water resistance) and poorer chemical resistance.

The resin dispersion of the present invention proposes to overcome the mentioned drawbacks of the prior art, while at the same time affording high dispersibility in water without any need for organic solvent and in the absence of groups that make the resin self-dispersing. This capacity makes it possible to obtain resin dispersions without any organic  
15 solvent or protective colloids and which are stable on storage, and to obtain coatings associated with high gloss and high hardness, and, by virtue of its hydrophobic nature, high water resistance, such as high resistance to yellowing over time. An additional advantage during the drying of the resin dispersions according to the present invention is the faster development over time of high, stable hardness, this being achieved without the need for  
20 systematic addition of a siccating agent of cobalt type. This therefore leads to an amicable solution for man and for his environment due to the absence of organic solvents in the dispersion and also the absence of siccating agents on drying, but also via the choice of the essential raw materials, insofar as a large proportion of these raw materials is of renewable and durable origin and may also lead to chemical structures that are more  
25 readily biodegradable. The dispersions of the invention and the coatings resulting therefrom are thus favorable toward environmental protection, while at the same time having application qualities that are at the very least identical, if not improved, with respect to conventional water-based coatings. In addition to the environmental protection, the highly renewable nature of said aqueous binders according to the present invention should  
30 be underlined, which binders are predominantly prepared from rosin and natural fatty substances. This advantage is appreciable since, in certain cases, the proportion of renewable raw materials reaches a level of 100% on the overall composition of the resin (surfactants excluded) of said dispersion. This enables the manufacture of this novel type

of resin dispersion, which may be used as binder, by virtue especially of the durable and seasonal availability of said raw materials. These same reasons also make it possible to limit the environmental impact via a reduced carbon imprint and an improved life cycle. These two parameters reflect the impact of the manufactured products on the environment and health. "Renewable" or "bio-sourced" resources in particular make it possible to reduce the emissions of greenhouse gases such as carbon dioxide.

With this aim, the present invention proposes a novel range of polyester resin dispersions based on oxidizable and/or non-oxidizable fatty acids, in particular alkyd resins, with a greatly reduced or zero short oil length, for their dispersion in water with the aid of surfactants, and which are capable of substantially curing without the excessive supply of unsaturated fatty oils or acids. These dispersions, which are commonly known as "emulsions", give, after application to a substrate, coatings that are stable over time and ensure low yellowing evolution and also substantial development of hardness after application and drying, despite having a greatly reduced or zero oil length. The very capacity of certain resins with a very small oil length, in particular from 0 to 15%, to cure strongly and rapidly with the drying time, and above all without the necessary supply of siccating agent, is a significant advantage in the current environmental context. More particularly, in this context, the use of cobalt-free drying systems is an increasingly important need, given the increasing environmental restrictions on the use of cobalt as a siccating agent.

More particularly, the resin of the dispersion according to the invention with a zero oil length (0%) or an oil length ranging up to 5% (meaning an oil length ranging from 0 to 5%), in addition to its capacity to be used as a resin for obtaining aqueous dispersions for water-based coatings, as described above, also has the capacity to be used as a binder resin for non-water-based coatings and more particularly for two-pack applications, for example as "coil" coating resins for application to metal sheets. The same performance improvements as with water-based coatings are obtained, especially in terms of hardness and chemical resistance, for example. Alkyds are oligomers that are conventionally obtained by polycondensation between diacids and polyols in the presence of a more or less large proportion of "oil" or of "oxidizable unsaturated fatty acids". The diacids and polyols usually used to form the polymer structure are phthalic anhydride, isophthalic acid, pentaerythritol and glycerine (or glycerol). The number-average molecular masses  $M_n$  may thus range between 1000 and 10 000 g/mol, as a function of the OH/CO<sub>2</sub>H

(hydroxy/carboxy) ratio used. Monoacids such as benzoic acid and rosin (mainly and predominantly containing natural resinous acids such as abietic acids including dehydroabietic acid, pimaric acids, mercusic acids and communic acids) may be added to the alkyds as acid component. These components thus make it possible to reduce the oil length and to increase the hardness of the alkyd. On the other hand, reducing the oil length makes the resin less readily dispersible in water with surfactants and above all without the aid of solvent. According to Paintindia, Nov. 2007, 61-65, it is essential to use organic solvent in order to facilitate the dispersion in water, but the presence of such an organic solvent is incompatible with environmental protection as demanded in the present invention. By reducing the oil length of certain alkyds, we have found, unexpectedly, that the rosin used under the conditions of the invention considerably facilitates the development over time of the hardness of the coatings, in particular alkyd coatings, thus formed during oxidative drying also known as siccation and also facilitates the aqueous dispersion of the resin without any need for organic solvent or protective colloid. The hardness associated with the observed curing of the resin increases over time after application of the coating composition and offers an excellent final hardness to the film, which is markedly superior to those recorded for conventional alkyd emulsions, with oil lengths usually of between 40% and 85%.

The invention relates firstly to an aqueous dispersion of polyester resin based on fatty acids, which is short in oil or of zero oil length, modified with rosin and/or derivatives thereof. These resins may be used as organic binders in aqueous dispersion for water-based coatings. More particularly, the resin with a zero oil length (0%) or with an oil length ranging up to 5% may also be used as organic binder for two-pack (2K) non-water-based coatings, in particular for "coil" or metal sheet and preferably for galvanized steel.

The subject of the invention concerns an aqueous dispersion of resin comprising at least one modified resin as defined above according to the invention or at least one organic binder composition comprising at least one resin as defined above.

Another subject of the invention concerns a process for preparing said aqueous dispersion according to the invention.

The invention also covers a coating composition which comprises at least one aqueous dispersion as defined according to the invention.

The invention also relates to the use of the aqueous dispersions according to the invention, as binder in coating compositions.

Thus, the first subject of the invention relates to an aqueous dispersion of resin, which dispersion comprises at least one polyester resin, in particular an alkyd resin, which resin:

- is based on at least one fatty acid
- 5 - has a zero oil length (0%) or an oil length between 0 and 35%, preferably greater than 0 and up to 25%, more preferentially up to 15%
- has a weight ratio of oxidizable fatty acids (monoacids) relative to the overall fatty acids of 0 or more than 0 and ranging up to 1
- is based on an acid component comprising, in addition to said fatty acid, from 30%  
10 to 85%, preferably from 35% to 75%, more preferentially from 40% to 75% and even more preferentially from 45% to 75% by weight, relative to the total weight of said resin, of rosin and/or rosin derivatives bearing at least one carboxylic acid function, and more particularly for its maleinized derivatives (maleinized rosin derivatives), bearing from 3 to 4 carboxylic functions
- 15 or  
said dispersion comprises at least one organic binder composition comprising at least one resin as defined above.

According to a preferred embodiment, the resin of the dispersion according to the invention comprises less than 5%, preferably less than 3% by weight and more  
20 preferentially no (0%) aromatic compound, for instance of phthalic type (phthalic, isophthalic, trimellitic or terephthalic acid or anhydride), besides the rosin derivatives that may be used. The term "rosin derivatives" means natural derivatives such as dehydroabiatic acid.

The resin of the dispersion according to the invention is, according to another  
25 preferred case, based on an acid component comprising, in addition to said fatty acid, in addition to said rosin and/or in addition to said rosin derivatives, at least one acid compound containing at least one carboxylic acid function and having an overall functionality of 2 to 3, the overall functionality including the acid function and another possible function, said compound being chosen from: saturated polyacids or ethylenically  
30 unsaturated polyacids or hydroxy acids. The saturated polyacids have no ethylenic unsaturation that is reactive during their use and may very well be derived from unsaturated polyacids, containing at least one reactive unsaturation, by hydrogenation of these unsaturated polyacids. More particularly, the resin of the dispersion according to the

invention may be based on an acid component which comprises at least two from among said acid compounds, with at least one chosen from saturated polyacids and another chosen from unsaturated polyacids, this being in addition to said fatty acid and said rosin and/or said rosin derivatives. As saturated polyacid that is suitable for use according to the invention, the choice may be made from the acid and/or the anhydride corresponding to:  
5 succinic acid of functionality 2, adipic acid of functionality 2, sebacic acid of functionality 2, dodecanedioic acid of functionality 2, citric acid of functionality 3, the C<sub>36</sub> fatty acid dimer of functionality 2 to 2.2 or the C<sub>54</sub> fatty acid trimer of functionality 2.5 to 3. As unsaturated polyacid that is suitable for use, the choice may be made from the existing acid  
10 and/or anhydride corresponding to: itaconic acid of functionality 2, maleic or fumaric acid of functionality 2 or tetrahydrophthalic acid (THP) of functionality 2. Among the preferred polyacids, mention may be made of polyacids comprising at least one C<sub>36</sub> fatty acid dimer and/or C<sub>54</sub> fatty acid trimer. As defined above, said acid compound, containing at least one carboxylic function and having an overall functionality of 2 to 3, may also be chosen from  
15 hydroxy acids that may thus be present in said acid component in addition to the fatty acids and the rosin and derivatives thereof. As preferred hydroxy acids that may thus be present, mention may be made of glycolic acid or lactic acid.

