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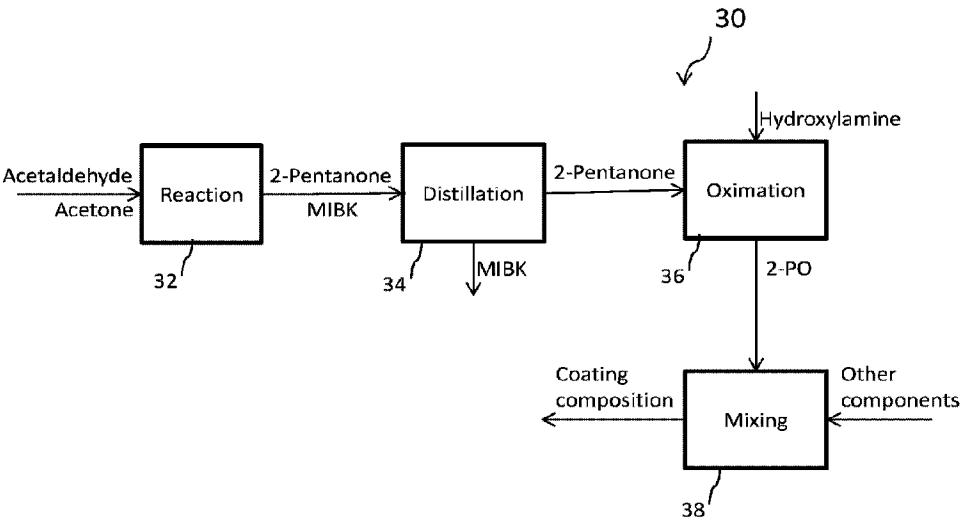

(57) Abrégé/Abstract:
A coating composition including at least one solvent, at least one resin, at least one drier, and an anti-skinning agent is provided, an anti-skinning composition, wherein the anti-skinning composition comprises at least 92 wt.%, or more particularly at least 98 wt.%, of an alkyl oxime having five carbon atoms selected from 2-pentanone oxime and 3-methyl-2-butanone oxime. In some embodiments, the high-purity 2-pentanone oxime includes less than 0.5 wt.% methyl isobutyl ketoxime. In some embodiments, the composition includes less than 0.006 wt.% methyl isobutyl ketoxime. A method for the preparation of a purified 2-pentanone stream suitable for oximation to a high-purity 2-pentanone oxime is also provided.

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(54) **Title**: COATING COMPOSITION INCLUDING ALKYL OXIMES

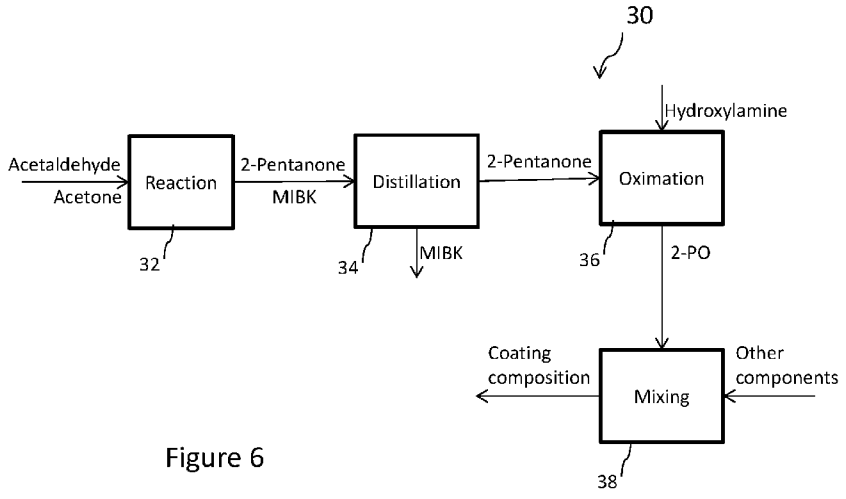

Figure 6

(57) **Abstract**: A coating composition including at least one solvent, at least one resin, at least one drier, and an anti-skinning agent is provided, an anti-skinning composition, wherein the anti-skinning composition comprises at least 92 wt.%, or more particularly at least 98 wt.%, of an alkyl oxime having five carbon atoms selected from 2-pentanone oxime and 3-methyl-2-butanone oxime. In some embodiments, the high-purity 2-pentanone oxime includes less than 0.5 wt.% methyl isobutyl ketoxime. In some embodiments, the composition includes less than 0.006 wt.% methyl isobutyl ketoxime. A method for the preparation of a purified 2-pentanone stream suitable for oximation to a high-purity 2-pentanone oxime is also provided.

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COATING COMPOSITION INCLUDING ALKYL OXIMES

FIELD

[0002] The present invention relates to coating compositions including an anti-skinning agent and, in particular, relates to high purity anti-skinning agents and methods of producing the same.

BACKGROUND

[0003] Air-drying coating compositions, like paints, include unsaturated resins dissolved in an organic or aqueous solvent medium along with additives such as driers that impact the drying profile. The driers are catalysts used to accelerate the drying process, and may include multiple metal salts, such as metal octoates. For example, a paint composition may include cobalt or manganese salts to promote the autoxidation, zirconium salts for the polymerization or crosslinking of the resin, and calcium salts to control the film formation. These catalyst driers enable the paint to dry within a few hours. The cobalt and/or manganese salts are oxidation catalysts that play an important role in initiating the oxidation process.

[0004] Coating compositions such as alkyd paints that can dry in air are typically stored in cans. During storage, the paint may react with the air present over the composition to form a thin skin of cured paint on top of the paint. This unwanted reaction is referred to as the "skinning" of paints. This skinning phenomenon deteriorates the quality of the paint composition, impacts the strength of the driers, and negatively impacts the drying profile of the remaining paint. This skin formation is due to oxidative crosslinking of the resin and results in drying of the paint composition. Thus, anti-skinning agent additives are added to the coating composition to prevent the skinning of paints.

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[0005] It is known that these anti-skinning agents not only behave as anti-oxidants to prevent oxidative crosslinking of the paint resin, but the anti-skinning agents also form complexes with the transition metal salt driers to avoid pre-mature drying inside the can. Without wishing to be held to any particular theory, it is believed that a complex formed between the anti-skinning agent and the transition metal salt driers is far less effective as a catalyst for the autoxidation polymerization process, and thus prevents premature drying of the paint in the can. When the coating composition is applied to a substrate, the surface area is increased, enabling the anti-skinning agent to evaporate. Evaporation of the anti-skinning agent destroys the complex between the anti-skinning agent and the metal salt driers, enabling the catalytic activity of the metal ions to be restored and the paint to dry.

[0006] Although several organic additives based on hydroxylamine derivatives, phenols, amino compounds and oximes of aldehydes and ketones have been used as anti-skinning agents, in practice, methyl ethyl ketoxime (MEKO) is typically regarded as the most effective and widely used anti-skinning agent. MEKO is known to form a complex with the primary metal salt driers to prevent premature drying in the can. MEKO will also evaporate easily to free the metal ion from the complex to facilitate the drying process once the paint is applied on a substrate. Additionally, MEKO provides benefits including low odor, low required dosage, applicability to a wide range of coatings, no yellowing or discoloration, no residue, no impact on the drying profile of the coating, and no impact on the performance of the coating, such as gloss, adhesion, or solvent resistance.

[0007] However, concerns have been raised relating to the toxicity of MEKO. MEKO has been identified as a skin sensitizer and a suspected carcinogen. In addition, the German Hazardous Substances Commission has reduced the Occupational Exposure Limit (OEL) for MEKO to a level of only 0.3 ppm. On February 2, 2016, the German Federal Institute for Occupational Safety and Health (BAuA) has notified the European Chemicals Agency (ECHA) of its intention to submit a proposal to revise the harmonized classification of MEKO from a Carcinogenic, Mutagenic, or Toxic for Reproduction (CMR) category Carc. 2 to the more severe CMR category Carc. 1B.

[0008] Other anti-skinning agents have been proposed as a replacement for MEKO, but each lacks one or more of the benefits of MEKO, as described above.

[0009] Improvements in the foregoing processes are desired.

SUMMARY

[0010] The present disclosure provides coating compositions comprising a high purity 2-pentanone oxime as an anti-skinning agent.

[0011] In one exemplary embodiment, there is provided a method for preparing a 2-pentanone product. The method includes conveying an input stream including 2-pentanone to a distillation apparatus, the input stream further including methyl isobutyl ketone; and distilling the input stream in the distillation apparatus to produce an overheads stream including less methyl isobutyl ketone than the input stream and a bottoms stream, wherein the overheads stream including more methyl isobutyl ketone than the input stream. In one more particular embodiment, the overheads stream comprises at least 98 wt.% 2-pentanone. In a more particular embodiment of either of the above embodiments, the overheads stream includes less than 0.5 wt.% methyl isobutyl ketone. In a more particular embodiment of any of the above embodiments, the input stream comprises at least 5 wt.% methyl isobutyl ketone.

[0012] In a more particular embodiment of any of the above embodiments, the distillation apparatus includes a first distillation column and a second distillation column. In a more particular embodiment of any of the above embodiments, the first distillation column includes an overheads stream divided between a first reflux stream returned to the first distillation column and a takeoff stream provided as a feed stream to the second distillation column. In a more particular embodiment of any of the above embodiments, a first reflux ratio is defined as a ratio of a flow rate of the first reflux stream to the takeoff stream, and wherein the first reflux ratio is from 1:2 to 5:1, preferably from 2:1 to 4:1, more preferably about 3:1. In a more particular embodiment of any of the above embodiments, the overheads stream from the first distillation column includes less than 5000 ppm methyl isobutyl ketone, preferably less than 1000 ppm methyl isobutyl ketone.

[0013] In a more particular embodiment of any of the above embodiments, the second distillation column includes a second overheads stream divided between a second reflux stream returned to the second distillation column and a recycle stream provided as a second input stream to the first distillation column. In a more particular

embodiment of any of the above embodiments, a second reflux ratio is defined as a ratio of a flow rate of the second reflux stream to the recycle stream, and wherein the second reflux ratio is from 2:1 to 20:1, preferably from 5:1 to 15:1, more preferably about 10:1. In a more particular embodiment of any of the above embodiments, the recycle stream includes less than 5 wt.% methyl isobutyl ketone, preferably less than 3 wt.% methyl isobutyl ketone.

[0014] In a more particular embodiment of any of the above embodiments, the second reflux ratio is at least 2 times greater than the first reflux ratio, preferably at least 3 times greater than the first reflux ratio, more preferably about 3.3 times greater than the first reflux ratio.

[0015] In a more particular embodiment of any of the above embodiments, the method further includes performing an oximation reaction on the overheads stream of the first distillation column to form a 2-pentanone oxime product.

[0016] In one exemplary embodiment, a coating composition is provided. The coating composition comprises at least one solvent, at least one resin, at least one drier, and an anti-skinning composition capable of preventing oxidative crosslinking of the resin to form a skin, the anti-skinning composition comprising at least 92 wt.% of an alkyl oxime based on the total weight of the anti-skinning composition, wherein the alkyl oxime is selected from 2-pentanone oxime and 3-methyl-2-butanone oxime.

[0017] In one exemplary embodiment, the anti-skinning composition is a high-purity 2-pentanone oxime. In one more particular embodiment, the anti-skinning composition has a purity of at least 92 wt.% 2-pentanone oxime. In one more particular embodiment, the anti-skinning composition has a purity of at least 98 wt.% 2-pentanone oxime. In another more particular embodiment, the anti-skinning composition comprises less than 0.5 wt.% methyl isobutyl ketoxime, based on the total weight of the anti-skinning composition. In another more particular embodiment, the coating composition comprises less than 0.06 wt.% methyl isobutyl ketoxime, based on the total weight of the composition. Preferably, the anti-skinning composition has a purity of at least 98 wt.% 2-pentanone oxime and has less than 0.5 wt.% methyl isobutyl ketoxime based on the total weight of the anti-skinning composition, preferably less than 0.06 wt.% methyl isobutyl ketoxime, based on the total weight of the composition. In one more particular embodiment, the anti-skinning

agent consists essentially of 2-pentanone oxime. In another more particular embodiment, the anti-skinning agent is a high-purity 3-methyl-2-butanone oxime.

[0018] In one exemplary embodiment, a coating composition is provided. The coating composition comprises at least one solvent, at least one resin, at least one drier, and an anti-skinning composition capable of preventing oxidative crosslinking of the resin to form a skin, wherein the anti-skinning composition comprises at least 92 wt.%, or more particularly at least 98 wt.%, of an alkyl oxime selected from 2-pentanone oxime and 3-methyl-2-butanone oxime.

