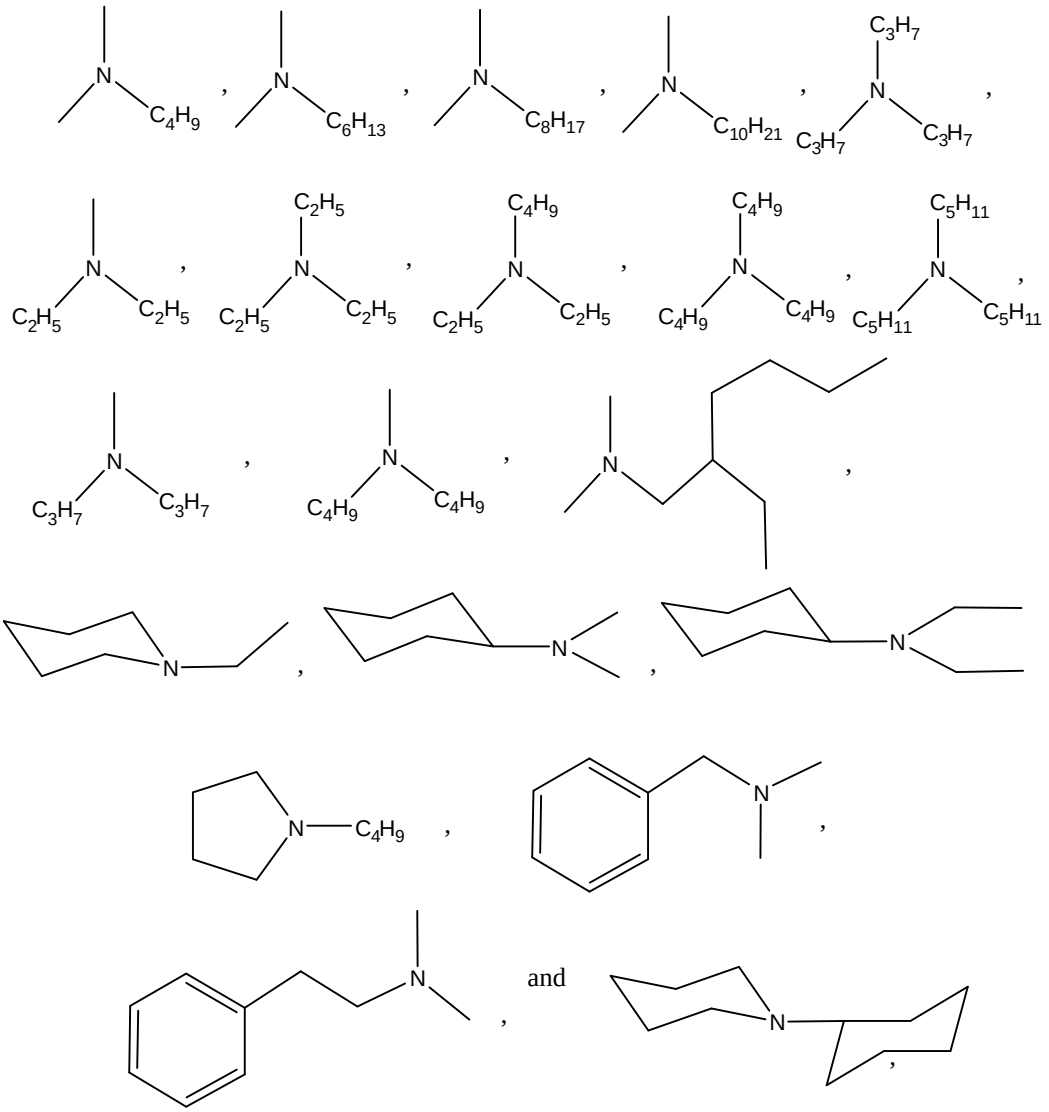
Claims:

1 A solvent drying composition, the composition comprising of:

a) a complex of at least one amine or ammonium salt containing compound and at least one carboxylic acid containing compound or an alkylsulfonic acid, preferably is~~o~~ethionic acid; or a combination thereof, in a solvent comprising

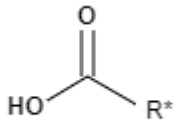
b) at least one amine containing compound at least one enolisable carbonyl and water, wherein in use water in the solvent is released to form an immiscible aqueous layer with the solvent drying composition; wherein the at least one amine containing compound in the solvent is a tertiary amine containing compound selected from the following:



more preferably, the tertiary amine containing compound is selected from a $N(C_1\text{-}C_7\ alkyl)_3$, $N(C_1\text{-}C_4\ alkyl)_3$ $N(C_2\ alkyl)_3$ (triethylamine) or ethylpiperidine.