A combination of several polyacids and monoacids is often used in order to optimize the physicochemical properties of the resin, in particular of the alkyd, and more particularly to obtain the desired hardness/suppleness compromise. The incorporation into  
20 the resins according to the invention, in particular into the alkyds, of aromatic acid derivatives such as phthalic derivatives (diacid/anhydride) or benzoic derivatives (monoacid) is possible, but preferably with a content of less than 5% by weight and more preferentially with less than 3% by weight. Even more preferentially, there is no aromatic  
25 derivative (0% aromatics) besides any possible natural rosin derivatives as described above. The presence of a monoacid component such as abietic or pimaric acids, in particular of rosin and/or derivatives thereof, and more particularly in such a high proportion, constitutes the essential element of the invention for enabling the particular properties observed. The rosin content is high and ranges from 30% to 85%, preferably  
30 from 35% to 75%, more preferentially from 40% to 75% and even more preferentially from 45% to 75%. The fatty acids used, given their natural origin, are mixtures comprising saturated fatty acids, unsaturated fatty acids containing non-conjugated unsaturations and unsaturated fatty acids containing conjugated unsaturations. These fatty acids, and also



fatty acid dimers and/or trimers synthesized from these same natural fatty acids, afford the suppleness and flexibility necessary for the binder and the coating obtained which results therefrom.

5 The term "fatty acid" defined in the broadest sense means a C<sub>12</sub> to C<sub>54</sub> carboxylic acid.

The term "oil length", as used in the present invention, means the weight percentage, relative to the total weight of the resin, of the weight of "fatty monoacids" or of oils or stand oil derivatives (stand oil is a product resulting from the reaction at high temperature, 250-300°C, of a mixture of oil and fatty acid), this weight percentage being  
10 expressed as a weight equivalent of triglyceride derivatives (oils) which correspond to the fatty acids, said fatty acids being "oxidizable". Any calculation or mention of this characteristic in the present invention is based on this definition. The term "oxidizable fatty acids" means, according to the present invention, fatty acids or derivatives (oils or stand oils) with an iodine number of greater than or equal to 80 mg of iodine per g of product.  
15 Said monoacids or triglycerides (oils) may be mixtures of natural origin, comprising up to 30% by weight of saturated fatty acids.

Preferably, the proportion of oxidizable (air-reactive) unsaturation in the resin of the invention is zero (0) or is greater than 0 and ranges up to 0.25 and preferably up to 0.15 mmol of oxidizable double bonds per gram of dry resin (undiluted).

20 According to a particular possibility, the resin of the dispersion according to the invention is based on an alcohol component comprising at least one polyol of functionality ranging from 2 to 10 and preferably from 3 to 6. The polyols that are suitable for use according to the invention may be selected from: ethylene glycol, polyethylene glycol, preferably with a number-average molecular mass M<sub>n</sub> ranging from 300 to 6000,  
25 propylene glycol (1,2-propanediol), 1,3-propanediol, dipropylene glycol, triethylene glycol, glycerol, diglycerol, trimethylolpropane or trimethylolethane, pentaerythritol, dipentaerythritol, sorbitol, mannitol, methyl glucoside, polyglycerol, in particular glycerol oligomers, such as Polyglycerol-3 (glycerol trimer) and decaglycerol and, preferably, glycerol oligomers and mixtures thereof, such as Polyglycerol-3, which Polyglycerol-3 is a  
30 mixture of glycerol oligomers (glycerol oligomerized in the presence of oligomers containing 30% to 55% by weight of glycerol trimer constituting the predominant oligomer), this product being sold by Solvay. The polyol that is most preferred is polyglycerol-3 which is oligomerized and has a molecular mass markedly greater than that

of glycerol, with a functionality ranging from 5 to 6. By virtue of its higher molecular mass and of its high functionality, this polyol makes it possible more readily to increase the final molecular mass of the resin, in particular of the alkyd resin, while at the same time ensuring a narrower molecular distribution.

5           The preferred resin of the dispersion according to the invention has an acid number of less than 8 and a number-average molecular mass  $M_n$  ranging from 1000 to 10 000 g/mol, measured by GPC in THF and expressed as polystyrene equivalents.

          The  $T_g$  of the resin of the dispersion according to the invention, measured by DSC, after two passages at a temperature sweep speed of 10°C/min, may range from -40 to 50°C  
10          and preferably from -20 to 35°C.

          More particularly, according to a first version, said resin has an oil length that is between 0 and 35%, and is preferably greater than 0 and ranges up to 25% and more preferentially up to 15%, with presence of at least one oxidizable fatty acid (monoacid). This means that said resin comprises an air-oxidizable structure. According to a more  
15          particular case of this oxidizable resin version, the content of oxidizable unsaturation in said resin is greater than 0 and may range up to 0.25 and preferably up to 0.15 mmol of oxidizable double bonds per gram of dry resin. In such a case (resin of oxidizable structure), said fatty acid is selected from fatty monoacids of plant or animal origin preferably of  $C_{16}$  to  $C_{24}$ , with a mean iodine number ranging from 100 to 200.

20          According to the given definition of the invention, the fatty acid may be an oxidizable fatty acid (fatty monoacid) or a non-oxidizable fatty acid, in particular a polyacid such as fatty acid oligomers and in particular  $C_{36}$  and  $C_{54}$  fatty acid dimers and/or trimers, respectively. Said fatty acid may be oxidizable and selected from fatty acids of soybean oil, sunflower oil, tall oil (TOFA), castor oil, dehydrated castor oil, linseed oil or  
25          rapeseed oil, said fatty acids being used as such or in the form of corresponding oils (triglyceride esters) of fatty acids or in the form of corresponding stand oils of fatty acid oils. Said stand oils, which are well known to those skilled in the art, are in fact derivatives of fatty acid oils obtained at high temperature by standolization of these oils. These cases of fatty acids or of fatty acid oils have oxidizable unsaturations as defined above according  
30          to the iodine number characteristic of greater than or equal to 80 mg of iodine per gram of produced acid or oil or stand oil of fatty acid oil.

          According to a preferred version of the resin of the dispersion according to the invention, it is based on a polyacid comprising at least one  $C_{36}$  fatty acid dimer and/or  $C_{54}$

fatty acid trimer and based on a polyol comprising at least one glycerol and/or pentaerythritol and/or dipentaerythritol oligomer, preferably a mixture of glycerol oligomers comprising the glycerol trimer, more particularly polyglycerol-3.

According to a more particular version, the polyester resin of the dispersion according to the invention is an alkyd resin, with an oil content (oil length) of greater than 0%, preferably ranging up to 25% and more preferentially up to 15%.

Another category of resin of the dispersion according to the invention has a zero oil length or oil content (0%) and is commonly referred to as being "oil-free", with said fatty acid being selected from non-oxidizable fatty acids and thus with a corresponding content of oxidizable unsaturation that is 0 mmol per gram of dry resin. In this case, said fatty acid is preferably selected from saturated fatty acids (including fatty acids that are initially oxidizable, which have been hydrogenated and consequently become non-oxidizable) or from fatty acid oligomers, preferably C<sub>36</sub> dimers (including hydrogenated dimers) and/or C<sub>54</sub> trimers (including hydrogenated trimers). Preferably, such a resin (0% oil) is based on an alcohol component comprising as polyol a glycerol oligomer, preferably a mixture of glycerol oligomers, and more preferentially polyglycerol-3, and, as fatty acid, a C<sub>36</sub> fatty acid dimer and/or a C<sub>54</sub> fatty acid trimer (hydrogenated or non-hydrogenated). A resin with comparable behavior, in particular for applications in a two-pack coating system, is also a resin with an oil content ranging up to 5%, which, in addition to said fatty acid selected from the non-oxidizable fatty acids as defined above, comprises (in addition) minor weight proportions of an oxidizable fatty acid leading to said oil proportion ranging up to 5%. Said oxidizable fatty acid, which is minor in the latter case, may be present as residual acid with the rosin used: for example, "tall oil" rosin comprises small proportions (about 4%) of tall oil fatty acid, which is oxidizable. Thus, as in this particular case, said oxidizable acid may also be present or added in such minor proportions to arrive at an oil length that may be up to 5%.

The preparation of said resin of the dispersion according to the invention, in particular the alkyd, is performed by polycondensation reaction under an inert atmosphere at standard temperatures of between 180°C and 300°C, preferably between 250°C and 270°C, and more preferentially with application of a vacuum (reduced pressure) of moderate level ranging from 50 to 250 mmHg, at the end of the polycondensation in order to reduce the reaction times. It is possible, in order to prevent and/or further reduce the coloration and oxidation of the rosin during the synthesis, to use additives, in particular

antioxidants, as employed in the preparation of rosin esters used in particular for adhesives: phenol sulfites, paraformaldehyde, hypophosphorous acid, trialkyl or triphenyl phosphites. A more exhaustive list of additives that may be used for this purpose is described in US 4 744 925, column 2, lines 50-62, which list is incorporated herein by reference.

5           According to the invention by way of alternative said dispersion may comprise an organic binder composition which comprises at least one resin as defined above.

          According to a more preferred case, this composition comprises at least two resins and, more precisely, in addition to the first resin as defined according to the invention above, it comprises at least one second resin different from the first, and with this second  
10       resin being selected from resins of polyesters based on fatty acids, preferably from modified alkyd resins. Thus, preferably, said polyesters based on fatty acids are chemically modified alkyds chosen from: silicone alkyds, urethane alkyds, alkyd-acrylic hybrids. These binder compositions may thus be used in the preparation of the aqueous dispersions of resins of the invention, for water-based coatings.