[0019] In one more particular embodiment, the anti-skinning composition comprises a high-purity 2-pentanone oxime and methyl ethyl ketoxime. In one more particular embodiment, the anti-skinning composition has less than 0.5 wt.% methyl isobutyl ketoxime, based on the total weight of the anti-skinning composition. In another more particular embodiment, the coating composition has less than 0.06 wt.% methyl isobutyl ketoxime, based on the total weight of the composition. In one more particular embodiment, the anti-skinning composition comprises 5 wt.% to 30 wt.% methyl isobutyl ketoxime and 95 wt.% to 70 wt.% 2-pentanone oxime, based on the total weight of the anti-skinning composition. In a more particular embodiment, the anti-skinning agent has a ratio of 2-pentanone oxime to methyl ethyl ketoxime of from 60:40 to 80:20, of from about 65:35 to 75:25, or of about 70:30. In one more particular embodiment, the anti-skinning composition consists essentially of 2-pentanone oxime and methyl ethyl ketoxime.

[0020] In one exemplary embodiment, a coating composition is provided including at least one solvent, at least one resin, at least one drier, and an anti-skinning composition capable of preventing oxidative crosslinking of the resin to form a skin, wherein the anti-skinning composition comprises at least 92 wt.%, or more particularly at least 98 wt.%, based on the total weight of the anti-skinning composition, of an alkyl oxime selected from 2-pentanone oxime and 3-methyl-2-butanone oxime.

[0021] In one more particular embodiment, the anti-skinning composition comprises at least 92 wt.% 2-pentanone oxime. In one more particular embodiment, the anti-skinning composition comprises at least 98 wt.% 2-pentanone oxime. In a more particular embodiment, the anti-skinning composition comprises at least 99 wt.% 2-pentanone oxime. In another more particular embodiment, the anti-skinning

composition comprises at least 99.5 wt.% 2-pentanone oxime. In still another more particular embodiment, the anti-skinning composition comprises at least 99.9 wt.% 2-pentanone oxime. In another more particular embodiment, the anti-skinning composition is a high-purity 3-methyl-2-butanone oxime.

[0022] In one exemplary embodiment, an anti-skinning composition capable of preventing oxidative crosslinking of the resin to form a skin is provided wherein the anti-skinning composition comprises at least 92 wt.%, or more particularly at least 98 wt.%, of an alkyl oxime selected from 2-pentanone oxime and 3-methyl-2-butanone oxime. In one more particular embodiment, the anti-skinning composition comprises 2-pentanone oxime provided in combination with a solvent selected from xylene, mineral spirits, alcohol, and water. In a more particular embodiment, the anti-skinning composition comprises at least 92 wt.% 2-pentanone oxime. In another more particular embodiment, the anti-skinning composition comprises at least 98 wt.% 2-pentanone oxime. In another embodiment, a coating composition comprising either of the above anti-skinning compositions is provided. In another more particular embodiment, the anti-skinning composition is a high-purity 3-methyl-2-butanone oxime.

[0023] In a more particular embodiment of any of the above embodiments, the anti-skinning composition comprises less than 0.5 wt.% methyl isobutyl ketoxime, based on the total weight of the anti-skinning composition. In another more particular embodiment of any of the above embodiments, the anti-skinning composition comprises less than 0.3 wt.% methyl isobutyl ketoxime, based on the total weight of the anti-skinning composition. In another more particular embodiment of any of the above embodiments, the anti-skinning composition comprises less than 0.1 wt.% methyl isobutyl ketoxime, based on the total weight of the anti-skinning composition.

[0024] In a more particular embodiment of any of the above embodiments, the anti-skinning agent comprises at least 92 wt.% 2-pentanone oxime, preferably at least 98 wt.% 2-pentanone oxime, at least 99 wt.% 2-pentanone oxime, at least 99.5 wt.% 2-pentanone oxime, and or at least 99.9 wt.% 2-pentanone oxime, based on the total weight of the composition. In another more particular embodiment of any of the above embodiments, the anti-skinning composition comprises less than 0.5 wt.% methyl isobutyl ketoxime, preferably less than 0.3 wt.% methyl isobutyl

ketoxime, or less than 0.1 wt.% methyl isobutyl ketoxime, based on the total weight of the composition. In a more particular embodiment of any of the above embodiments, the anti-skinning composition comprises at least 92 wt.% 2-pentanone oxime, preferably at least 98 wt.% 2-pentanone oxime, at least 99 wt.% 2-pentanone oxime, at least 99.5 wt.% 2-pentanone oxime, or at least 99.9 wt.% 2-pentanone oxime and the anti-skinning composition comprises less than 0.5 wt.% methyl isobutyl ketoxime, less than 0.3 wt.% methyl isobutyl ketoxime, or less than 0.1 wt.% methyl isobutyl ketoxime, based on the total weight of the anti-skinning composition.

[0025] In a more particular embodiments of any of the above embodiments, the at least one resin comprises one or more alkyd resins. In another more particular embodiment of any of the above embodiments, at least one drier comprises one or more transition metal salt, such as one or more transition metal salts selected from the group consisting of cobalt salts, manganese salts, zirconium salts, and calcium salts. In another more particular embodiment of any of the above embodiments, the at least one solvent comprises at least one solvent selected from the group consisting of: xylene, mineral spirits, alcohol, and water, and combinations thereof. In another more particular embodiment of any of the above embodiments, the coating composition further includes at least one additive selected from the group consisting of: fillers, pigments, surfactants, stabilizers, thickeners, emulsifiers, texture additives, adhesion promoters, biocides, and additives to modify viscosity or finished appearance.

[0026] In a more particular embodiment of any of the above embodiments, the coating composition has a drying time at least as short as a similar composition having the same components except that the weight percentage of 2-pentanone oxime and/or 3-methyl-2-butanone oxime is replaced with an equivalent weight percentage of methyl ethyl ketoxime.

[0027] In one embodiment, a method of making a coating composition is provided. The method includes combining at least one solvent, at least one resin, at least one drier, and an anti-skinning composition capable of preventing oxidative crosslinking of the resin to form a skin, to make the coating composition, wherein the anti-skinning composition comprises at least 92 wt.% 2-pentanone oxime, or more particularly, at least 98 wt.% 2-pentanone oxime, based on the total weight of the anti-skinning composition. In a more particular embodiment, the method further

includes providing a product including 2-pentanone and methyl isobutyl ketone; removing at least a portion of the methyl isobutyl ketone to produce a high purity product of 2-pentanone, wherein the high purity product of 2-pentanone comprises less than 0.5 wt.% methyl isobutyl ketone; and reacting the high purity product of 2-pentanone with hydroxylamine to produce the high purity product 2-pentanone oxime anti-skinning agent. In one more particular embodiment, the high purity product 2-pentanone oxime comprises at least 98 wt. % of 2-pentanone oxime.

[0028] The above mentioned and other features of the invention, and the manner of attaining them, will become more apparent and the invention itself will be better understood by reference to the following description of embodiments of the invention taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0029] FIG. 1 shows the oximation of 2-pentanone to form 2-pentanone oxime ("2-PO") using hydroxylamine.

[0030] FIG. 2 shows the production of 2-pentanone from acetaldehyde and acetone.

[0031] FIG. 3 shows the formation of methyl isobutyl ketone ("MIBK") from the self-condensation of acetone.

[0032] FIG. 4 shows the oximation of MIBK to methyl isobutyl ketoxime ("MIBKO") using hydroxylamine.

[0033] FIG. 5 shows an exemplary process for producing a 2-PO product.

[0034] FIG. 6 shows an exemplary process for producing a coating composition including a high-purity 2-PO product.

[0035] FIG. 7 is a schematic of an exemplary distillation and oximation scheme for the process of FIG. 6.

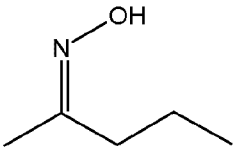
[0036] FIG. 8 is a schematic of an exemplary first distillation column for the distillation scheme of FIG. 7.

[0037] FIG. 9 is a schematic of an exemplary second distillation column for the distillation scheme of FIG. 7.

DETAILED DESCRIPTION

[0038] Alkyl oximes having five carbon atoms include 2-pentanone oxime and 3-methyl-2-butanone oxime. As shown below, it has been discovered that high-purity 2-pentanone oxime and 3-methyl-2-butanone oxime function as effective anti-skinning agents.

[0039] 2-pentanone oxime ("2-PO"), also known as methyl propylketoxime, is an alkyl oxime having the following formula (I):

[0040] 

[0041] As shown below, it has been discovered that high-purity 2-PO functions as an effective anti-skinning agent. 2-PO has a vapor pressure similar to that of MEKO. In addition, 2-PO provides similar benefits to MEKO, including low required dosage, applicability to a wide range of coatings, no yellowing or discoloration, no residue, and no impact on the performance of the coating, such as gloss, adhesion, or solvent resistance. Additionally, high-purity 2-PO, which includes relatively low levels of methyl isobutyl ketoxime (MIBKO) as described below, provides similar drying profiles to MEKO, as well as low odor.

[0042] However, 2-PO has a positive toxicology profile compared to MEKO.

[0043] The saturated vapor concentration of MEKO is 1350 ppm, while that of 2-PO is only 300 ppm, or less than 25% of that of MEKO. The lower saturated vapor concentration provides a lower inhalation risk for 2-PO compared to MEKO.

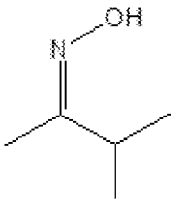
[0044] For dermal irritation, MEKO is a slight irritant, while 2-PO produces no irritation. For eye irriation, MEKO is categorized as causing serious eye damage (code H318), while 2-PO is categorized as only causing serious eye irritation (code H319).

[0045] MEKO is classified as a sensitizer (R43), while 2-PO is not a sensistizer.

[0046] MEKO has an effective concentration of 50% growth inhabitation (EC_{50}) for algae of only 7 ppm, while the corresponding EC_{50} of 2-PO for algae is 88 ppm. MEKO has an lethal concentration of 50% mortality (LC_{50}) for fish of only 48 ppm, while the corresponding LC_{50} of 2-PO for fish is greater than 100 ppm.

[0047] The positive toxicology profile of 2-PO compared to MEKO was unexpected.

[0048] 3-methyl-2-butanone oxime, also known as methyl isopropyl ketoxime, is a alkyl oxime having the following formula (II):



[0049]

[0050] 3-methyl-2-butanone oxime has a vapor pressure at 20°C of less than 0.975 mm Hg, compared to about 1.60 mm Hg for 2-PO and 2.00 mm Hg for MEKO.

[0051] *1. Typical production of 2-pentanone oxime*

[0052] 2-pentanone oxime is produced from the oximation of 2-pentanone with hydroxylamine, as shown in Figure 1. 2- pentanone is commercially produced from acetaldehyde and acetone via aldol condensation, dehydration and hydrogenation, as shown by the reaction summarized in Figure 2.

[0053] However, in the reaction shown in Figure 2, it is known and unavoidable that a portion of the acetone reactant will undergo self-condensation following the same reaction pathway to form methyl isobutyl ketone (MIBK), also known as 4-methyl-2- pentanone. This side reaction is shown in Figure 3. As a result, the 2-pentanone product produced by the reaction shown in Figure 1 will contain at least some MIBK, which may be as much as 8-10 wt.% of the total mixture of 2-pentanone and MIBK.

[0054] However, in direct oximation of a 2-pentanone feed that also includes MIBK, the hydroxylamine also reacts with the MIBK product in an oximation reaction as shown in Figure 4 to form methyl isobutyl ketoxime (MIBKO).

[0055] The above reactions are summarized by process 20 shown in Figure 5. As shown in Figure 5, acetaldehyde and acetone are reacted in reaction 22 to form 2-pentanone by the reaction mechanism shown in Figure 2. However, a portion of the acetone undergoes self-condensation to form MIBK, as shown in Figure 3. Accordingly, the product of reaction 22 includes a mixture of 2-pentanone and MIBK, as shown in Figure 5. The oximation 24 of this mixture with hydroxylamine results in oximation of 2-pentanone to form 2-PO, as shown in Figure 1, and the oximation of

MIBK to form MIBKO, as shown in Figure 4. The product of oximation 24 is a mixture of 2-PO and MIBKO. In this manner, direct oximation of 2-pentanone to form a 2-PO product will include a significant amount of MIBKO, due to the unavoidable presence of at least some MIBK in the 2-pentanone reactant.

[0056] The presence of methyl isobutyl ketoxime (MIBKO) in coating compositions is undesirable for several reasons.

[0057] First, the vapor pressure of MIBKO, about 0.13 hPa, is significantly lower than that of 2-pentanone oxime, about 2.14 hPa, at 20°C. Like MEKO and 2-PO, MIBKO will also form complexes with the transition metal salt driers. However, due to the significantly lower vapor pressure of MIBKO, complexes formed between MIBKO and the transition metal salt driers will be much more stable and retard the drying process to a significantly greater extent than complexes formed between 2-PO and the transition metal salt driers, leading to an undesirably lengthy drying time for the coating composition.

[0058] Second, MIBKO is known to have very strong objectionable odor, which is undesirable in coating formulations such as alkyd paints. The objectionable odor would negatively affect the desirability of use of alkyd paints and other coating compositions which include MIBKO, especially for indoor applications and for do-it-yourself (DIY) customers.