2 The composition as claimed in claim 1 wherein the carboxylic acid containing compound is selected from one or more of the following:

a) compound of Formula I,



Formula I

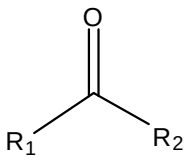
wherein R* is selected from, -C_1-C_7 alkyl-OH, -C_1-C_7 alkyl, -C_1-C_7 alkyl-NH_2, -C_1-C_7 alkyl-NHR^3 and -C_1-C_7 alkyl NR^3R^4, wherein each R^3 and R^4 are selected from -H, -OH, -halo, -C_1-C_7 alkyl, -C_1-C_7 alkyl-OH, -C(O)OH, -C(O)-H, or -C(O)-(C_1-C_7 alkyl);

preferably the carboxylic acid containing compound of Formula I is selected from acetic acid, citric acid and glycolic acid or a combination thereof;

b) a polymer containing one or more carboxylic acid groups.

~~3 The composition as claimed in claim 1 or claim 2, wherein the solvent from which the water is recovered comprises at least one amine containing compound and at least one enolisable carbonyl, preferably the solvent comprises at least a secondary or tertiary amine or a combination thereof.~~

~~4~~3 The composition as claimed in ~~any one of claims 1 to 3~~claim 1 or claim 2, wherein the solvent comprises at least one enolisable carbonyl of Formula II,



Formula II

wherein

a) R_1 and R_2 are independently selected from a -C_1-C_7 alkyl or a -C_3-C_7 monocyclic or a phenyl; or

b) one of R_1 or R_2 is selected from a -O-(C_1-C_7 alkyl) and the other is selected from a -C_1-C_7 alkyl, or

c) R_1 and R_2 together, with the carbonyl of Formula II, form a 3-15 membered monocyclic ketone or a 3-15 membered monocyclic heterocyclic ketone or acetephenone

wherein if R_1 is -C_1-C_7 alkyl, R_1 may be optionally substituted with one or more substituents selected from -OH, -C_1-C_7 alkyl, -(C_1-C_7 alkyl)-OH, -NH_2, -NH(C_1-C_7 alkyl),-N(C_1-C_7 alkyl)$_2$, -C(O)OH; -C(O)-H, or -C(O)-(C_1-C_7 alkyl); and

wherein preferably, the enolisable carbonyl of Formula II is 2-butanone.

~~5~~4 The composition as claimed in any one of claims 1 to ~~4~~3, wherein the molar ratio of the at least one amine or ammonium salt containing compound to the at least one carboxylic acid containing compound or an alkylsulfonic acid; or a combination thereof, is selected from

(a) ~~about~~ 1:99 or 99:1;

(b)~~. about~~ 1:50 or 50:1;

(c) ~~about~~ 1:10 or 10:1;