15           The aqueous dispersion of resin according to the present invention therefore comprises at least one resin as defined above or at least one binder composition as defined above. According to a particular preferred variant of this aqueous dispersion according to the invention, it comprises, in addition to said resin or said binder composition, both as defined according to the invention described above, at least one surfactant selected from:  
20       at least one anionic surfactant and at least one nonionic surfactant or at least one surfactant of mixed structure and with an overall weight content relative to said resin ranging from 2% to 15% and preferably from 5% to 10%. According to the present invention, a surfactant of mixed structure is a surfactant which comprises both a nonionic structure, such as a polyoxyalkylene segment (more particularly oxyethylene and/or oxypropylene units) and  
25       an anionic structure (for instance a sulfonate or sulfate or phosphate or phosphinate group) on the same molecule or molecular chain. Examples of such surfactants that may be mentioned include sulfonate or sulfate or phosphate phosphinate esters of polyether alcohols or of alkoxyated fatty alcohols, with nonionic structures (polyether) and anionic structures (sulfate, sulfonate or phosphate or phosphinate), combined on the same  
30       molecule. The dispersion according to the invention may have a solids content ranging from 30% to 70% and preferably from 40% to 60% and a mean particle size ranging from 100 to 500 nm. The preferred dispersion according to the invention is free of any organic solvent, this meaning, according to the present invention, a corresponding content of

volatile organic compounds (VOC) in said dispersion of less than 1000 ppm, preferably less than 500 ppm and more preferentially less than 100 ppm.

Even more particularly, the aqueous dispersion of resin according to the present invention is a mixture of, or comprises as a mixture, a first aqueous dispersion of resin as defined according to the invention as described above and at least one second dispersion of resin, which second dispersion is different from the first dispersion, this second dispersion of resin being selected from dispersions of alkyds, which are optionally modified, or acrylic, including styrene-acrylic, dispersions (or emulsions), or dispersions of other polymers and in particular dispersions of saturated or unsaturated polyesters, or polyurethanes. According to this particular case of aqueous dispersion, the weight content of said first dispersion ranges from 50% to 99.5%. Said modified alkyd dispersions that may be suitable for said second dispersion, according to this particular case, are chosen from alkyd dispersions modified with acrylic, styrene, styrene-acrylic, vinyl, silicone or urethane. Said second dispersion is also selected so as to be compatible with the first aqueous dispersion as defined according to this particular dispersion case and, more particularly, it is based on a resin or a polymer that is compatible with the resin of the present invention, which resin has as specificity a greatly reduced or zero oil length.

Another subject of the invention concerns a process for preparing said aqueous dispersion, which process comprises a step of emulsification at a temperature of from 30 to 90°C and preferably from 50 to 85°C of at least one resin and/or of at least one organic binder composition, the resin and the binder composition as defined above according to the invention, by phase inversion in a reactor stirred via a dual-flow stirring system.

In point of fact, the resins, after the final polycondensation phase, are cooled to 120-180°C and are then transferred into an emulsifier in order to be dispersed therein in water in the presence of surfactants. The emulsion is preferably obtained via the phase inversion technique using a reactor stirred via a dual-flow system at a temperature of between 30°C and 90°C and preferably at 50-85°C. The direct emulsification technique is incompatible with this type of resin. The temperature imposed during the phase inversion is adjusted as a function of the intrinsic viscosity at elevated temperature of the alkyd or polyester resin. The resin is emulsified, at neutral or slightly alkaline pH, via more or less partial neutralization of the residual carboxylic functions, according to a standard process combining a surfactant or, preferably, a mixture of ionic (anionic) surfactant and of nonionic surfactant. For these two types of process, at least one surfactant is used. This

surfactant is selected from ionic, preferably anionic, and/or nonionic and/or hybrid surfactants of mixed structure (comprising in the same molecule a nonionic structure such as an ethoxylated and/or propoxylated structure and an anionic structure). The presence of surfactants improves the stability of the dispersion, thus preventing sedimentation and/or coalescence during the hot forming process and during the storage/use of the product. A selection criterion for the nonionic surfactants used is the HLB index (hydrophilic-lipophilic balance) representing the ratio of hydrophilic and hydrophobic characters in the surfactant. Preferably, a combination of a nonionic surfactant and of an anionic surfactant is preferred to obtain stable dispersions with a small particle size, preferably less than 300 nm. Among the anionic surfactants that are suitable for this invention, mention may be made of sodium, lithium, potassium, ammonium or magnesium salts, alkyl ether sulfates with alkyl ranging from C<sub>8</sub> to C<sub>18</sub> or C<sub>12</sub> alkyl benzene sulfates or alkyl sulfates, alkyl phosphate or dialkyl sulfosuccinate esters or even soaps obtained from the corresponding fatty acids. The anionic surfactants are preferably used with at least one nonionic surfactant. Examples of mixed surfactants (nonionic + anionic mixed structure) include alkoxyated alkyl phenol sulfonates or phosphonates. The nonionic surfactants may be used alone, but, preferably, they are in combination with an anionic surfactant. As preferred examples of suitable nonionic surfactants, mention may be made of: ethoxylated C<sub>12</sub>-C<sub>18</sub> fatty alcohols (6 to 50 OE), ethoxylated iso C<sub>10</sub> fatty alcohols (6 to 50 OE), ethoxylated mono-branched C<sub>10</sub>-C<sub>18</sub> fatty alcohols (6 to 50 OE), sorbitol fatty esters, ethoxylated sorbitol esters (5-50 OE), alkyl polyglucosides, glucamides, glycerol, diglycerol or polyglycerol fatty esters, ethoxylated fatty acids (7-100 OE), ethoxylated castor oil (hydrogenated or non-hydrogenated) (30-40 OE), glycol or polyethylene glycol fatty acids, nonionic polymers and other block copolymers, for instance poly(propylene glycol)-poly(ethylene glycol) block copolymer. The preferred aqueous dispersion comprises at least one nonionic surfactant optionally combined with at least one anionic surfactant in an overall (nonionic plus anionic) weight content relative to the alkyd or polyester resin of from 2% to 15%, preferably from 5% to 10%, and with a preferred ionic to nonionic weight ratio ranging from 25/75 to 50/50 in the case of a nonionic and anionic combination. The pH of the medium is preferably adjusted as a function of the acidity of the resin. This is why a basic aqueous solution, of from 1% to 50% and preferably from 10% to 20% by weight of base, is initially introduced after the addition of the surfactants, at the emulsification temperature (cf. table 4). To this end, basic (alkaline) aqueous

solutions are used starting with LiOH, NaOH, KOH, aqueous ammonia or amines, preferably tertiary or hindered amines that are more or less hydrophilic, such as diethanolamine, triethanolamine, aminomethylpropane or triethylamine.

The aqueous dispersion of the resin may also be obtained by self-emulsification of  
5 the resin without surfactant, for a resin with an acid number of at least 40 mg KOH/g, after at least partial neutralization of the carboxylic functions of the resin. However, in the context of the present invention, it is preferable for the acid number to be  $< 8$  in order to have the best water resistance for the resulting final coating.

The aqueous dispersion according to the invention is preferably free of any  
10 protective colloid.

The dry extracts or solids contents of said dispersions of the invention range from 30% to 70%, preferably from 40% to 60% and more preferentially from 40% to 55%.

Another subject of the invention relates to a coating composition which comprises  
as binder at least one aqueous dispersion, with said aqueous dispersion being as defined  
15 above according to the invention. According to a more particular and preferred case, said composition is a water-based coating composition. Said coating is preferably selected from decorative or industrial coatings, and in particular, for industrial coatings, chosen from anticorrosion coatings, and preferably from water-based coatings for adhesives, paints, surface coatings, primers and varnishes. The preferred coating is selected from decorative  
20 or industrial water-based varnishes or paints. These water-based coating compositions and in particular paints and varnishes have the additional advantage of drying without mandatorily supplying (or at a reduced level) a siccating agent.

The coating composition based on aqueous dispersions may also comprise a  
siccating agent, which may be present in a reduced or zero content (normal), and in this  
25 case said resin used as binder preferably has an oil length ranging up to 25% and preferably from 15% to 25%. Given their appropriate molecular masses and oil length, said resins in particular with an oil content ranging from 15% to 25%, under the effect of a siccating agent such as cobalt, allow, in addition to high hardness and great resistance to yellowing, excellent blocking resistance, with no point of attachment or of peeling  
30 observed in a test, after drying for 24 hours at room temperature and 24 hours of contact. Such blocking resistance performance is expected only for certain acrylic dispersions, but is entirely exceptional for polyester dispersions, in particular alkyd dispersions, as described in the present invention.

Moreover, the presence of hydroxyl functions in the resins defined according to the invention makes it possible to produce, for applications termed industrial, crosslinks by means of a second component (two-pack system known as 2K) such as isocyanates (blocked or non-blocked) or melamines to form films with a higher molecular weight  
5 leading to superior mechanical or chemical properties: chemical resistance and mechanical strength such as increased longevity and durability.

A penultimate subject of the invention relates to the use of at least one aqueous dispersion, as defined above according to the invention, as binder in coatings. More particularly, this use relates to decorative or industrial water-based coatings selected from  
10 adhesives, paints, surface coatings, primers or varnishes. These coatings are suitable for substrates selected from: wood, metals, plaster, concrete, composites or plastics, plastics such as silicone, polyethylene, PVC, polycarbonate, polypropylene or polystyrene.