[0059] Removal of MIBKO from 2-PO by distillation is relatively difficult. Both MIBKO and 2-PO are temperature sensitive materials, which are subject to thermal decomposition below their respective atmospheric boiling points. As a result, vacuum distillation is required for the distillation of these oximes. In an apparatus to produce MIBKO substantially free of 2-PO in the bottoms, an operating pressure less than 50 mm Hg would be required. Additionally, the MIBKO rich bottoms product has limited economic value, and incineration of the bottoms product would be required for disposal. The methods disclosed herein avoid the need to remove MIBKO from 2-PO by separating MIBK from 2-pentanone prior to the oximation reaction.

[0060] *2. Coating compositions including a high-purity 2-PO or high-purity 3-methyl-2-butanone oxime*

[0061] In one exemplary embodiment, a coating composition is provided. The coating composition may be a paint composition, such as an alkyd paint

composition. The coating composition includes an anti-skinning agent in the form of a high-purity alkyl oxime, or more particularly an alkyl oxime having 5 carbon atoms, such as 2-PO or high-purity 3-methyl-2-butanone oxime.

[0062] The term "high purity 2-PO" is generally used herein to refer to an anti-skinning composition which comprises at least 92 wt.%, preferably at least 98 wt.%, at least 99 wt.%, at least 99.5 wt.%, or at least 99.9 wt.% 2-PO by weight of the anti-skinning agent composition. Preferably the "high purity 2-PO" comprises less than 0.5 wt.% methyl isobutyl ketoxime, less than 0.3 wt.% methyl isobutyl ketoxime, or less than 0.1 wt.% methyl isobutyl ketoxime of the total anti-skinning agent composition.

[0063] The term "high purity 3-methyl-2-butanone oxime" is generally used herein to refer to an anti-skinning composition which at least 92 wt.%, least 98 wt.%, at least 99 wt.%, 99.5 wt.%, or at least 99.9 wt.% 3-methyl-2-butanone oxime by weight of the anti-skinning agent composition.

[0064] In some embodiments, the coating composition includes one or more components selected from the group consisting of: one or more binders, one or more fillers, one or more pigments, one or more solvents, and one or more driers. For example, the coating composition may include one or more solvents and one or more driers, or may include one or more binders and one or more pigments, or may include one or more solvents, one or more driers, and one or more pigments. Exemplary solvents include xylene, mineral spirits, alcohol, and water.

[0065] In some embodiments, the coating composition has a similar drying time or a similar drying rate than that of a similar coating composition in which the 2-pentanone oxime, 3-methyl-2-butanone oxime, or mixture thereof is replaced on an equal weight basis with MEKO. In some embodiments, the coating composition has a faster drying time and/or a greater drying rate than that of a similar coating composition in which the 2-pentanone oxime, 3-methyl-2-butanone oxime, or mixture thereof is replaced on an equal weight basis with MEKO.

[0066] *a. Anti-skinning agent*

[0067] In one exemplary embodiment, the coating composition includes at least one high-purity alkyl oxime having 5 carbon atoms as an anti-skinning agent, such as 2-PO or high-purity 3-methyl-2-butanone oxime. As disclosed herein, the purity levels of the anti-skinning agent are expressed as a weight percentage, either

as a weight percentage of the anti-skinning chemical compound in connection with a particular anti-skinning agent, or in connection with an anti-skinning agent composition including one or more particular anti-skinning agent chemical compounds. Exemplary anti-skinning chemical compounds include 2-PO, 3-methyl-2-butanone oxime, and MEKO. Exemplary impurities include MIBKO.

[0068] In one exemplary embodiment, the high-purity alkyl oxime is 2-PO. In a more particular embodiment, the purity level of 2-PO is at least 92 wt.%, greater than 97 wt,%, at least 98 wt.%, greater than 98 wt.%, at least 99 wt.%, greater than 99 wt.%, at least 99.5 wt.%, greater than 99.5 wt.%, or at least 99.9 wt.%, or within any range defined between any two of the foregoing values, such as at least 92 wt.% to 99.9 wt.%, greater than 97 wt.% to 99.9 wt.%, greater than 98 wt.% to 99.9 wt.%, 99 wt.% to 99.9 wt.%, greater than 99 wt.% to 99.9 wt.%, 99.5 wt.% to 99.9 wt.% or greater than 99.5 wt.% to 99.9 wt.%.

[0069] In one exemplary embodiment, the high purity 2-PO comprises no more than 2 wt.% MIBKO, no more than 1.5 wt.% MIBKO, no more than 1 wt.% MIBKO, no more than 0.5 wt.% MIBKO, no more than 0.3 wt.% MIBKO, or no more than 0.1 wt.% MIBKO.

[0070] In some embodiments, the composition includes as little as 0.1 wt.%, 0.2 wt.%, 0.25 wt.%, 0.3 wt.%, 0.35 wt.%, 0.4 wt.%, as great as 0.5 wt.%, 0.99 wt.% 1.0 wt.%, 1.25 wt.%, 1.5 wt.%, 2 wt.%, 3 wt.%, of the high-purity 2-PO based on the total weight of the composition, or within any range defined between any two of the foregoing values such as 0.1 wt.% to 3 wt.%, 0.2 wt.% to 2 wt.%, 0.25 wt.% to 1.5 wt.%, 0.3 wt.% to 1.25 wt.%, 0.35 wt.% to 0.99 wt.%, or 0.4 wt.% to 0.5 wt.%. It will also be appreciated that the composition may comprise 0.2 wt.% to 0.5 wt.%, 0.2 wt.% to 0.4 wt.%, 0.25 wt. % to 1.0 wt.% or 0.5 wt.% to 0.99 wt.% of the total anti-skinning agent based on the total weight of the composition.

[0071] In some embodiments, the composition includes the same or less 2-PO as an anti-skinning agent than the amount of MEKO in a similar composition to achieve at least one of the same drying time and the same drying rate.

[0072] In some embodiments, the composition comprises no more than 0.06 wt.% MIBKO, preferably no more than 0.05 wt.% MIBKO, no more than 0.02 wt.% MIBKO, no more than 0.01 wt.% MIBKO, no more than 0.005 wt.% MIBKO, no more than 0.002 wt.% MIBKO, no more than 0.001 wt.% MIBKO, no more than 0.0005

wt.% MIBKO, no more than 0.0002 wt.% MIBKO, or no more than 0.0001 wt.% MIBKO, based on the total weight of the composition.

[0073] In another exemplary embodiment, the anti-skinning agent includes a mixture of 2-PO and MEKO. In some exemplary embodiments, the anti-skinning agent includes as little as 0 wt.%, 5 wt.%, 10 wt.%, as great as 20 wt.%, 30 wt.%, or 50 wt.%, of MEKO, with the balance being a composition comprising 2-PO (e.g. a composition comprising high purity 2-PO, such as at least 98 wt.% 2-PO, or a composition consisting essentially of 2-PO), or within any range defined between any two of the foregoing values, such as 0 wt.% to 50 wt.% MEKO or 5 wt.% to 30 wt.% MEKO, with the balance being a composition comprising 2-PO (e.g. a composition comprising high purity 2-PO, such as at least 98 wt.% 2-PO, or a composition consisting essentially of 2-PO). The anti-skinning agent may comprise 2-PO and MEKO in a ratio of from about 60:40 to 80:20, from about 65:35 to 75:25, or about 70:30. In one exemplary embodiment, the anti-skinning agent consists essentially of 2-pentanone oxime and methyl ethyl ketoxime In some embodiments, the composition includes as little as 0.1 wt.%, 0.2 wt.%, 0.3 wt.%, 0.35 wt.%, 0.4 wt. %, 0.5 wt.%, as great as 1.0 wt.%, 1.25 wt.%, 1.5 wt.%, 2 wt.%, 3 wt.%, of the total anti-skinning agent based on the total weight of the composition, or within any range defined between any two of the foregoing values such as 0.1 wt.% to 3 wt.%, 0.2 wt.% to 2 wt.%, 0.25 wt.% to 1.5 wt.%, 0.3 wt.% to 1.35 wt.%, 0.3 wt.% to 0.99 wt.%, or 0.4 wt.% to 0.5 wt.%. It will also be appreciated that the composition may comprise 0.25 wt. % to 1.0 wt.% or 0.2 wt.% to 1.5 wt.% of the total anti-skinning agent based on the total weight of the composition.

[0074] In one exemplary embodiment, the high-purity alkyl oxime is 3-methyl-2-butanone oxime. In a more particular embodiment, the purity level of 3-methyl-2-butanone oxime is at least 92 wt.%, greater than 97 wt,%, at least 98 wt.%, greater than 98 wt.%, at least 99 wt.%, greater than 99 wt.%, at least 99.5 wt.%, greater than 99.5 wt.%, or at least 99.9 wt.%, or within any range defined between any two of the foregoing values, such as at least 92 wt.% to 99.9 wt.%, greater than 97 wt.% to 99.9 wt.%, greater than 98 wt.% to 99.9 wt.%, 99 wt.% to 99.9 wt.%, greater than 99 wt.% to 99.9 wt.%, 99.5 wt.% to 99.9 wt.% or greater than 99.5 wt.% to 99.9 wt.%.

[0075] In some embodiments, the composition includes as little as 0.1 wt.%, 0.2 wt.%, 0.25 wt.%, 0.3 wt.%, 0.35 wt.%, 0.4 wt.%, as great as 0.5 wt.%, 0.99 wt.%

1.0 wt.%, 1.25 wt.%, 1.5 wt.%, 2 wt.%, 3 wt.%, of the high-purity 3-methyl-2-butanone oxime based on the total weight of the composition, or within any range defined between any two of the foregoing values such as 0.1 wt.% to 3 wt.%, 0.2 wt.% to 2 wt.%, 0.25 wt.% to 1.5 wt.%, 0.3 wt.% to 1.25 wt.%, 0.35 wt.% to 0.99 wt.%, or 0.4 wt.% to 0.5 wt.%. It will also be appreciated that the composition may comprise 0.2 wt.% to 0.5 wt.%, 0.2 wt.% to 0.4 wt.%, 0.25 wt. % to 1.0 wt.% or 0.5 wt.% to 0.99 wt.% of the total anti-skinning agent based on the total weight of the composition.

[0076] In some embodiments, the composition includes the same or less 3-methyl-2-butanone oxime as an anti-skinning agent than the amount of MEKO in a similar composition to achieve at least one of the same drying time and the same drying rate.

[0077] In another exemplary embodiment, the anti-skinning agent includes a mixture of 3-methyl-2-butanone oxime and MEKO. In some exemplary embodiments, the anti-skinning agent includes as little as 0 wt.%, 5 wt.%, 10 wt.%, as great as 20 wt.%, 30 wt.%, or 50 wt.%, of MEKO, with the balance being a composition comprising 3-methyl-2-butanone oxime (e.g. a composition comprising high purity 3-methyl-2-butanone oxime, such as at least 98 wt.% 3-methyl-2-butanone oxime, or a composition consisting essentially of 3-methyl-2-butanone oxime), or within any range defined between any two of the foregoing values, such as 0 wt.% to 50 wt.% MEKO or 5 wt.% to 30 wt.% MEKO, with the balance being a composition comprising 3-methyl-2-butanone oxime (e.g. a composition comprising high purity 3-methyl-2-butanone oxime, such as at least 98 wt.% 3-methyl-2-butanone oxime, or a composition consisting essentially of 3-methyl-2-butanone oxime). The anti-skinning agent may comprise 3-methyl-2-butanone oxime and MEKO in a ratio of from about 60:40 to 80:20, from about 65:35 to 75:25, or about 70:30. In some embodiments, the composition includes as little as 0.1 wt.%, 0.2 wt.%, 0.3 wt.%, 0.35 wt.%, 0.4 wt. %, 0.5 wt.%, as great as 1.0 wt.%, 1.25 wt.%, 1.5 wt.%, 2 wt.%, 3 wt.%, of the total anti-skinning agent based on the total weight of the composition, or within any range defined between any two of the foregoing values such as 0.1 wt.% to 3 wt.%, 0.2 wt.% to 2 wt.%, 0.25 wt.% to 1.5 wt.%, 0.3 wt.% to 1.35 wt.%, 0.3 wt.% to 0.99 wt.%, or 0.4 wt.% to 0.5 wt.%. It will also be appreciated

that the composition may comprise 0.25 wt. % to 1.0 wt.% or 0.2 wt.% to 1.5 wt.% of the total anti-skinning agent based on the total weight of the composition.

[0078] In another exemplary embodiment, the anti-skinning agent includes a mixture of 2-PO and 3-methyl-2-butanone oxime.

[0079] In another exemplary embodiment, the anti-skinning agent includes a mixture of 2-PO, 3-methyl-2-butanone oxime, and MEKO.