Moreover, the high hydrophobicity and the excellent adhesion, which are qualities afforded by said resins in aqueous dispersion according to the present invention, make it a  
15 preferred binder that may be used in coatings in aqueous medium for preventing the corrosion of metal surfaces. Among the other substrates selected, wood may also be found, it being noted that the hydrophobic nature and the presence of "rosin" units derived from the wood, offer excellent properties of adhesion to wood. Surprisingly, we have also found, by chance, that these binders also had high properties of adhesion to plastics such as  
20 silicone, polyethylene, ABS, polycarbonate or PVC, or to plaster, ceramic, brick or composite materials. The coating compositions formulated with at least one aqueous dispersion of resin, according to the invention, may contain a significantly reduced, or even zero, content of at least one siccative agent. Preferably, these compositions may be free of siccative agents and in particular free of cobalt as siccative agent. Similarly, by  
25 virtue of its high potential for physical drying, slightly larger coating thicknesses would be allowed for equivalent drying times, thus increasing the productivity and also improving the conditions and working intervals (shortened interval) for the handling and use of coated pieces, after coating.

The final subject of this invention relates to substrates coated with at least one  
30 (substrate) coating, obtained from at least one aqueous dispersion of resin or from at least one coating composition, as defined above according to the present invention. In certain applications with a high concentration of fillers and in a two-pack system, supplying a siccative agent based on cobalt, manganese, lead, vanadium, calcium, barium,



strontium, cerium, zinc and iron is unnecessary. Already, given the physical drying performance demonstrated by the compositions based on dispersions of resin of reduced oil length, in particular from 0 to 15%, the presence of siccative agent is in no way essential with such a coating composition.

5

### EXPERIMENTAL SECTION

By way of illustration of the invention, the following examples describe, without any limitation on the claimed subjects, the synthesis of said resins for water-based binders, and the performance of the dispersions and of the coatings thus obtained.

10 1) Raw materials used (see Table 1 below)

Table 1: Raw materials used for the preparation of the tested resins

Commercial name or product type	Supplier	Chemical name	Function	Iodine number (mg I <sub>2</sub> /g)	Acid or hydroxyl number (mg KOH/g)
Nouracid <sup>®</sup> SZ35	Oleon	Soybean fatty acid	Fatty acid	120-150	195-205
SYLFAT <sup>®</sup> 2	Arizona	Tall oil fatty acid	Fatty acid	155	194
Pripol <sup>®</sup> 1009	Croda	Fatty acid dimer	Polyacid	/	195-205
Pripol <sup>®</sup> 1017	Croda	Mixture of fatty acid dimers and trimers (75/25)	Polyacid	/	195-210
Itaconic acid	Acros Organics	Itaconic acid	Polyacid	/	860
Rosin of Chinese <i>Pinus massoniana</i> type	TER-HELL & CO GMBH	Pine oil rosin, with a content of resinous acids ~90%	Rosin	/	165-175
FOR85	Forchem	Tall oil rosin, resinous acids: >85%	Rosin	/	165-175
Hydrogral <sup>®</sup>	DRT	Hydrogenated rosin Resinous acids: ~89%	Rosin	/	163
Succinic acid	Aldrich	Succinic acid	Polyacid	/	950
Sebacic acid	Aldrich	Sebacic acid	Polyacid	/	550
Polyglycerol-3	Solvay	Polyglycerol (mixture of oligomers, centered on 35-55% trimers)	Polyol	/	1000-1200
Pentaerythritol	Perstorp	Pentaerythritol	Polyol	/	1645
Glycerol	Cargill	1,2,3-Propanetriol	Polyol	/	1828

AOX-R	Alladchem	4,4'-Thiobis(3-methyl-6-tert-butylphenol) (CAS 96-69-5)	Antioxidant		
Zephyr <sup>®</sup> 3300	CRODA	Ammonium dodecylbenzenesulfonate	Anionic surfactant		
Atlas <sup>®</sup> G5000	CRODA	Propylene oxide/ethylene oxide block copolymer	Nonionic surfactant		
Synaqua <sup>®</sup> 4804*	Cray Valley	Short-oil (37%) alkyd resin as a dispersion in water (solids content: 50%)	Reference resin		
Synolac <sup>®</sup> 9605 S 65	Cray Valley	Polyester resin for general "coil" application	Reference resin		
BORCHI <sup>®</sup> OXY-COAT	OMG-BORCHERS	Iron complex dissolved in propylene glycol	Siccating agent		
DURHAM <sup>®</sup> COBALT 10WM	ROCKWOOD PIGMENTS	Cobalt complex dissolved in a dearomatized hydrocarbon-based solvent	Siccating agent		
ACTICIDE <sup>®</sup> MBS	THOR CHEMIE	Aqueous solution of methylisothiazoline (MIT) and of benzisothiazolinone (BIT)	Biocide		
DISPERBYK <sup>®</sup> 190	BYK CHEMIE	Block copolymers containing groups with high affinity for pigments	Dispersant		
BYK <sup>®</sup> 022	BYK CHEMIE	Polysiloxane base antifoam	Antifoam		
TIONA <sup>®</sup> 595	CRISTAL GLOBAL	Titanium dioxide	Pigment		
AQUAFLOW <sup>®</sup> NMS 450	AQUALON-HERCULES	Hydrophobically modified polyacetal polyether	Thickener		
AQUAFLOW <sup>®</sup> NHS 300	AQUALON-HERCULES	Modified polyacetal polyether	Thickener		

\*Symbolized as SA4804 in figures 1 and 2

2) Preparation of the starting resins

13 resins were prepared according to the corresponding procedures described below in Examples 1 to 13.

5 Example 1

185.2 g of Pripol® 1009, 1453.3 g of pine oil rosin, 6 g of AOX-R (phenol sulfite) and 185.2 g of polyglycerol-3 are placed in a stirred, temperature-regulated 5-liter reactor, under a nitrogen atmosphere. The mixture is heated to 250-270°C and the water of condensation is removed until an acid number of 6 mg KOH/g is obtained.

10

Example 2

The same procedure as for Example 1 is used with the following products and amounts: 592.0 g of Pripol® 1009, 1034.0 g of pine oil rosin, 6 g of AOX-R (phenol sulfite) and 374.0 g of polyglycerol-3. The water of condensation is removed until an acid

15

Example 3

The same procedure as for Example 1 is used, but with the following products and amounts: 6.5 g of soybean fatty acid Nouracid® SZ35, 71.4 g of pine oil rosin and 22.0 g of

20

Example 4

85.0 g of tall oil fatty acid, 837.0 g of tall oil rosin (For 85), 84.0 g of succinic acid and 264.9 g of polyglycerol-3 are placed in a stirred, temperature-regulated 2-liter reactor, under a nitrogen atmosphere. The mixture is heated to 250-270°C and the water of condensation is removed until an acid number of less than 6 mg KOH/g is obtained.

25

Example 5

The same procedure as for Example 4 is used, but starting with the following amounts: 9.3 g of soybean fatty acid, 64.2 g of pine oil rosin, 5.2 g of succinic acid and 22.0 g of polyglycerol-3. The mixture is heated to 250-270°C and the water of condensation is removed until an acid number of less than 4 mg KOH/g is obtained.

30

Example 6

9.5 g of soybean fatty acid, 65.6 g of pine oil rosin and 21.2 g of polyglycerol-3 are placed in a stirred, temperature-regulated 0.25 liter reactor, under a nitrogen atmosphere.  
5 The mixture is heated to 250-270°C and the water of condensation is removed until an acid number of less than 2-3 mg KOH/g is obtained. Next, 3.25 g of itaconic acid are added at 150°C and the mixture is heated at 180°C until a final acid number of 8 mg KOH/g is obtained.

10 Example 7

139.6 g of soybean fatty acid Nouracid® SZ35, 868.2 g of pine oil rosin, 83.6 g of succinic acid, 68.1 g of sebacic acid and 340.5 g of polyglycerol-3 are placed in a stirred reactor as in Example 4. The mixture is heated to 250-270°C and the water of condensation is removed until an acid number of less than 6 mg KOH/g is obtained.

15

Example 8

116.5 g of soybean fatty acid Nouracid® SZ35, 801.5 g of tall oil rosin, 67.6 g of succinic acid and 264.9 g of polyglycerol-3 are placed in a stirred reactor as in Example 4. The mixture is heated to 250-270°C and the water of condensation is removed until an acid  
20 number of less than 7 mg KOH/g is obtained. 16.5 g of succinic acid are then added and the condensation is continued until an acid number of 5.5 mg KOH/g is obtained.

Example 9

180.0 g of SYLFAT® 2 (tall oil fatty acid), 770.0 g of pine oil rosin, 69.0 g of  
25 succinic acid and 273.9 g of polyglycerol-3 are placed in a stirred reactor as in Example 4. The mixture is heated to 250-270°C and the water of condensation is removed until an acid number of less than 7 mg KOH/g is obtained. Next, 22.8 g of succinic acid are added and the condensation is continued until an acid number of 4 mg KOH/g is obtained.

30 Example 10

220.0 g of SYLFAT® 2 (tall oil fatty acid), 664.0 g of pine oil rosin, 73.6 g of succinic acid, 255.9 g of Pripol® 1017 (75/25 fatty acid dimer/trimer mixture) and 255.9 g of polyglycerol-3 are placed in a stirred reactor as in Example 4. The mixture is heated to

250-270°C and the water of condensation is removed until an acid number of less than 5 mg KOH/g is obtained.

Example 11

5           224.0 g of SYLFAT<sup>®</sup> 2 (tall oil fatty acid), 630.0 g of pine oil rosin, 35.0 g of sebacic acid, 69.0 g of succinic acid and 273.9 g of polyglycerol-3 are placed in a stirred reactor as in Example 4. The mixture is heated to 250-270°C and the water of condensation is removed until an acid number of less than 7 mg KOH/g is obtained. Next, 17.8 g of succinic acid are added and the condensation is continued until an acid number of 3 mg  
10 KOH/g is obtained.