[0080] *b. Binders*

[0081] In one exemplary embodiment, the coating composition includes one or more binders. Exemplary binders include various types of alkyd resins. Exemplary alkyd resins include alkyd resins having short, medium, long, and very long oil length. The term "alkyd resin" also includes alkyds modified with other resins such as acrylic, epoxy, phenolic, urethane, polystyrene, silicone, rosin and rosin ester alkyds, and bio-alkyds, such as Setal 900 SM-90, in which the polyester segment is derived from renewable acids and esters.

[0082] In some embodiments, the composition includes as little as 1 wt.%, 5 wt.%, 10 wt.%, 15 wt.%, 25 wt.%, 30 wt.%, as great as 35 wt.%, 40 wt.%, 50 wt.%, 60 wt.%, of the one or more binders based on the total weight of the composition, or within any range defined between any two of the foregoing values such as 1 wt.% to 60 wt.%, 5 wt.% to 50 wt.%, 10 wt.% to 40 wt.%, 15 wt.% to 35 wt.% or 25 wt.% to 30 wt.%. It will also be appreciated that the composition may comprise 5 wt.% to 60 wt.%, 5 wt.% to 10 wt.%, 20 wt.% to 30 wt.%, or 35 wt.% to 60 wt.% of the one or more binders based on the total weight of the composition.

[0083] *c. Solvents*

[0084] In one exemplary embodiment, the coating composition includes one or more aqueous or organic solvents like mineral spirits and alcohols. Exemplary solvents include hydrocarbon solvent or their blends. The hydrocarbon solvents may be aliphatic or aromatic solvents. Examples of organic solvents are petroleum distillates such as pentane, hexane, petroleum naptha, heptanes, and 90 solvent (an aliphatic solvent with a flash point of 140°F). Aromatic solvents include xylene, toluene, Aromatic 100 and other suitable aromatic solvents. The term "mineral spirits", also known as "white spirits", encompasses compositions which comprise a mixture of C_7 to C_{12} aliphatic and alicyclic hydrocarbons, and in a more particular embodiment comprises 15 wt.% to 20 wt.% or less of C_7 to C_{12} aromatic

hydrocarbons, based on the total weight of the composition. Mineral spirits include mixtures or blends of paraffins, cycloparaffins, and aromatic hydrocarbons. Typical mineral spirits have boiling ranges between about 150ºC and 220ºC, are generally clear water-white liquids, are chemically stable and non-corrosive, and possess a mild odor. Exemplary mineral spirits include Low Aromatic White Spirit (LAWS) such as Shell Sol 15 (CAS 64742-88-7) and ShellSol H (CAS 64742-82-1). The term "alcohol" encompasses is intended to encompass C_1 to C_{12} alcohols, including C_1 to C_{12} straight chain and branched alcohols. Exemplary alcohols include triethylene glycol (CAS 112-27-6) and diethylene glycol ethylether (CAS 111-90-0). In a more particular embodiment, the coating composition comprises a solvent selected from the group consisting of xylene, mineral spirits, alcohol, water, and combinations thereof.

[0085] In some embodiments, the composition includes as little as 5 wt.%, 10 wt.%, 15 wt.%, 17 wt.%, 20 wt.%, 25 wt.%, as great as 30 wt.%, 40 wt.%, 60 wt.%, of the one or more solvents based on the total weight of the composition, or within any range defined between any two of the foregoing values such as 5 wt.% to 60 wt.%, 10 wt.% to 40 wt.%, or 25 wt.% to 30 wt.%. It will also be appreciated that the composition may comprise 10 wt.% to 20 wt.%, 25 wt.% to 35 wt.%, or 40 wt.% to 60 wt.% of the one or more solvents based on the total weight of the composition.

[0086] *d. Driers*

[0087] In one exemplary embodiment, the coating composition includes one or more driers. The driers are catalysts used to accelerate the drying process. Exemplary driers include oxidation catalysts such as cobalt or manganese salts, polymerization catalysts such as zirconium salts, and/or auxiliary catalysts such as calcium salts that control the film formation. Driers enable the paint to fully dry within a few hours, such as within three hours, two hours, or less, after application to a surface. Cobalt or manganese esters are oxidation catalysts that play a role in initiating the oxidation process, and include esters of C_6-C_{19} branched fatty acids. Examples are Cobalt 2-ethylhexanoate, propionate, Neodecanoate, Naphthenate, Cobalt embeded polymer product called ECOS ND15 available from Umicore, Manganese Octoate, Manganese-amine complex called Nuodex® Drycoat available from Huntsman.

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[0088] In some embodiments, the drier composition includes as little as 0.1 wt.%, 0.3 wt.%, 0.6 wt.%, as great as 1.0 wt.%, 1.2 wt.%, 1.5 wt.%, 3.5 wt.%, 6.0 wt.%, of the one or more driers based on the total weight of the composition, or within any range defined between any two of the foregoing values such as 0.1 wt.% to 6 wt.%, 0.3 wt.% to 3.5 wt.% or 0.6 wt.% to 1.5 wt.%. It will also be appreciated that the composition may comprise 0.1 wt.% to 1.0 wt.%, 1.0 wt.% to 3.0 wt.%, or 3.0 wt.% to 6 wt.% of the one or more driers based on the total weight of the composition.

[0089] *e. Additives*

[0090] In one exemplary embodiment, the coating composition includes one or more additives such as fillers, pigments, surfactants, stabilizers, thickeners, emulsifiers, texture additives, adhesion promoters, biocides, flow promoters, dispersing agents, and additives to modify viscosity or finished appearance.

[0091] In some embodiments, the composition includes as little as 0.1 wt.%, 0.5 wt.%, 1.0 wt.%, 1.5 wt.%, as great as 2.0 wt.%, 5.0 wt.%, 10.0 wt.%, 20 wt.%, 25 wt.%, 30 wt.%, of the one or more additives based on the total weight of the composition, or within any range defined between any two of the foregoing values such as 0.1 wt.% to 10 wt.%, 1.0 wt.% to 5.0 wt.% or 1.5 wt.% to 2.0 wt.%. It will also be appreciated that the composition may comprise 0.1 wt.% to 1.5 wt.%, 1.5 wt.% to 5.0 wt.%, or 5.0 wt.% to 10.0 wt.% of the one or more additives based on the total weight of the composition.

[0092] In one exemplary embodiment, the coating composition includes one or more fillers to thicken and increase the volume of the composition. Exemplary fillers include titanium oxide, calcium carbonate, clays, and talc.

[0093] In one exemplary embodiment, the coating composition includes one or more pigments to color the composition and/or provide opacity to the composition. As used herein, pigment includes both inorganic metal oxides and organic Color pigments. Exemplary pigments include metal oxides such as titanium oxide and iron oxides, Zinc Chromates, Chromium oxides, Cadmium sulfides, Azurite (made from kaolin, Sodium carbonate, sulfur and carbon), Lithopone (zinc sulfide and Barium sulfate blend). Examples of organic color pigments are Phthalocyanine Blue (alpha & beta), Dinitraniline Orange (PO-5), Perylene Red, Toluidine Red (PR-3), Diarylide Yellow (PY-12,13) and Quinacridone Red (PV-19)

[0094] In some embodiments, the composition includes as little as 0 wt.%, 1 wt.%, 5 wt.%, 10 wt.%, as great as 15 wt.%, 20 wt.%, 25 wt.%, 30 wt.% of a filler and/or pigment, such as titanium dioxide based on the total weight of the composition, or within any range defined between any two of the foregoing values such as 0 wt.% to 30 wt.%, 5 wt.% to 25 wt.%, or 15 wt.% to 30 wt.%.

[0095] In one exemplary embodiment, the coating composition includes one or more additives selected from the group consisting of surfactants, stabilizers, thickeners, emulsifiers, texture additives, adhesion promoters, biocides, and additives to modify viscosity or finished appearance.

[0096] *3. Process for producing a coating composition*

[0097] Referring next to Figure 6, a process 30 for producing a coating composition is provided. The process includes distilling 34 the MIBKO from the 2-pentanone after the reaction process 32 and prior to the oximation reaction 36. By performing this step prior to addition of the hydroxylamine, the MIBK is removed from the 2-pentanone reactant stream, and does not undergo the oximation reaction shown in Figure 5. This in turn prevents the formation of the undesirable MIBKO product component as a part of the 2-PO product during the oximation reaction 36. A coating composition is then formed by combining 38 the resulting high-purity 2-PO product with other components, such as resins, fillers, pigments, solvents, driers, and other additives as described above.

[0098] FIG. 7 is a schematic of an exemplary distillation 34 and oximation 36 schematic for the process 30 of FIG. 6. As shown in Figure 7, distillation 34 illustratively includes a first distillation column 42, and a second distillation column 44 for separating the 2-pentanone from the MIBK, and a third distillation column 46 for purifying the MIBK from other impurities. In the exemplary embodiment illustrated in Figure 7, the first distillation column 42 and the second distillation column 44 work together, in tandem, to separate MIBK from 2-pentanone. Although the distillation system in Figure 7 includes two distillation columns for separating 2-pentanone from MIBK, it will be appreciated that as few as one or as many as three, four, or more suitable distillation columns may be used. In addition, although the distillation system in Figure 7 includes one distillation column for purifying MIBK, it will be appreciated that as many as two, three, four, or more suitable distillation columns may be used.

[0099] As shown in Figure 7, each distillation column illustratively includes an overhead condenser 52 for condensing gases removed from the top of each distillation column. Each distillation column also illustratively includes a circulation pump 54 and reboiler 56 for vaporizing liquids removed from the bottom of each distillation column. Referring to Figures 8 and 9, the system may include a plurality of control valves 58.

[00100] In the exemplary embodiment illustrated in Figure 7, a 2-pentanone product containing MIBK is provided as the inlet stream 60 to the first distillation column 42. In one exemplary embodiment, the inlet stream 60 includes as little as 1 wt.%, 2 wt.%, 5 wt.%, 7 wt.%, as much as 10 wt.%, 15 wt.%, 20 wt.% or more MIBK, or within any range defined between any two of the foregoing values, such as 1 wt.% to 20 wt.%, 2 wt.% to 15 wt.%, 5 wt.% to 10 wt.% or 7 wt.% to 10 wt.%.

[00101] Figure 8 illustrates an exemplary first distillation column 42. The flow of inlet stream 60 is illustratively controlled by a flow control valve 58. An overhead stream 62 enriched in 2-pentanone is removed from the top of first distillation column 42 and condensed in condenser 52. Overhead stream 62 is split between reflux stream 68, which returns a portion of the enriched 2-pentanone to the top of first distillation column 42, and high-purity product stream 66. In one exemplary embodiment, the overhead stream 62 includes less than 5000 ppm, less than 2000 ppm, less than 1000 ppm, less than 500 ppm, or less than 100 ppm of MIBK.

[00102] As shown in Figure 7, the high-purity product stream 66 may be provided as the reactant for an oximation reaction 36 to form 2-PO.

[00103] Referring again to Figure 8, the relative flow rates of overhead stream 62 between reflux stream 68 and high-purity product stream 66 is illustratively controlled by a plurality of flow control valves. The ratio of the flow rate of reflux stream 68 and the flow rate of high-purity product stream 66 defines a first column reflux ratio. In one exemplary embodiment, the first distillation column operates at a relatively moderate first column reflux ratio as low as 1:2, 1:1, 2:1, as high as 3:1, 4:1, 5:1, or within any range defined between any two of the foregoing values, such as 1:2 to 5:1, 1:1 to 4:1, or 2:1 to 4:1. In one exemplary embodiment, the first column reflux ratio is about 3:1.

[00104] A bottoms stream 64 enriched in MIBK is removed from the bottom of first distillation column 42. Bottoms stream 64 is split between reboiler stream 70,

which is vaporized in reboiler 56 and returns a portion of the enriched MIBK to the bottom of first distillation column 42, and intermediate stream 72. As shown in Figures 7 and 9, the intermediate stream 72 is illustratively provided as the inlet stream for second distillation column 44. The relative flow rates of bottoms stream 64 between reboiler stream 70 intermediate stream 72 is illustratively controlled by a plurality of flow control valves.

[00105] Referring again to Figure 8, first distillation column 42 illustratively includes a top bed 74, a middle bed 76, and a lower bed 78 separated by distributor 80 and redistributor 82. In one exemplary embodiment, the first distillation column is structured packing for hydraulic efficiency. In one exemplary embodiment, top bed 74 is as little as about 10 feet, 12 feet, 15 feet, as great as about 20 feet, 25 feet, or 30 feet and includes structured packing material. In one exemplary embodiment, middle bed 76 is as little as about 10 feet, 15 feet, 20 feet, as great as about 25 feet, 30 feet, or 40 feet and includes structured packing material. In one exemplary embodiment, lower bed 78 is as little as about 10 feet, 15 feet, 20 feet, as great as about 25 feet, 30 feet, or 40 feet and includes structured packing material.

[00106] In addition to inlet stream, first distillation column 42 illustratively includes a second input, recycle stream 84. As illustrated in Figure 7, in one embodiment recycle stream 84 is a portion of the overhead stream 86 of second distillation column 44.

[00107] Figure 9 illustrates an exemplary second distillation column 44. An overhead stream 86 enriched in 2-pentanone is removed from the top of second distillation column 44 and condensed in condenser 52. Overhead stream 86 is split between reflux stream 88, which returns a portion of the enriched 2-pentanone to the top of second distillation column 44, and recycle stream 84, which returns a portion of the enriched 2-pentanone to back to the first distillation column 42. In one exemplary embodiment, the overhead stream 86 includes less than 5 wt.%, less than 3 wt.%, less than 2 wt.%, less than 1 wt.%, or less than 0.5 wt.% of MIBK.

[00108] The relative flow rates of overhead stream 86 between reflux stream 88 and recycle stream 84 is illustratively controlled by a plurality of flow control valves. The ratio of the flow rate of reflux stream 88 and the flow rate of recycle stream 84 defines a second column reflux ratio. In one exemplary embodiment, the second distillation column operates at a relatively high second column reflux ratio as low as

2:1, 3:1, 5:1, as high as 10:1, 15:1, 20:1 or within any range defined between any two of the foregoing values, such as 2:1 to 20:1, 3:1 to 15:1, 5:1 to 15:1, or 5:1 to 10:1. In one exemplary embodiment, the first column reflux ratio is about 10:1.

[00109] In one exemplary embodiment, the first reflux ratio and second reflux ratio are significantly different. In some exemplary embodiments, the second reflux ratio is as little as 2 times, 2.5 times, 3 times, as great as 3.5 times, 4 times, or 5 times greater than the first reflux ratio. In one exemplary embodiment, the second reflux ratio is about 3.33 times greater than the first reflux ratio.

[00110] A bottoms stream 90 enriched in MIBK is removed from the bottom of second distillation column 44. Bottoms stream 90 is split between reboiler stream 92, which is vaporized in reboiler 56 and returns a portion of the enriched MIBK to the bottom of second distillation column 44, and outlet stream 94. As shown in Figure 7, the outlet stream 90 is illustratively provided as the inlet stream for third distillation column 46. The relative flow rates of bottoms stream 90 between reboiler stream 92 outlet stream 94 is illustratively controlled by a plurality of flow control valves.

[00111] Second distillation column 44 illustratively includes a top bed 96, a middle bed 98, and a lower bed 100 separated by distributor 102 and redistributor 104. In one exemplary embodiment, the second distillation column is relatively thermally inefficient and includes high separation efficiency packing material to increase separation efficiency. In one exemplary embodiment, top bed 96 is as little as about 15 feet, 20 feet, 25 feet, as great as about 30 feet, 40 feet, or 50 feet and includes high-efficiency packing material. In one exemplary embodiment, middle bed 98 is as little as about 10 feet, 15 feet, 20 feet, as great as about 25 feet, 30 feet, or 40 feet and includes high-efficiency packing material. In one exemplary embodiment, lower bed 100 is as little as about 10 feet, 12 feet, 15 feet, as great as about 20 feet, 25 feet, or 30 feet and includes high-efficiency packing material.

[00112] As shown in Figure 7, the outlet stream 94, which is enriched in MIBK, may be provided to a third distillation column 46. Third distillation column 46 illustratively removes impurities from the MIBK in outlet stream 94. An overhead stream 106 enriched in MIBK is removed from the top of third distillation column 46 and condensed in condenser 52. Overhead stream 106 is split between reflux stream 108, which returns a portion of the enriched MIBK to the top of third

distillation column 46, and purified MIBK stream 110. A bottoms stream 112 enriched in impurities is removed from the bottom of third distillation column 46. Bottoms stream 112 is split between reboiler stream 114, which is vaporized in reboiler 56 and returns a portion to the bottom of third distillation column 46, and bottoms outlet stream 116.

[00113] *4. Examples*

[00114] The coating formulations below were evaluated according to the following test methods.

[00115] Film formation of the coating was determined by visual observation. If a film was observed, it was removed and the film thickness was measured. Film formation may be observed after two months at room temperature or after accelerated aging for four weeks at 50°C.

[00116] Drying times were determined using a drying time recorder according to ASTM D5895, standard test methods for evaluating drying or curing during film formation of organic coatings using mechanical recorders.

[00117] An initial stage dry time was determined 1 day following paint preparation. A coating sample was applied to a Leneta sheet at a fixed humid thickness. The drying time recorder was immediately placed on the wet film and the stylus lowered on to the wet paint. After the stylus has moved across the sheet at a constant speed, the stages of drying time are determined by examining the sheet. Stage I is a set-to-touch time; Stage II is a tack-free time, Stage III is a dry-hard time, and Stage IV is a dry-through time.

[00118] A post-aging drying time was determined following storage of a sample at an elevated temperature of 50°C for four weeks to model accelerated aging of the sample. The samples were placed in closed containers having a large air volume compared to the coating formulation volume to further accelerate the aging process. After four weeks, the samples were visually inspected for film formation. A post-aging drying time was determined using the same method as for the initial stage dry time.

[00119] *a) Example 1: Glossy white one-coat finish using various purity anti-skinning agents*

[00120] Glossy white one-coat finish = EU SF 3.11 //cobalt drier formulations were prepared according to the weight percentages shown in Table 1:

[00121] **Table 1: Example 1 formulations (wt.%)**

Part	Component	Function	Wt. %
A	SETAL AF 681 TB	Alkyd resin	30
A	White spirit D60	Solvent	10
A	Borchi® Gen 911	Wetting and dispersing agent	2.6
A	Kronos® 2310	Titanium dioxide	26
A	Borchi® Gol E, 50% in Solvesso 100	Flow promoter and release agent	1
A	Octa-Soligen Calcium 10, basic	Calcium-containing drier	0.5
B	SETAL AF 681 TB	Alkyd resin	20
B	White spirit D60	Solvent	7.6
B	Borchi® Gol OL 17, 10% in xylene	Flow promoter and release agent	1
B	Octa-Soligen Zirconium 12	Zirconium-containing drier	0.5
B	Octa-Soligen 69	Cobalt-containing drier	0.3
C	Anti-skinning agent	Anti-skinning agent	0.5

[00122] The Part A components were subjected to ball milling at 3500 rpm for 45 minutes prior to cooling. The Part B components were then incorporated under gentle agitation/homogenization for 5 minutes.

[00123] The Part C anti-skin additive for each formulation was varied according to the formulations provided in Table 2. The Part C anti-skin additive was incorporated into Part A and Part B one day following preparation of Part A and Part B for Ex. 1-3 and 9, two days for Ex. 4-7, and seven days following preparation for Ex. 8.

[00124] **Table 2: Anti-skinning agent composition (wt.%)**

Formulation	% MEKO	% 2-PO	% MIBKO
Ex. 1	-	92%	8%
Ex. 2	-	94%	6%
Ex. 3	-	96%	4%
Ex. 4	-	97%	3%
Ex. 5	-	98%	2%
Ex. 6	-	99%	1%
Ex. 7	-	99.5%	0.50%
Ex. 8	-	99.7%	0.30%
Ex. 9	100%	-	-

[00125] In addition, an Ex. 10 formulation was similarly prepared, but lacking any anti-skinning agent.

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[00126] Each formulation was subjected to an additional initial drying test, in which the times for Stage I "Set-to-Touch," Stage II "Tack-free," and Stage IV "Dry-through" were determined. The results are provided in Table 4

[00127] **Table 3: Initial drying times for Example 1**

Formulation	Stage I Dry Time (hr)	Stage II Dry Time (hr)	Stage IV Dry Time (hr)
Ex. 1	1.61	3.77	5.44
Ex. 2	1.57	3.69	5.25
Ex. 3	1.72	3.92	5.59
Ex. 4	1.56	3.54	4.89
Ex. 5	1.57	3.71	5.20
Ex. 6	1.57	3.59	5.02
Ex. 7	1.63	3.92	5.39
Ex. 8	1.44	3.16	4.46
Ex. 9	1.55	3.46	4.82
Ex. 10	1.30	-	3.01

[00128] Each formulation was also subjected to an additional initial drying test, as well as determining film formation and a drying test following accelerated aging for four weeks at 50°C. In addition, film formation was determined following two months at room temperature. The results are provided in Table 4

[00129] **Table 4: Additional results for Example 1**

Formulation	Initial Stage IV Dry Time (hr)	Post-aging Stage IV Dry Time (hr)	Skin Formation – 2 mo @ RT	Skin Formation – 4 wk @ 50°C	Dry skin thickness after aging 4wk @ 50°C (mm)
Ex. 1	5.46	11.74	None	Yes	0.3
Ex. 2	5.27	11.11	None	Yes	0.25
Ex. 3	5.62	12.42	None	Yes	0.34
Ex. 4	4.87	12.77	None	Yes	0.47
Ex. 5	5.24	9.73	None	None	Easily redispersible
Ex. 6	5.04	9.86	None	None	Easily redispersible
Ex. 7	5.43	11.19	None	None	Easily redispersible
Ex. 8	4.48	11.27	None	None	Easily redispersible
Ex. 9	4.84	10.13	None	None	Easily redispersible
Ex. 10	3.05	N/A	Yes (solid)	Yes	N/A

[00130] The Ex. 10 formulation, having no anti-skinning agent, was completely solid following two months at room temperature.

[00131] As shown in Tables 3 and 4, the Ex. 1-8 formulations had relatively similar initial dry times to the Ex. 9 MEKO formulation. The Ex. 5-8 formulations, having a 2-PO purity of at least 98 wt.% 2-PO had no skin formation following the accelerated aging test.

[00132] Example 1 illustrates that compositions having a purity of at least 92 wt.% 2-PO are effective anti-skinning agents and can function as a substitute anti-skinning agent for MEKO.

[00133] *b) Example 2A: Glossy white one-coat finish with cobalt-based drier*

[00134] Glossy white one-coat finish = EU SF 3.11 //cobalt drier formulations at 0.25 wt.% anti-skinning agent, 0.35 wt.% anti-skinning agent, and 0.5 wt.% anti-skinning agent were prepared according to the weight percentages shown in Table 5. The amount of the solvent white spirit D60 added in Part B and the anti-skinning agent added in Part C for each formulation are provided in Table 6.

[00135] **Table 5: Example 2A formulations (wt.%)**

Part	Component	Function	Wt.%
A	SETAL AF 681 TB	Alkyd resin	30
A	White spirit D60	Solvent	10
A	Borchi Gen 911	Wetting and dispersing agent	2.6
A	Kronos 2310	Titanium dioxide	26
A	Borchi Gol E, 50% in Solvesso 100	Flow promoter and release agent	1
A	Octa-Soligen Calcium 10, basic	Calcium-containing drier	0.5
B	SETAL AF 681 TB	Alkyd resin	20
B	White spirit D60	Solvent	See Table 6
B	Borchi Gol OL 17, 10% in xylene	Flow promoter and release agent	1
B	Octa-Soligen Zirconium 12	Zirconium-containing drier	0.5
B	Octa-Soligen 69	Cobalt-containing drier	0.3
C	Anti-skinning agent	Anti-skinning agent	See Table 6

[00136] **Table 6: Anti-skinning agent composition (wt.%)**

Formulation	Part B White spirit D60	MEKO	2-PO	3-methyl-2-butanone oxime
Ex. 11	7.85	0.25	-	-
Ex. 12	7.75	0.35	-	-
Ex. 13	7.60	0.50	-	-
Ex. 14	7.85	-	0.25	-
Ex. 15	7.75	-	0.35	-
Ex. 16	7.60	-	0.50	-
Ex. 17	7.85	-	-	0.25
Ex. 18	7.75	-	-	0.35
Ex. 19	7.60	-	-	0.50

[00137] The MEKO was provided as a 100% MEKO composition. The 2-PO was provided as a >99.9 wt.% 2-PO composition. The 3-methyl-2-butanone oxime was provided as a 100% 3-methyl-2-butanone oxime composition.

[00138] The Part A components were subjected to ball milling at 3500 rpm for 45 minutes prior to cooling. The Part B components were then incorporated under gentle agitation/homogenization for 5 minutes.

[00139] The Part C anti-skin additive for each formulation was varied according to the formulations provided in Table 6. The Part C anti-skin additive was incorporated into Part A and Part B seven days following preparation of Part A and Part B for Ex. 11-15, and eight days following preparation for Ex. 16-19.

[00140] Each formulation was subjected to an additional initial drying test, in which the times for Stage I "Set-to-Touch," Stage II "Tack-free," and Stage IV "Dry-through" were determined. The results are provided in Table 7.