Example 12

270.0 g of SYLFAT<sup>®</sup> 2 (tall oil fatty acid), 520.0 g of pine oil rosin, 47.5 g of sebacic acid, 69.0 g of succinic acid and 273.9 g of polyglycerol-3 are placed in a stirred  
15 reactor as in Example 4. The mixture is heated to 250-270°C and the water of condensation is removed until an acid number of less than 7 mg KOH/g. Next, 17.8 g of succinic acid are added and the condensation is continued until an acid number of 3-4 mg KOH/g is obtained.

20 Example 13

310 g of SYLFAT<sup>®</sup> 2 (tall oil fatty acid), 475 g of pine oil rosin, 69.0 g of succinic acid, 78.1 g of sebacic acid and 273.9 g of polyglycerol-3 are placed in a stirred reactor as in Example 4. The mixture is heated to 250-270°C and the water of condensation is removed until an acid number of 3 mg KOH/g is obtained.

25           The compositions of the 13 resins prepared according to Examples 1-13 are presented in Table 2 and the corresponding physicochemical characteristics are given in Table 3 below.

Table 2: Chemical composition (weight%) of the resins of Examples 1-13

Example	1	2	3	4	5	6	7	8	9	10	11	12	13
Resin	72.6	51.7	71.4	65.8	64.2	65.6	57.9	63.3	58.5	43.3	50.4	43.4	39.4
Polyglycerol-3	18.1	18.7	22.1	20.8	21.2	21.7	22.7	20.9	20.8	20.9	21.9	22.9	22.7
Soybean fatty acid (Nouracid® SZ35)			6.5	6.7	9.3	9.5	9.3	9.2					
Tall oil fatty acid (Sylfat® 2) + residual tall oil fatty acid present in resin**									13.7	14.3	17.9	22.5	25.7
Pripol® 1009	9.3	29.6											
Pripol® 1017										16.7			
Succinic acid				6.6	5.2		5.6	6.6	7.0	4.8	6.9	7.2	5.7
Sebacic acid							4.5				2.9	4.0	6.5
Itaconic acid						3.2							
Oil length (weight% vs resin)	0	0	7	10	10	10.5	10	13	15	16	20	25	29

\* The mass content indicated in the table corresponds only to the proportion of resin; any residual fatty acids that may be present in the initial mixture are not counted.

\*\* This comment concerns only the examples in which tall oil resin was used (this starting material contains about 4% tall oil fatty acid).

Table 3: Physicochemical properties of the resins for air drying application via an aqueous formulation according to Examples 1 to 13

Example	1	2	3	4	5	6	7	8	9	10	11	12	13
Rosin* weight% vs resin	72.7	51.8	71.4	65.8	64.2	65.6	57.9	63.3	58.5	43.3	50.4	43.4	39.4
Oil length (%) (oxidizable)	0	0	7	10	10	10.5	10	13	15	16	20	25	29
Overall fatty acid content (oxidizable or non-oxidizable)	9.3	29.6	6.5	9.2	9.3	9.5	9.3	11.7	13.7	31.1	17.9	22.5	25.7
Oxidizable fatty acid content/overall fatty acid content	0	0	1	1	1	1	1	1	1	0.46	1	1	1
Ratio: rosin equivalent/fatty acid equivalent (oxidizable or non-oxidizable)	6.4	1.4	9.1	8.1	5.7	5.7	5.1	5.7	3.5	1.1	2.3	1.6	1.3
Oxidizable C=C (mol/kg)	0	0	0.035	0.058	0.052	0.051	0.051	0.058	0.089	0.106	0.117	0.147	0.168
Measured Mn (SEC or GPC)	1350	2550	1100	2000	1750	1700	2550	2000	2250	3250	3000	3250	3350
Tg resin (°C)	33	10	29	21	18	21	19	11	13	-7	3	-13	-20
Gardner color	6.5	5.0	9.0	6.0	6.6	8.0	8.2	5.1	6.0	8.0	8.5	7.0	8.0
Acid number	6.2	4.0	4.0	5.6	2.1	7.0	2.4	5.5	4.2	5.0	3.0	3.5	3.0

\* The mass content indicated in the table corresponds only to the proportion of rosin: any residual fatty acids that may be present in the initial mixture are not counted

3) Preparation of the tested aqueous dispersions, corresponding to the resins prepared according to Examples 1 to 13

The resins prepared according to the conditions described in Examples 1 to 13 (see point 2 above) are dispersed in water according to the same general procedure and as described below, with the sole exception of the dispersion temperature, which may vary as a function of the initial viscosity of the resin to be dispersed.

435.0 g of resin, as prepared according to Examples 1-13 described above (see point 2), melted beforehand at between 60 and 100°C, as a mixture with the following surfactants, 18.5 g of ATLAS® G5000 and 8.5 g of ZEPHYRUM® 3300B (both supplied by Croda) are placed in a 1.5 liter reactor equipped with an efficient stirring system (mechanical) and are stirred for 45 minutes at a temperature of between 60°C and 80°C (see the values indicated in Table 4 below). If need be, the acid number of the resins is adjusted before neutralization by addition of soybean fatty acid, Nouracid® SZ35, in order to obtain a minimum acid number of 4-5 mg KOH/g. A neutralizing solution of 10% LiOH in water is then gradually added at the same temperature. It is important to note that this addition-neutralization is accompanied by a large increase in the viscosity of the medium, which is why it is essential to employ efficient mechanical stirring that is capable of operating in extremely viscous media. Finally, water is introduced at between 60-67°C until a solids content of 40-55% is obtained. The solids content and the pH are adjusted if necessary. The final emulsion is then cooled and discharged in order subsequently to be characterized and evaluated.

The results of the characterization of the emulsions are collated in Table 4 below.



Table 4: Characteristics of the aqueous dispersions of the resins of Examples 1 to 13

Example vs resin	1	2	3	4	5	6	7	8	9	10	11	12	13
Emulsification temperature	70°C	80°C	67°C	70°C	70°C	70°C	70°C	70°C	70°C	70°C	70°C	80°C	80°C
Particle size (nm)	232	153	159	301	332	140	332	274	263	236	244	315	285
Particle polydispersity	0.06	0.02	0.07	0.17	0.10	0.16	0.18	0.04	0.00	0.03	0.05	0.00	0.00
pH	8.9	8.5	9.5	8.0	8.8	9.4	8.9	7.4	9.1	8.7	8.5	8.3	8.2
% solids content	50.0	46.3	39.0	50.1	49.9	41.5	50.2	50.4	50.3	50.4	50.7	48.9	50.8

4) Preparation of varnish formulations based on the dispersions prepared from resins according to Examples 1 to 13

The general procedure for preparing these varnish formulations is as follows:

15 150 g of aqueous binder (aqueous dispersion) as prepared according to the description in point 3) above are poured into an approximately 250 ml cylindrical container. The medium is then stirred vigorously (with a Dispermat® CV machine) at room temperature (20-25°C). In the case of the siccated resins, the siccating agent (Durham Co 10 WM, 0.1% cobalt metal on dry binder) is added slowly and gradually with stirring (at 700 rpm) for 5 minutes. The medium is then left to stand for 24 hours before  
10 application.

5) Characterization methods used

5.1) Determination of the Tg of the resins

The glass transition temperature Tg measurement is performed using a DSC1-700  
15 type DSC machine from Mettler with a temperature sweep at 10°C/min from -80°C to 150°C and after two consecutive passages (sweeps). The Tg retained is that corresponding to the second passage (sweep).

5.2) Molecular masses of the resins

20 The measurements are taken by steric exclusion chromatography (SEC), using THF as eluent, under the following conditions:

- two mixed columns D + one 100Å column, + one 50Å column
- Elution with THF as the mobile phase, at 1 ml/min and at an elution temperature of 35°C, with detection by refractive index (RI).
- 25 \* Calibration with 11 polystyrene standards having monodisperse molecular masses ranging from 162 to 377 400.

5.3) Evaluation of the performance of the novel binders according to Examples 1 to 13 as aqueous dispersions

30 The hardness evaluation is performed on films obtained by applying to a glass plate a coat of aqueous dispersion with a wet thickness of 100 µm. These are siccated and non-siccated gloss varnish formulations. The siccating agent chosen is a cobalt-

based monometallic system (Durham Co 10 WM, with 0.1 weight% of cobalt metal relative to the weight of dry resin). The dispersion used as comparative reference is an alkyd dispersion, which is the product Synaqua<sup>®</sup> 4804 sold by Cray Valley. The performance qualities in terms of development of hardness over time after application and of evolution of the resistance to yellowing over ageing time of the novel binders are thus compared with those of Synaqua<sup>®</sup> 4804, taken as market reference in this field.

5.3.1) Preparation of gloss varnish and paint formulations based on dispersions prepared according to Examples 1 to 13

10 Preparation of varnish formulations

The general procedure for preparing the varnish formulations is as follows:

15 150 g of aqueous binder (aqueous dispersion) prepared as above are poured into an approximately 250 ml cylindrical container. The medium is then stirred vigorously (with a Dispermat<sup>®</sup> CV machine) at room temperature (20-25°C). Figure 2 shows the results for the hardness evolution and Table 5 shows the results for the yellowing evolution for the non-siccativated varnishes.