[00141] **Table 7: Initial drying times for Example 2A**

Formulation	Stage I Dry Time (hr)	Stage II Dry Time (hr)	Stage IV Dry Time (hr)
Ex. 11	1.52	2.86	3.47
Ex. 12	1.43	2.98	4.13
Ex. 13	1.49	3.27	4.42
Ex. 14	1.49	3.32	4.28
Ex. 15	1.52	3.65	4.89
Ex. 16	1.37	3.20	4.57
Ex. 17	1.45	2.88	3.89
Ex. 18	1.51	2.87	3.78
Ex. 19	1.53	3.14	4.46

[00142] Each formulation was also subjected to an additional initial drying test, as well as determining film formation and a drying test following accelerated aging for four weeks at 50°C. In addition, film formation was determined following two months at room temperature. The results are provided in Table 8

[00143] **Table 8: Additional results for Example 2A**

Formulation	Initial Stage IV Dry Time (hr)	Post-aging Stage IV Dry Time (hr)	Skin Formation – 2 mo @ RT	Skin Formation – 4 wk @ 50°C	Dry skin thickness after aging 4wk @ 50°C (mm)
Ex. 11	3.50	7.58	None	Yes	0.25
Ex. 12	4.15	10.39	None	Yes	0.40
Ex. 13	4.45	>13.7	None	Yes	0.52
Ex. 14	4.31	7.31	None	Yes	0.22
Ex. 15	4.93	10.00	None	Yes	0.25
Ex. 16	4.60	>13.7	None	Yes	0.67
Ex. 17	3.92	8.32	Yes	Yes	0.27-0.60
Ex. 18	3.81	13.25	None	Yes	0.35
Ex. 19	4.48	13.23	None	Yes	0.62

[00144] As shown in Tables 7 and 8, the formulations containing MEKO (Ex. 11-13) had similar drying times to formulations having equivalent levels of 2-PO (Ex. 14-16) and 3-methyl-2-butanone oxime (Ex. 17-19).

[00145] Example 2A illustrates that 2-PO and 3-methyl-2-butanone oxime can function as a substitute anti-skinning agent at equivalent levels as MEKO in a glossy white one-coat finish with a cobalt-based drier.

[00146] *c) Example 2B: Glossy white one-coat finish with cobalt-free drier*

[00147] Glossy white one-coat finish = EU SF 3.11 //cobalt free formulations at 0.25 wt.% anti-skinning agent, 0.35 wt.% anti-skinning agent, and 0.5 wt.% anti-skinning agent were prepared according to the weight percentages shown in Table 9. The amount of the solvent white spirit D60 added in Part B and the anti-skinning agent added in Part C for each formulation are provided in Table 10.

[00148] **Table 9: Example 2B formulations (wt.%)**

Part	Component	Function	Wt.%
A	SETAL AF 681 TB	Alkyd resin	30
A	White spirit D60	Solvent	10
A	Borchi Gen 911	Wetting and dispersing agent	2.6
A	Kronos 2310	Titanium dioxide	26
A	Borchi Gol E, 50% in Solvesso 100	Flow promoter and release agent	1
A	Octa-Soligen Calcium 10, basic	Calcium-containing Drier	0.5
B	SETAL AF 681 TB	Alkyd resin	20
B	White spirit D60	Solvent	See Table 6
B	Borchi Gol OL 17, 10% in xylene	Flow promoter and release agent	1
B	Borchi OXY - coat	Manganese-containing drier	1
C	Anti-skinning agent	Anti-skinning agent	See Table 6

[00149] **Table 10: Anti-skinning agent composition (wt.%)**

Formulation	Part B White spirit D60	MEKO	2-PO	3-methyl-2-butanone oxime
Ex. 20	8.37	0.25	-	-
Ex. 21	8.27	0.35	-	-
Ex. 22	8.12	0.50	-	-
Ex. 23	8.37	-	0.25	-
Ex. 24	8.27	-	0.35	-
Ex. 25	8.12	-	0.50	-
Ex. 26	8.37	-	-	0.25
Ex. 27	8.27	-	-	0.35
Ex. 28	8.12	-	-	0.50

[00150] The MEKO was provided as a 100% MEKO composition. The 2-PO was provided as a >99.9 wt.% 2-PO composition. The 3-methyl-2-butanone oxime was provided as a 100% 3-methyl-2-butanone oxime composition.

[00151] The Part A components were subjected to ball milling at 3500 rpm for 45 minutes prior to cooling. The Part B components were then incorporated under gentle agitation/homogenization for 5 minutes.

[00152] The Part C anti-skin additive for each formulation was varied according to the formulations provided in Table 6. The Part C anti-skin additive was incorporated into Part A and Part B eight days following preparation of Part A and Part B for Ex. 20-23, and nine days following preparation for Ex. 24-28.

[00153] Each formulation was subjected to an additional initial drying test, in which the times for Stage I "Set-to-Touch," Stage II "Tack-free," and Stage IV "Dry-through" were determined. The results are provided in Table 11.

[00154] **Table 11: Initial drying times for Example 2B**

Formulation	Stage I Dry Time (hr)	Stage II Dry Time (hr)	Stage IV Dry Time (hr)
Ex. 20	1.43	2.77	3.37
Ex. 21	1.25	2.61	3.27
Ex. 22	1.48	2.80	3.66
Ex. 23	1.38	2.64	3.86
Ex. 24	1.41	2.77	2.54
Ex. 25	1.46	2.92	3.69
Ex. 26	1.42	2.47	3.49
Ex. 27	1.52	2.81	3.92
Ex. 28	1.32	2.63	3.54

[00155] Each formulation was also subjected to an additional initial drying test, as well as determining film formation and a drying test following accelerated aging for four weeks at 50°C. In addition, film formation was determined following two months at room temperature. The results are provided in Table 12

[00156] **Table 12: Additional results for Example 2B**

Formulation	Initial Stage IV Dry Time (hr)	Post-aging Stage IV Dry Time (hr)	Skin Formation – 2 mo @ RT	Skin Formation – 4 wk @ 50°C	Dry skin thickness after aging 4wk @ 50°C (mm)
Ex. 20	3.26	5.72	None, but gel formation	Yes	7-8
Ex. 21	3.29	>13.7	None, but gel formation	None	Easily redispersible
Ex. 22	3.68	>13.7	None	None	Easily redispersible
Ex. 23	3.91	5.4	None	Yes	4-5
Ex. 24	3.67	6.73	None	Yes	7
Ex. 25	3.73	6.41	None	Yes	Gelation on top part of paint
Ex. 26	3.52	9.20	None	Yes	1.3
Ex. 27	3.96	6.08	None	Yes	Gelation on top part of paint
Ex. 28	3.59	6.80	None	Yes	Gelation on top part of paint

[00157] As shown in Tables 11 and 12, the formulations containing MEKO (Ex. 20-22) had similar drying times to formulations having equivalent levels of 2-PO (Ex. 23-25) and 3-methyl-2-butanone oxime (Ex. 26-28).

[00158] Example 2B illustrates that 2-PO and 3-methyl-2-butanone oxime can function as a substitute anti-skinning agent at equivalent levels as MEKO in a glossy white one-coat finish with a cobalt-free drier.

[00159] *d) Example 3: Clear gloss base*

[00160] Anti-skinning agent was added to a clear gloss base as shown in Table 13.

[00161] **Table 13: Example 3 formulations (g)**

Formulation	Clear gloss base (g)	MEKO (g)	2-PO (g)
Ex. 29	36	0.35	-
Ex. 30	36	0.5	-
Ex. 31	36	0.8	-
Ex. 32	36	-	0.35
Ex. 33	36	-	0.5
Ex. 34	36	-	0.8

[00162] Each formulation was subjected to an additional initial drying test, in which the times for Stage I "Set-to-Touch," Stage II "Tack-free," and Stage IV "Dry-through" were determined. The results are provided in Table 14.

[00163] **Table 14: Initial drying times for Example 3**

Formulation	Stage I Dry Time (hr)	Stage IV Dry Time (hr)
Ex. 29	0.57	1.82
Ex. 30	0.56	1.67
Ex. 31	0.56	1.55
Ex. 32	0.69	1.98
Ex. 33	0.59	1.62
Ex. 34	0.61	1.37

[00164] Each formulation was also subjected to an additional initial drying test, as well as determining film formation and a drying test following accelerated aging for four weeks at 50°C. In addition, film formation was determined following two months at room temperature. The results are provided in Table 12

[00165] **Table 15: Additional results for Example 3**

Formulation	Initial Stage IV Dry Time (hr)	Post-aging Stage IV Dry Time (hr)	Skin Formation – 2 mo @ RT	Skin Formation – 4 wk @ 50°C	Dry skin thickness after aging 4wk @ 50°C (mm)
Ex. 29	1.87	4.39	None	None	None, but gelation
Ex. 30	1.71	3.32	None	None	None, but gelation
Ex. 31	1.59	3.06	None	None	None, but gelation
Ex. 32	2.02	-	None	None	None, but gelation
Ex. 33	1.66	2.37	None	None	None, but gelation
Ex. 34	1.35	4.19	None	None	None, but gelation

[00166] As shown in Tables 14 and 15, the formulations containing MEKO (Ex. 29-31) had similar drying times to formulations having equivalent levels of 2-PO (Ex. 32-34).

[00167] Example 3 illustrates that 2-PO can function as a substitute anti-skinning agent at equivalent levels as MEKO in a clear gloss base.

[00168] *e) Example 4: Satin clear base*

[00169] Anti-skinning agent was added to a satin clear base as shown in Table 16.

[00170] **Table 16: Example 4 formulations (g)**

Formulation	Satin clear base (g)	MEKO (g)	2-PO (g)
Ex. 35	99.65	0.35	-
Ex. 36	99.5	0.5	-
Ex. 37	99.2	0.8	-
Ex. 38	99.65	-	0.35
Ex. 39	99.5	-	0.5
Ex. 40	99.2	-	0.8

[00171] Each formulation was subjected to an additional initial drying test, in which the times for Stage I "Set-to-Touch," Stage II "Tack-free," and Stage IV "Dry-through" were determined. The results are provided in Table 17.

[00172] **Table 17: Initial drying times for Example 4**

Formulation	Stage I Dry Time (hr)	Stage IV Dry Time (hr)
Ex. 35	0.60	2.15
Ex. 36	0.60	2.52
Ex. 37	0.58	2.47
Ex. 38	0.64	3.01
Ex. 39	0.62	2.98
Ex. 40	0.71	4.06

[00173] Each formulation was also subjected to an additional initial drying test, as well as determining film formation and a drying test following accelerated aging for four weeks at 50°C. In addition, film formation was determined following two months at room temperature. The results are provided in Table 12

[00174] **Table 18: Additional results for Example 4**

Formulation	Initial Stage IV Dry Time (hr)	Post-aging Stage IV Dry Time (hr)	Skin Formation – 2 mo @ RT	Skin Formation – 4 wk @ 50°C	Dry skin thickness after aging 4wk @ 50°C (mm)
Ex. 35	2.18	2.00	Yes – gelation	Yes	0.85, gelation of liquid paint
Ex. 36	2.54	1.84	Yes – gelation	Yes	1, gelation of liquid paint
Ex. 37	2.49	3.69	No	Yes	N/A, gelation of liquid paint
Ex. 38	3.04	2.52	Yes – gelation	Yes	0.9, gelation of liquid paint
Ex. 39	3.01	3.14	Yes – gelation	Yes	1, gelation of liquid paint
Ex. 40	4.09	N/A	Yes – gelation	Yes	N/A, gelation of liquid paint

[00175] For Ex. 40, aging at 50°C induced severe modifications in the liquid paint, and the drying time determination became meaningless.

[00176] As shown in Tables 17 and 18, the formulations containing MEKO (Ex. 35-37) had similar drying times to formulations having equivalent levels of 2-PO (Ex. 38-40).

[00177] Example 4 illustrates that 2-PO can function as a substitute anti-skinning agent at equivalent levels as MEKO in a satin clear base.

[00178] While this invention has been described as relative to exemplary designs, the present invention may be further modified within the spirit and scope of this disclosure. Further, this application is intended to cover such departures from the present disclosure as come within known or customary practice in the art to which this invention pertains.

What is claimed is:

1. A coating composition comprising:

at least one solvent;

at least one resin;

at least one drier for catalyzing drying the resin, the at least one drier comprising at least one metal ester salt; and

an anti-skinning composition capable of preventing oxidative crosslinking of the resin to form a skin, the anti-skinning composition comprising at least 92 wt.% of an alkyl oxime based on the total weight of the anti-skinning composition, wherein the alkyl oxime is selected from 2-pentanone oxime and 3-methyl-2-butanone oxime, provided that a composition containing aluminum diisopropoxide monoethyl acetoacetate is excluded.

2. A coating composition comprising:

at least one solvent;

at least one resin;

at least one drier for catalyzing drying the resin, the at least one drier comprising at least one metal ester salt; and

an anti-skinning composition capable of preventing oxidative crosslinking of the resin to form a skin, wherein the anti-skinning comprises 2-pentanone oxime, the anti-skinning composition comprising less than 0.5 wt.% methyl isobutyl ketoxime based on the total weight of the anti-skinning composition.

3. The coating composition of claim 1, wherein the anti-skinning composition comprises at least 98 wt.% 2-pentanone oxime, based on the total weight of the anti-skinning composition.

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4. The coating composition of claim 1, wherein the metal ester salt is selected from a cobalt salt, a manganese salt, a zirconium salt, a calcium salt, or a combination thereof.

5. The coating composition of claim 1, wherein the at least one resin comprises one or more alkyd resins present in a total amount of from 15 wt.% to 60 wt.% based on a total weight of the coating composition.

6. The coating composition of claim 1, wherein the alkyl oxime is 2-pentanone oxime.

7. The coating composition of claim 1, wherein the at least one drier is a combination of a calcium metal ester salt and a manganese metal ester salt.

8. The coating composition of claim 2, wherein the anti-skinning composition comprises at least 98 wt.% 2-pentanone oxime, based on the total weight of the anti-skinning composition.

9. The coating composition of claim 2, wherein the metal ester salt is selected from a cobalt salt, a manganese salt, a zirconium salt, a calcium salt, or a combination thereof.

10. The coating composition of claim 2, wherein the at least one resin comprises one or more alkyd resins present in a total amount of from 15 wt.% to 60 wt.% based on a total weight of the coating composition.

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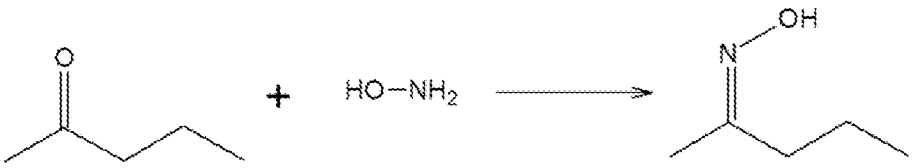


2-pentanone **Hydroxylamine** **2-PO**

Figure 1

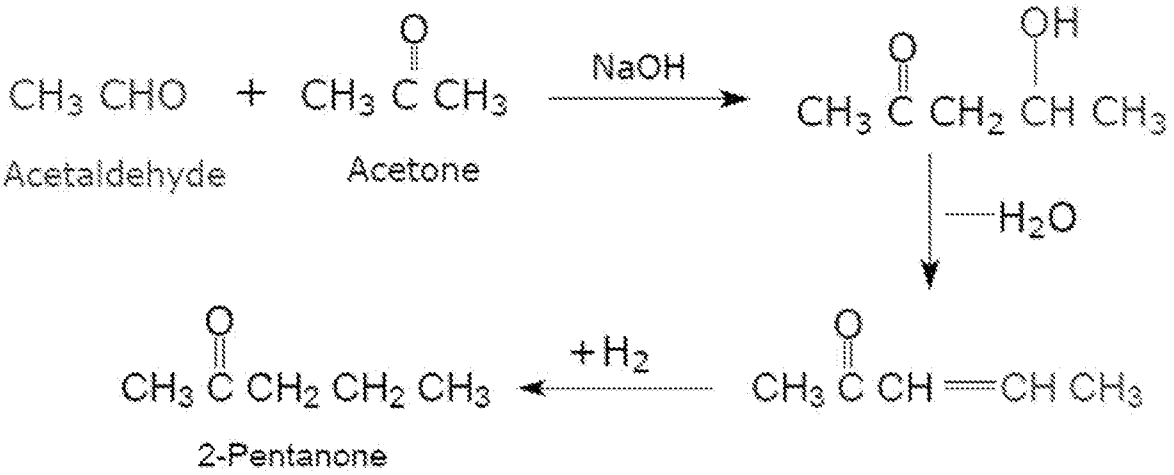


Figure 2

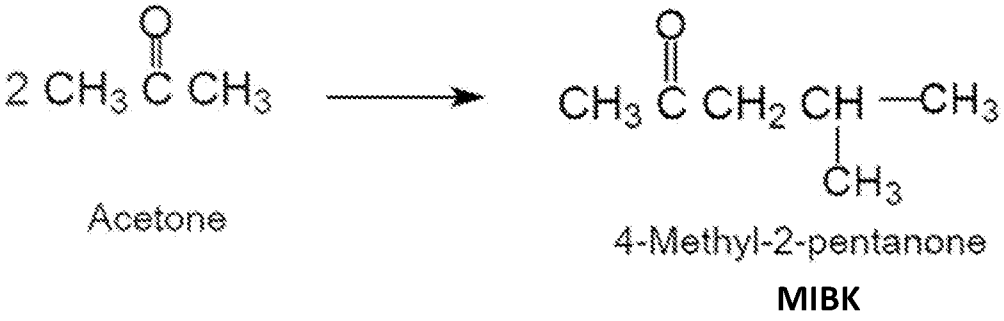


Figure 3

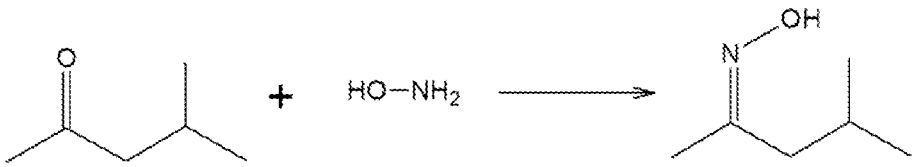


Figure 4

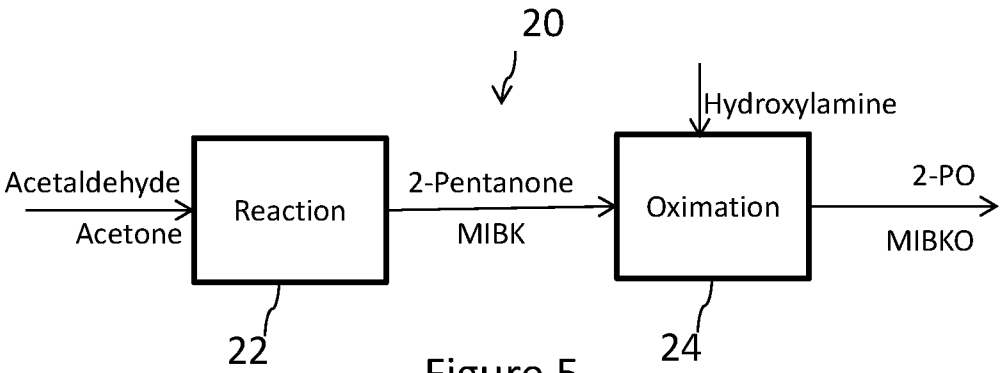
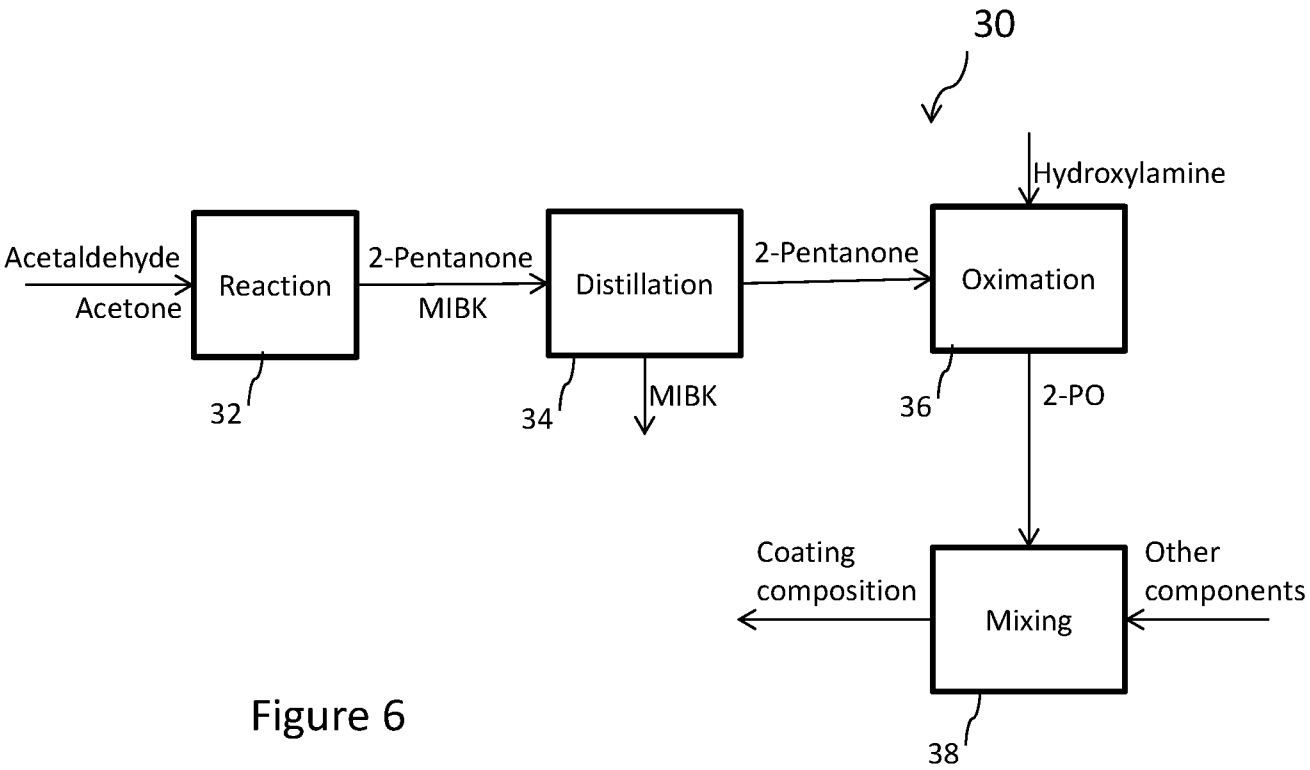


Figure 5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Acetone
Reaction
2-Pentanone
MIBK
Distillation
2-Pentanone
Oximation
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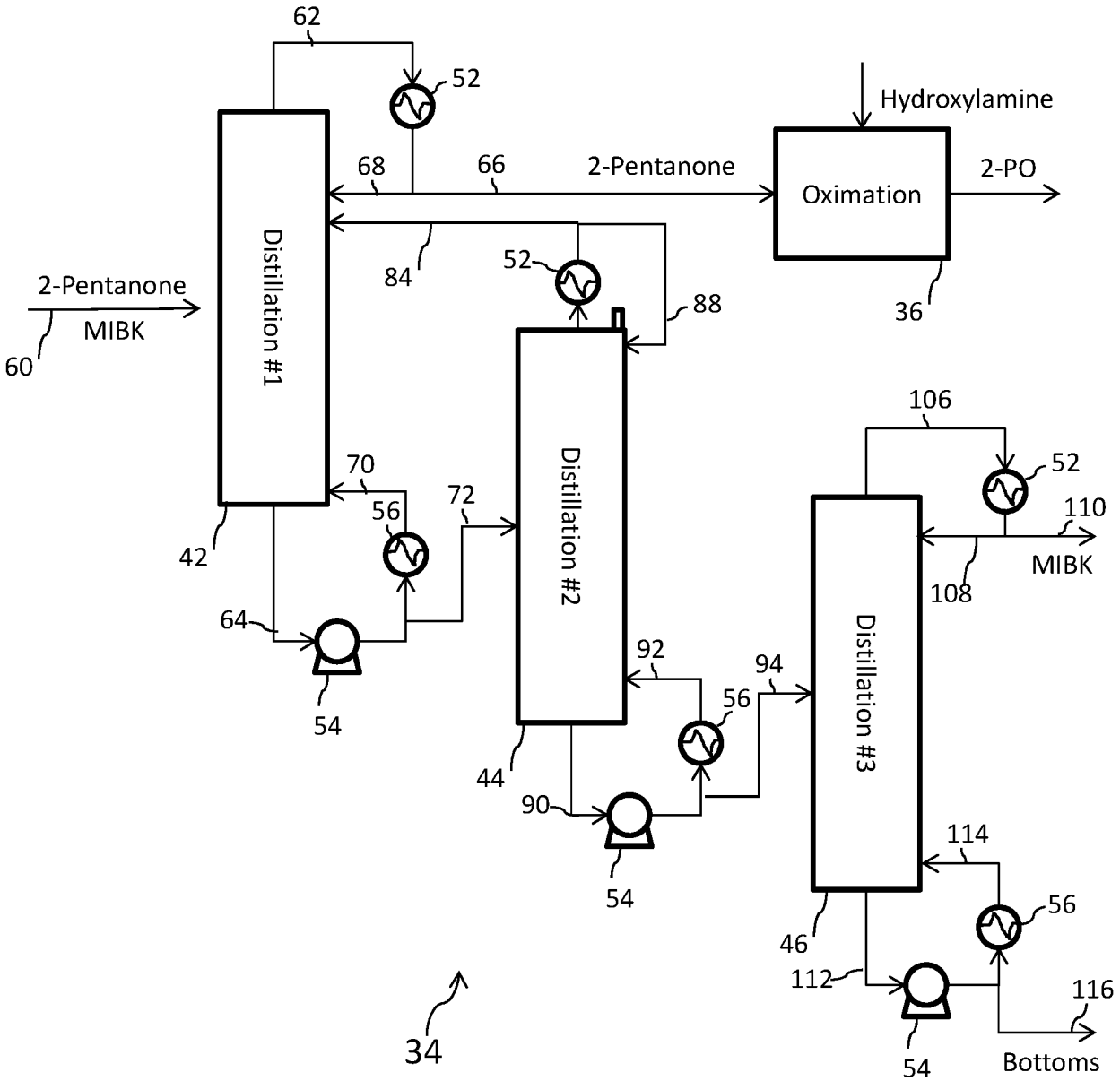
MIBK
36
2-PO
Coating
composition
Mixing
Other
components
38