For the siccativated varnishes, the siccativating agent is Durham Co 10 WM, added at 0.1% of cobalt metal relative to the dry binder (solids content of the tested dispersion) slowly and gradually while stirring at 700 rpm, over 5 minutes. The medium is then left to stand for 24 hours before application. The results in terms of the hardness evolution for these siccativated varnishes are presented in Figure 1.

Preparation of the gloss paint formulations

25 For the manufacture of a milling base, the water and the various constituents detailed below are placed successively in a container with stirring at high speed in a Disperlux model 2075 disperser, until a fineness < 10 µm is obtained.

30 For the manufacture of paint, the binder (tested dispersion), the milling base prepared previously, the water and the various constituents are placed successively in a container with stirring. The siccativating agent (Borcher Oxi-Coat) is added slowly and gradually with stirring (at 700 rpm) over 5 minutes to about 1.5% for the dispersions of the invention and 0.25% for the reference Synaqua 4804<sup>®</sup> (percentage expressed relative to the

dry binder) in order to obtain a series of dry paints that can be recoated 6 hours after application. The composition of the paint formulation is presented below.

Composition of the paint formulations of resin dispersions of Examples 1 to 13

5

Constituent	Function	Parts by weight (%)
Water	-	4.50
ACTICIDE MBS	Biocide	0.20
DISPERBYK 190	Dispersant	0.58
BYK 022	Antifoam	0.10
TIONA 595	Pigment	23.00
<b>Total milling base</b>		<b>28.38</b>
Tested dispersion	-	60.50
BORCHI <sup>®</sup> OXY-COAT*	Siccating agent	0.45*
Water	-	8.81
AQUAFLOW <sup>®</sup> NMS 450	Thickener	0.75
AQUAFLOW <sup>®</sup> NHS 300	Thickener	1.15
<b>Total paint</b>		<b>100</b>

\* amount for reference resin Synaqua<sup>®</sup> 4804 adjusted corresponding to 0.25% relative to the dry binder (solids content of the resin dispersion).

Characteristics of formulations (calculated by means of the formulation software "PV-  
10 FORMULA Version 2-3" from Pierre Vergne – Inter Deposti Digital Number: IDDM.FR.001.280022.001.S.P.2001.0003.030265):

Volume-based pigment concentration: VPC = 19%

Solids content by weight = 51.1%

Solids content by volume = 38.1%

15 Density d = 1.26

Comparative tests of yellowing evolution were performed on these formulations, and the results are presented in Table 6.

5.3.2) Hardness test: according to the method ISO 1522

This is a Persoz hardness determined at 23°C and at 50% relative humidity. The varnishes are applied at a wet thickness of 100 µm and are then dried on a perfectly horizontal surface at 23°C and at a relative humidity of 50% for 24 hours before the first measurement.

5.3.3) Measurement of the yellowing: according to the Yellowing index (Yi) method ASTM E313-96

The yellowing measurements are taken on a Leneta 2A card with a wet thickness of 150 µm. The surface is then dried totally horizontally at 23°C and at 50% relative humidity for 24 hours before the measurement using a Minolta CM2600D spectrophotometer (measurement on the white part of the card). The yellowing is then accelerated by placing the Leneta cards in an oven at 50°C in the absence of light, for 15 days.

5.3.4) Blocking resistance

The blocking resistances are determined on a Leneta 2A card with a wet thickness of 150 µm. For this test, two films of gloss paint are applied (preparation detailed in point 5.3.1) with replacement of the siccative agent BORCHI® OXY-COAT with Durham Co 10 WM (0.1% cobalt metal on dry binder)) on separate Leneta cards, which are then positioned after 24 hours of drying at room temperature face to face so that the paints are in contact. A weight of 50 g.cm<sup>-2</sup> is then placed on the two cards that are face-to-face, exerting a pressure of 50 g.cm<sup>-2</sup>. After 24 hours of contact, the two Leneta cards are separated and examined. The result obtained is expressed qualitatively as a function of the total surface area of white paint peeled off, with a note ranging from 0 (0 = no point of peeling) to 8 (8 being the worst note with the plate highly degraded).

6) Results for development of hardness, resistance to yellowing and blocking resistance for coatings based on aqueous dispersions obtained from the resins according to Examples 1 to 13

The results as regards the development of hardness are presented in figures 1 and 2, respectively, for siccative and non-siccative varnishes.

The results as regards the yellowing on varnishes whose formulation is specified in point 5.3.1) without siccating agent are presented in Table 5 for the binders not requiring any siccating agent in order to dry (touch-dry < 24 hours) and having an oil length up to 15% (resins from Examples 1 to 9).

5 The yellowing results for all of the binders of the invention for a siccated gloss paint formulation, as described in point 5.3.1), are presented in Table 6. The content of siccating agent is adjusted and optimized to obtain a dry paint that can be recoated after 6 hours.

10 Table 5: Yellowing evolution of non-siccated varnishes

Resin	Ex 1	Ex 3	Ex 4	Ex 5	Ex 6	Ex 7	Ex 8	Ex 9	Synaqua® 4804 (reference)
Yellowing evolution	+58%	+37%	+58%	+92%	+90%	+54%	+115%	+120%	+137%

Table 6: Yellowing evolution of gloss paints

Resin	Ex 1	Ex 2	Ex 3	Ex 4-7	Ex 8	Ex 9	Ex 10	Ex 11	Ex 12	Synaqua® 4804 (reference)
Yellowing evolution (%)	+58	+34	+34	+80	+67	+60	+90	+75	+100	+150

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The capacity to cure faster for the novel aqueous binders of the invention is even more perceptible and notable in the absence of siccation (see figure 2). Figure 2 illustrates the development of hardness for the aqueous binders based on resins having the shortest oil length ranging from 0 to 15%, which means a zero oil length (0%) or an oil length ranging up to 15%, which is quite surprising given these very low or even zero contents. In contrast, it is noted that the resins with an oil length of about 15% to 30% require the use of siccating agent in order to develop their high hardness potential. On the other hand, good or even excellent levels of hardness may be recorded without

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supplying siccative agent, using resins with a low or even zero oil length (0-15%) (see figure 2).

In general, these novel dispersions of resins show rapid development of hardness with hardness levels (at 15 days) largely superior to those of the reference dispersion Synaqua<sup>®</sup> 4804. For some of them (dispersions of resins among the smallest oil lengths), the final hardnesses reached without using siccative agent are even identical to or greater than those of the siccative reference dispersion of resin (4804<sup>®</sup>). This capacity to cure greatly, without necessary supply of siccative agent, is a major advantage in the current environmental context.

Advantageously, faced with the toxicity problems experienced with cobalt salts, these dispersions can dry with less harmful siccative agents (which are for the majority less active when compared with the conventional cobalt-based systems) such as iron salts (Borcher Oxy-Coat), vanadium or manganese salts. Much more advantageously, certain dispersions of resins (0-15%) can dry and cure with high performance levels without the need for any siccative agent.

Still advantageously, these dispersions of resins with a greatly reduced oil length, in the absence or presence of siccative agent, show less yellowing evolution over time (see the details in Table 5 and 6 above) when compared with the reference dispersion of resin (Synaqua<sup>®</sup> 4804). Figure 1 shows the evolution over time, after application, of the hardness of the coatings obtained for coating compositions (varnishes described above) in the presence of siccative agent. The dispersions according to the invention have at least the same if not better performance in terms of rapid growth of the hardness over time (in particular for the range of dispersions based on resins with an oil length from 0 to 15%) than that of the reference dispersion (based on Synaqua<sup>R</sup> 4804 resin) despite a higher oil length for the latter.

Figure 2 shows even better the performance of the dispersions according to the invention in the total absence of siccative agent on varnishes. The reference dispersion is also represented in the presence of siccative agent (0.1%) to show that the dispersions corresponding to an oil length ranging from 0 to 15%, in the absence of any siccative agent, show better performance (on varnishes) than the reference dispersion even when comparing the latter in the presence of 0.1% siccative agent (comparative conditions more unfavorable for the dispersions of the invention).

A substantial gain in hardness is observed on the coatings (varnishes) obtained from the aqueous dispersions of the invention dried in the open air (see figures 1 and 2).

Advantageously, the dispersions of resins with an oil length ranging from 15% to 25%, siccativated with cobalt as described above, show excellent blocking resistance in particular relative to the reference dispersion of resin (Synaqua<sup>®</sup> 4804). Figure 3 explicitly and qualitatively shows this marked difference in blocking resistance between a dispersion prepared according to Example 11 (in the left part of figure 3) and the reference dispersion of resin (Synaqua<sup>®</sup> 4804 in the right part). Surprisingly, the dispersion of resin of the invention under these conditions does not lead to any point of attachment or peeling of the coating during the blocking resistance test (note = 0), in contrast with the reference dispersion of resin (note = 8). Since the application support for the white paint is black, this means that the black parts of the image in figure 3 correspond to the parts peeled off during the test (right part with note = 8). In the case of the resin dispersion according to Example 11 (invention), the white image demonstrates the absence of any peeling (note = 0).

15 A substantial gain in hardness is observed on the coatings (varnishes) obtained from the aqueous dispersions dried in the open air (see figures 1 and 2).