Figure 6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88
36
Distillation #2
106
52
70
72
56
110
MIBK
42
108
64
Distillation #3
92
94
56
54
44
90
54
114
56
46
112
116
54
Bottoms
34

Figure 7

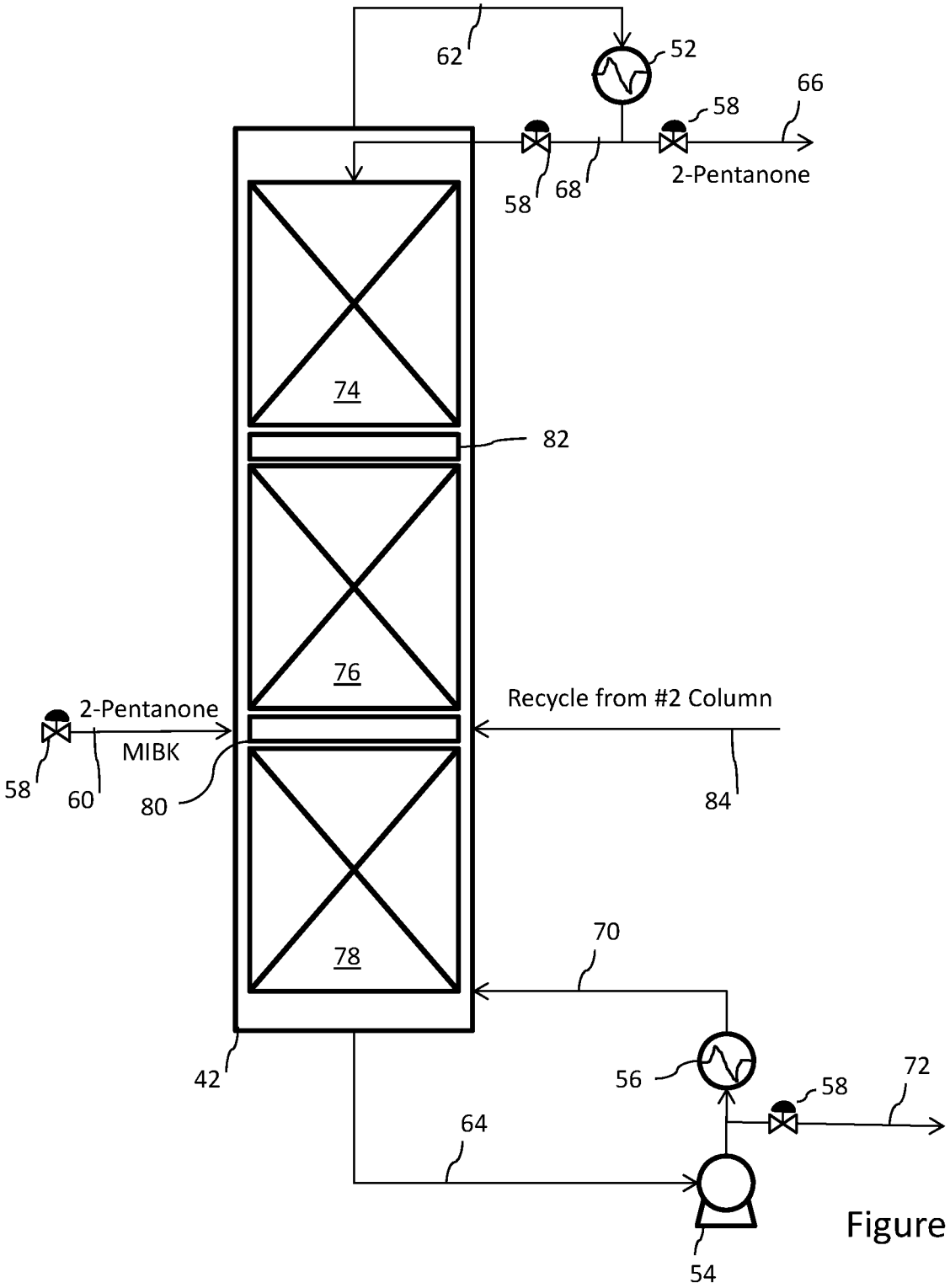

62
52
66
58
58
68
2-Pentanone
74
82
76
2-Pentanone
MIBK
58
60
80
Recycle from #2 Column
84
78
70
42
56
58
72
64
54

Figure 8

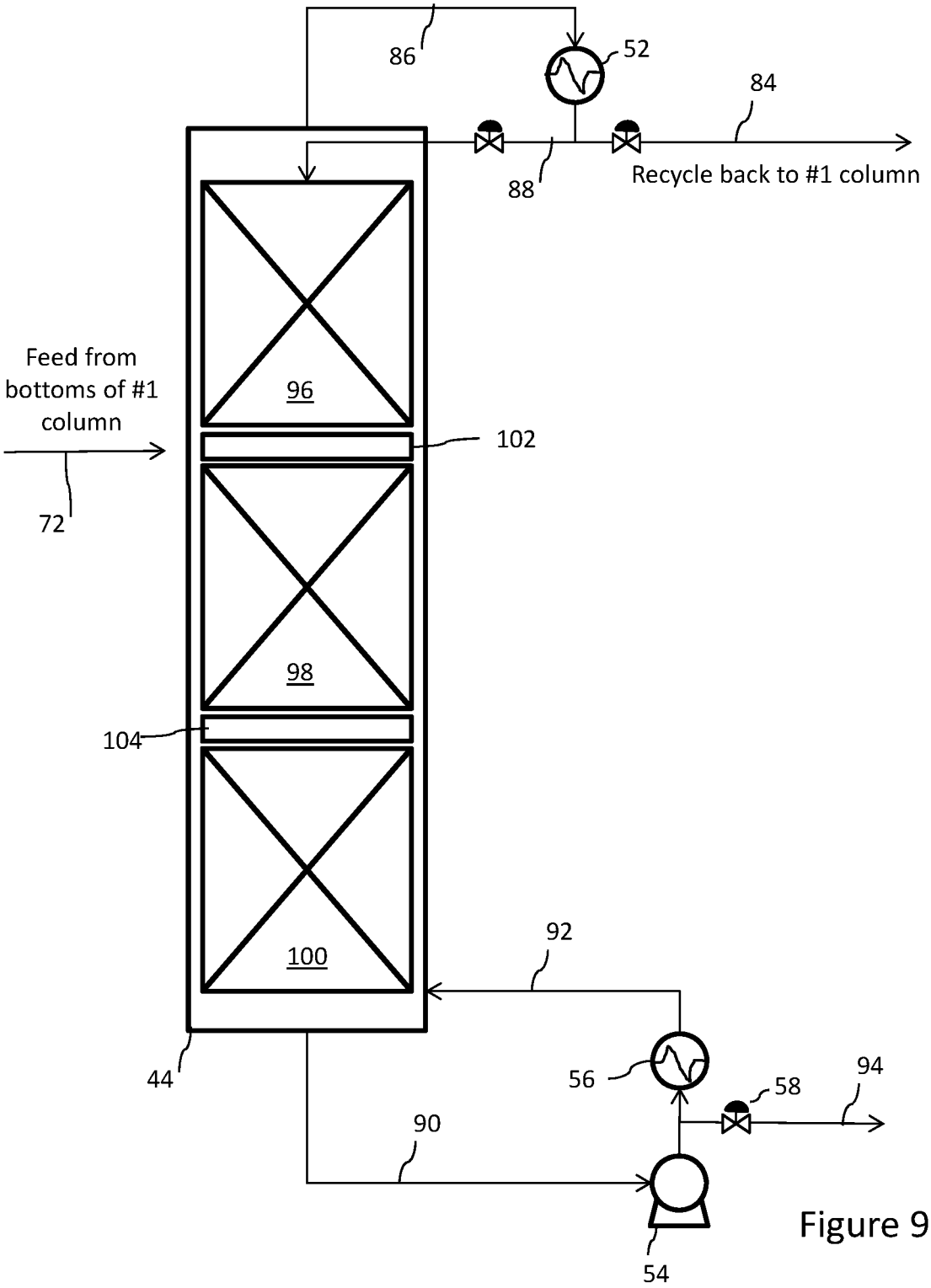
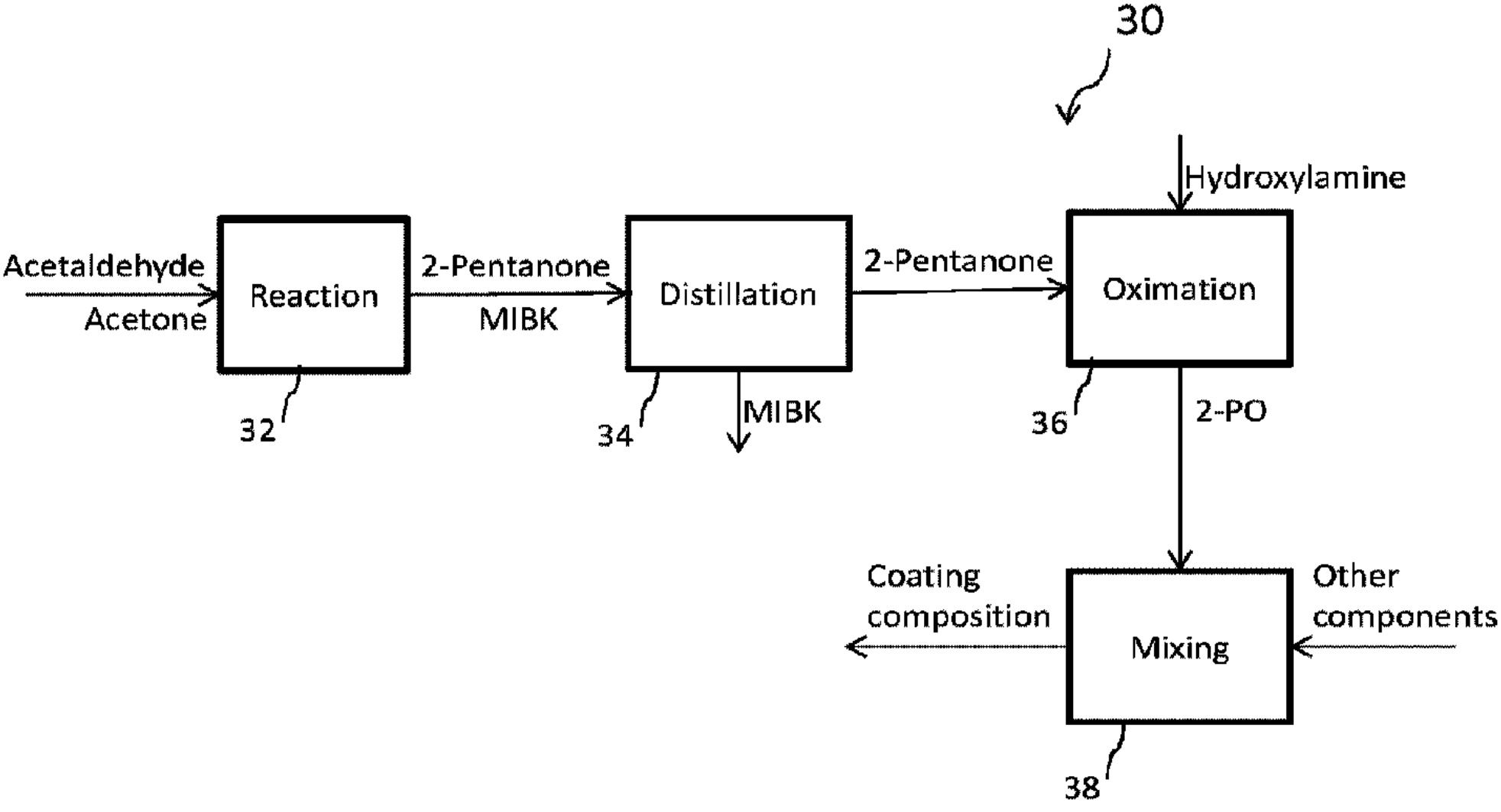

86
52
84
88
Recycle back to #1 column
Feed from bottoms of #1 column
96
102
72
98
104
100
92
44
56
58
94
90
54

Figure 9


30
Hydroxylamine
Acetaldehyde
Acetone
Reaction
2-Pentanone
MIBK
Distillation
2-Pentanone
Oximation
32
34
MIBK
36
2-PO
Coating
composition
Mixing
Other
components
38