### Patentkrav

1. Vandig harpiksdispersion, **kendetegnet ved, at** den omfatter mindst én polyesterharpiks, især alkydharpiks, hvor harpiksen:
- 5 - er baseret på mindst én fedtsyre  
- har en olielængde på nul (0%) eller mellem 0 og 35%, fortrinsvis større end 0 og op til 25, mere foretrukket op til 15%  
- har et vægtforhold af oxiderbare fedtsyrer (monosyrer) i forhold til de samlede fedtsyrer på 0 eller større end 0 og op til 1
- 10 - er baseret på en syrekomponent, der ud over fedtsyren omfatter fra 30 til 85%, og fortrinsvis fra 35 til 75 vægt%, mere foretrukket fra 40 til 75 vægt% og endnu mere foretrukket fra 45 til 75 vægt%, i forhold til den samlede vægt af harpiksen, kolofonium og/eller kolofoniumderivater med mindst en carboxylsyrefunktion,
- 15 eller **ved, at** dispersionen omfatter mindst én organisk bindemiddelsammensætning, som omfatter mindst én harpiks så som defineret ovenstående.
2. Dispersion ifølge krav 1, **kendetegnet ved, at** harpiksen omfatter mindst 5 vægt%, fortrinsvis mindre end 3 vægt%, og mere foretrukket ingen (%) aromatisk forbindelse ud over eventuelle kolofoniumderivater.
- 20
3. Dispersion ifølge krav 1 eller 2, **kendetegnet ved, at** harpiksen er baseret på en syrekomponent, som ud over fedtsyren omfatter kolofonium og/eller ud over kolofoniumderivaterne omfatter mindst én syreforbindelse, som har mindst én carboxylsyrefunktion og en samlet funktionalitet på 2 til 3, udvalgt blandt: mættede polysyrer eller ethylenisk umættede polysyrer eller hydroxysyrer.
- 25
4. Dispersion ifølge krav 3, **kendetegnet ved, at** syrekomponenten omfatter mindst to af syreforbindelserne, hvor mindst én er udvalgt fra mættede polysyrer, og mindst én er udvalgt fra umættede polysyrer, ud over fedtsyren og
- 30

kolofonium og/eller kolofoniumderivaterne.

- 5
5. Dispersion ifølge krav 3 eller 4, **kendetegnet ved, at** polysyren omfatter mindst én C<sub>36</sub>-fedtsyredimer og eller C<sub>54</sub>-fedtsyretrimer.
- 10
6. Dispersion ifølge et af kravene 3 til 5, **kendetegnet ved, at** syrekomponenten desuden omfatter mindst én af syreforbindelserne, som er udvalgt blandt hydroxysyrerne, fortrinsvis blandt glycolsyre eller mælkesyre.
- 15
7. Dispersion ifølge et af kravene 1 til 6, **kendetegnet ved, at** indholdet af oxiderbare umættetheder i harpiksen er nul (0), eller det er mere end 0 og op til 0,25, og fortrinsvis op til 0,15 mmol oxiderbare dobbeltbindinger per g tør harpiks.
- 20
8. Dispersion ifølge et af kravene 1 til 7, **kendetegnet ved, at** harpiksen er baseret på en alkoholkomponent, som omfatter mindst én polyol med en funktionalitet fra 2 til 10 og fortrinsvis fra 3 til 6.
- 25
9. Dispersion ifølge et af kravene 1 til 8, **kendetegnet ved, at** harpiksen har et syretal, der er mindre end 8, og en talgennemsnitlig molekylemasse M<sub>n</sub>, målt med GPC som polystyren ækvivalent i THF fra 1 000 til 10 000.
- 30
10. Dispersion ifølge et af kravene 1 til 9, **kendetegnet ved, at** harpiksen har en T<sub>g</sub> målt med DSC efter to gennemgange med en temperatursøgningshastighed på 10°C/min, som går fra -40 til 50°C, og fortrinsvis fra -20 til 35°C.
11. Dispersion ifølge et af kravene 1 til 10, **kendetegnet ved, at** olielængden ligger mellem 0 og 35%, og fortrinsvis er den større end 0 og går op til 25%, og mere foretrukket op til 15%, med tilstedeværelse af mindst én oxiderbar fedtsyre (monosyre).

12. Dispersion ifølge krav 11, **kendetegnet ved, at** indholdet af oxiderbare umættetheder i harpiksen er større end 0 og op til 0,25, og fortrinsvis op til 0,15 mmol oxiderbare dobbeltbindinger per g tør harpiks.
- 5      13. Dispersion ifølge krav 11 eller 12, **kendetegnet ved, at** fedtsyren fortrinsvis er udvalgt blandt C<sub>16</sub>- til C<sub>24</sub>-monofedtsyrer af vegetabilsk eller animalsk oprindelse, med et gennemsnitligt jodtal fra 100 til 200.
- 10      14. Dispersion ifølge et af kravene 11 til 13, **kendetegnet ved, at** fedtsyren er udvalgt blandt fedtsyrer af soja-, solsikke-, tall- (TOFA), ricinus-, dehydreret ricinus-, hør-, rapsolie, hvor fedtsyrerne anvendes som sådan eller i form af tilsvarende olie (triglyceridestere) af fedtsyrer eller tilsvarende standolier af fedtsyreolier.
- 15      15. Dispersion ifølge et af kravene 11 til 14, **kendetegnet ved, at** harpiksen er baseret på en polysyre, som omfatter mindst én C<sub>36</sub>-fedtsyredimer og/eller én C<sub>54</sub>-fedtsyretrimer, og baseret på en polyol, som omfatter mindst én glycerin- og/eller pentaerythritol- og/eller dipentaerythritololigomer, fortrinsvis glycerintrimer, nærmere bestemt polyglycerin-3.
- 20      16. Dispersion ifølge et af kravene 1 til 15, **kendetegnet ved, at** polyesteren er en alkydharpiks med et olieindhold over 0%, fortrinsvis op til 25%, mere foretrukket op til 15%.
- 25      17. Dispersion ifølge et af kravene 1 til 10, **kendetegnet ved, at** harpiksen har et olieindhold på nul (0%), og at fedtsyren er udvalgt blandt ikke-oxiderbare fedtsyrer med en tilsvarende andel af oxiderbare umættetheder på 0 mmol per g tør harpiks, eller **ved, at** harpiksen har et olieindhold op til 5%, og at ud over den fedtsyre, som er udvalgt blandt de ikke-oxiderbare
- 30      fedtsyrer, i mindre vægtproportioner omfatter en fedtsyre, som resulterer i, at olieindholdet går op til 5%.

- 5 **18.** Dispersion ifølge krav 17, **kendetegnet ved, at** den ikke oxiderbare fedtsyre er udvalgt blandt mættede fedtsyrer, herunder oprindeligt oxiderbare fedtsyrer, som er hydrogenet, eller blandt fedtsyreoligomerer, fortrinsvis C<sub>36</sub>-dimerer (herunder hydrogenerede) og/eller C<sub>54</sub>-trimerer (herunder hydrogenerede).
- 10 **19.** Dispersion ifølge krav 17 eller 18, **kendetegnet ved, at** harpiksen er baseret på en alkoholkomponent, der som polyol omfatter en glycerinoligomer, fortrinsvis polyglycerin-3, og som ikke oxiderbar fedtsyre en C<sub>36</sub>-fedtsyredimer og/eller en C<sub>54</sub>-fedtsyretrimer (hydrogenerede eller ikke).
- 15 **20.** Vandig dispersion ifølge et af kravene 1 til 19, **kendetegnet ved, at** den ud over harpiksen omfatter mindst ét overfladeaktivt middel, der er udvalgt blandt: mindst ét anionisk overfladeaktivt middel og mindst ét ikke-ionisk overfladeaktivt middel og mindst ét overfladeaktivt middel med blandet struktur og med et samlet vægttal i forhold til harpiksen, som går fra 2 til 15%, fortrinsvis fra 5 til 10%.
- 20 **21.** Dispersion ifølge et af kravene 1 til 20, **kendetegnet ved, at** den har en tørmasse, som går fra 30 til 70%, og fortrinsvis fra 40 til 60% og en gennemsnitlig partikelstørrelse fra 100 til 500 nm.
- 25 **22.** Dispersion ifølge et af kravene 1 til 21, **kendetegnet ved, at** den er fri for ethvert organisk opløsningsmiddel med en tilsvarende andel af VOC under 1 000 ppm, fortrinsvis under 500 ppm, og mere foretrukket under 100 ppm.
- 30 **23.** Vandig harpiksdispersion, **kendetegnet ved, at** den i blanding omfatter en første vandig harpiksdispersion så som defineret ifølge et af kravene 1 til 22 og mindst én anden harpiksdispersion, der er forskellig fra den første, hvor denne anden harpiksdispersion er udvalgt blandt eventuelt modificerede alkyddispersioner, acryldispersioner (eller -emulsioner) (herunder styrol-acryl-dispersioner) eller dispersioner af andre polymerer og især dispersioner

af polyuretan, mættede eller umættede polyestere.

**24.** Dispersion ifølge et af kravene 1 til 23, **kendetegnet ved, at** den er fri for enhver beskyttelseskolloid.

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**25.** Fremgangsmåde til fremstilling af en vandig dispersion så som defineret ifølge et af kravene 1 til 24, **kendetegnet ved, at** den omfatter et trin med emulgering ved en temperatur fra 30 til 90°C, fortrinsvis fra 50 til 85°C, af mindst én harpiks så som defineret ifølge et af kravene 1 til 19 og/eller af mindst én bindemiddelsammensætning, som omfatter mindst én sådan harpiks, gennem faseinversion i en reaktor, der omrøres via et omrøringsystem med dobbelt strømning.

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**26.** Coatingssammensætning, **kendetegnet ved, at** den som bindemiddel omfatter mindst én vandig dispersion så som defineret ifølge et af kravene 1 til 24.

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**27.** Sammensætning ifølge krav 26, **kendetegnet ved, at** sammensætningen er en sammensætning af vandige coatingssammensætninger.

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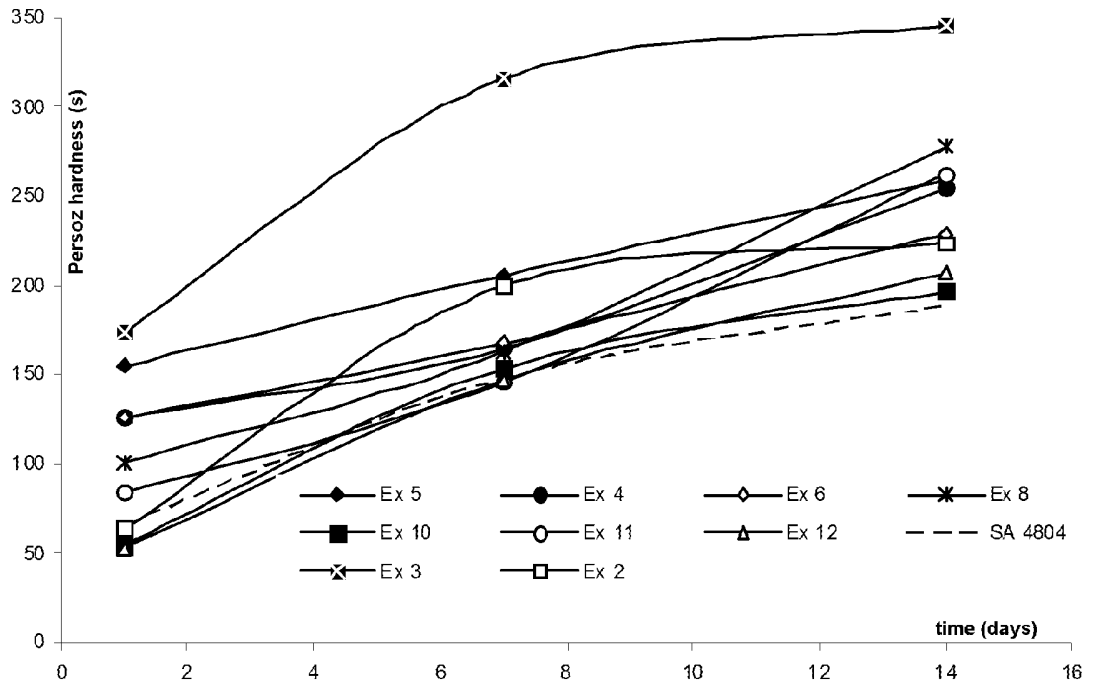
**28.** Coatingssammensætning ifølge krav 26 eller 27, **kendetegnet ved, at** coatingen er udvalgt blandt dekorative eller industrielle coatings, for industrielle coatings især korrosionsbeskyttende coatings, fortrinsvis blandt vandige coatings: klæbemidler, malinge, lasurfarver, grundmalinger og lak.

25

**29.** Coatingssammensætning ifølge et af kravene 26 til 28, **kendetegnet ved, at** den er baseret på en vandig dispersion så som defineret ifølge et af kravene 1 til 24, **ved, at** den omfatter et tørremiddel, og **ved, at** den harpiks, der anvendes som bindemiddel, har en olielængde (indhold) helt op til 25% og fortrinsvis fra 15 til 25%.

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30. Anvendelse af mindst én vandig dispersion så som defineret ifølge et af kravene 1 til 24, **kendetegnet ved, at** det drejer sig om anvendelse som binde­middel i coatings.
- 5      31. Anvendelse ifølge krav 30, **kendetegnet ved, at** det drejer sig om vandi­ge dekorative eller industrielle coatings, der er udvalgt blandt klæbemidler, lasurfarver, grundmalinger eller lak.
- 10     32. Anvendelse ifølge krav 31, **kendetegnet ved, at** det drejer sig om coa­tings til substrater udvalgt blandt: træ, metal, gips, beton, kompositmaterialer eller plastmaterialer.
33. Substratcoatings, **kendetegnet ved, at** de opnås fra mindst én dispersi­on så som defineret ifølge et af kravene 1 til 24.



**FIG. 1:** Development of hardness on varnishes as a function of time, with siccation with 0.1% of Co metal (Durham Co 10 WM, 0.1% of cobalt metal on dry binder)

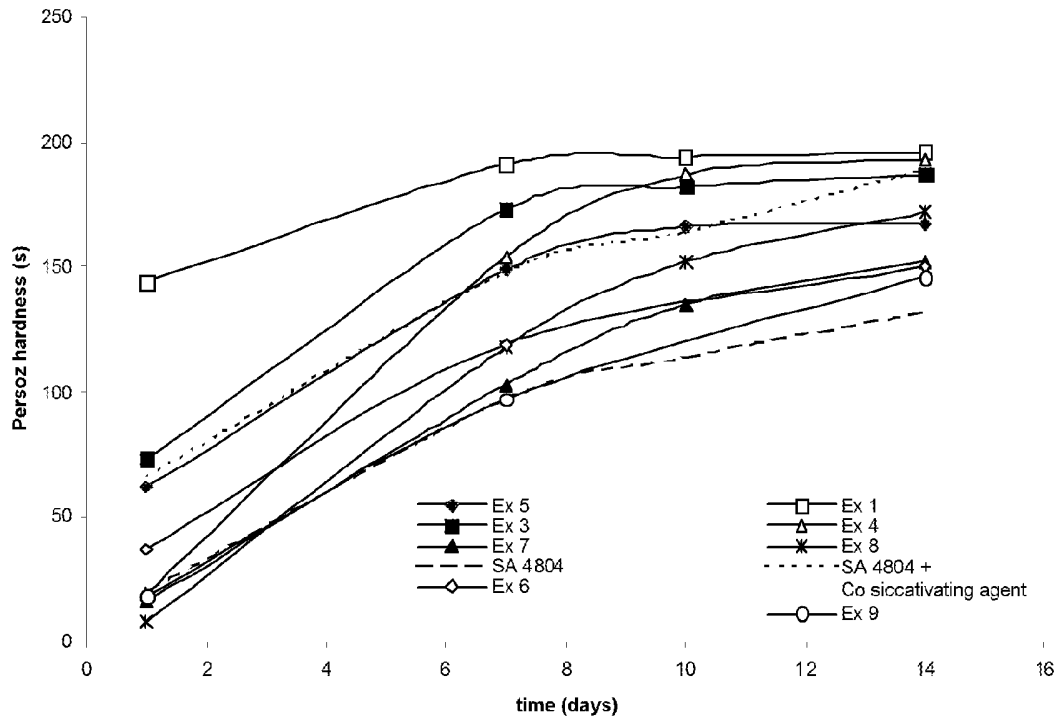
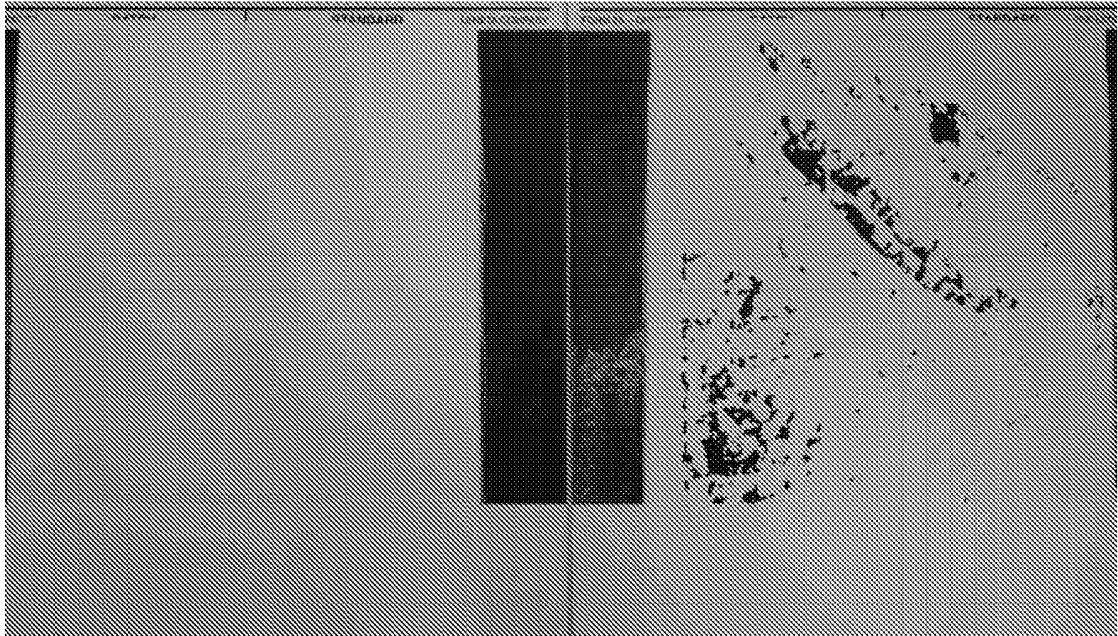


FIG. 2: Development of hardness on varnishes as a function of time, without siccativation





Dispersion according to Example 11

Synaqua® 4804

**FIG. 3:** Test of blocking resistance after 24 hours of drying (Durham Co 10 WM, 0.1% of cobalt metal on dry binder) and 24 hours of contact