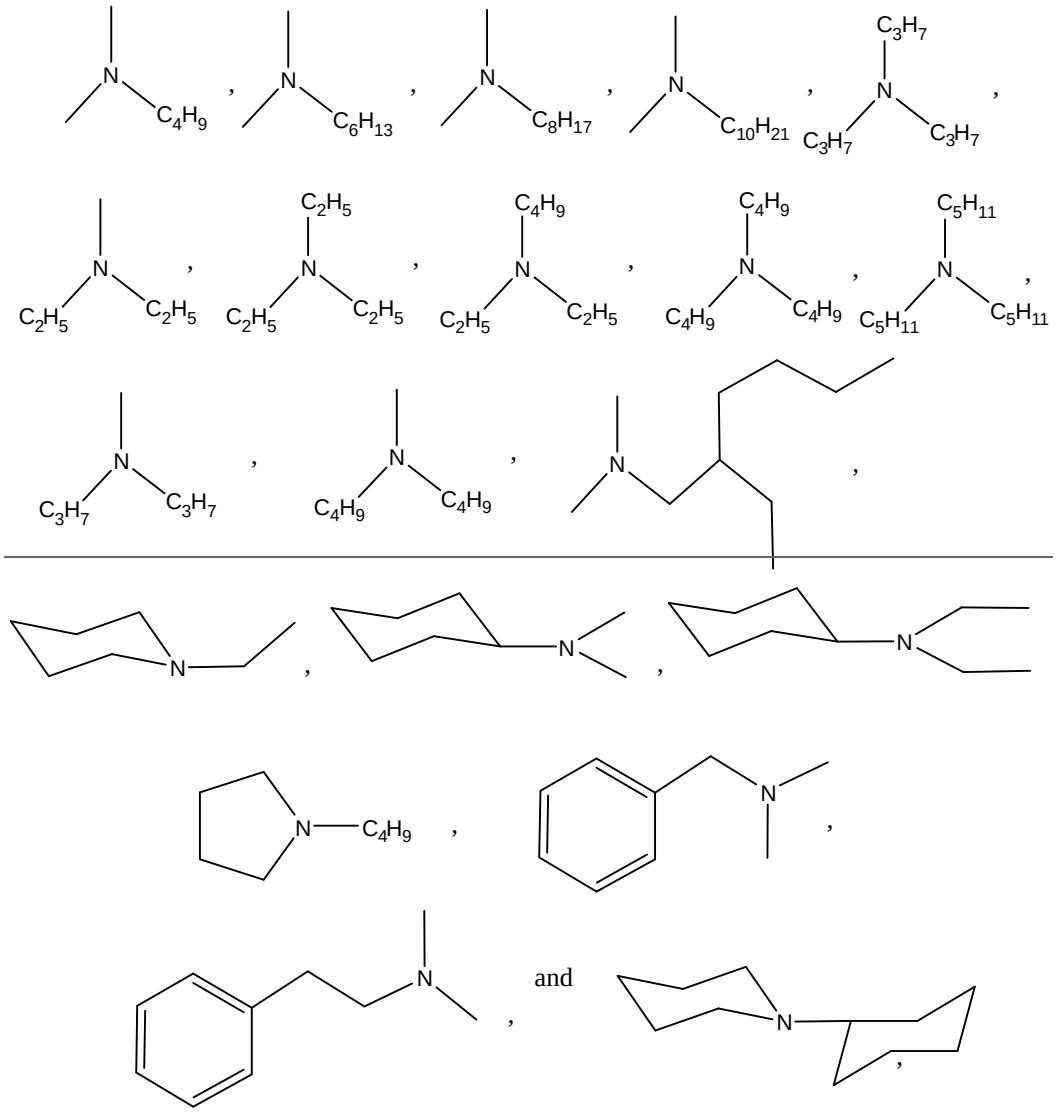
(d) ~~about~~ 1:5 or 5:1;

(e) ~~about~~ 1:3 or 3:1;

(f) ~~about~~ 1:2 or 2:1; and

(g) ~~about~~ 1:1.

~~6 The composition as claimed in any of claims 1 to 5 wherein the solvent includes at least one amine containing compound, which amine may be the same or different from the amine containing compound in the complex preferably the amine containing compound of the complex or solvent is selected from a conjugated, aliphatic, asymmetric or cyclic tertiary amine, more preferably the amine containing compound is a tertiary amine containing compound selected from the following:~~



~~more preferably, the tertiary amine containing compound is selected from a $N(C_1-C_7$ alkyl$)_3$, $N(C_1-C_4$ alkyl$)_3$, $N(C_2$ alkyl$)_3$ (triethylamine) or ethylpiperidine.~~

~~7~~5 The composition as claimed in ~~any one of claims 4 to 6~~ claim 3 or 4, wherein the molar ratio of the at least one tertiary amine containing compound to the one or more enolisable carbonyls of Formula II are present in a ratio of

(a) ~~about~~ 1:99 or 99:1;

(b)~~. about~~ 1:50 or 50:1;

(c) ~~about~~ 1:10 or 10:1;

(d) ~~about~~ 1:5 or 5:1;

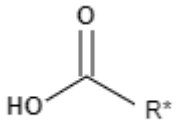
(e) ~~about~~ 1:3 or 3:1;

(f) ~~about~~ 1:2 or 2:1; or

(g) ~~about~~ 1:1.

~~8~~6 The composition as claimed in any one of claims 1 to ~~7~~5, wherein the at least one amine or ammonium salt containing compound and at least one carboxylic acid containing compound or an alkylsulfonic acid; or a combination thereof, is irreversibly protonated.

~~9~~7 A complex composition comprising at least one amine or ammonium salt containing compound, preferably a secondary or tertiary amine or combination thereof, and at least an alkylsulfonic acid, preferably is~~o~~ethionic acid; or at least one carboxylic acid containing compound of Formula I; or a combination thereof;



Formula I

wherein R* is selected from, -C_1-C_7 alkyl-OH, -C_1-C_7 alkyl, -C_1-C_7 alkyl-NH_2, -C_1-C_7 alkyl-NHR^3 and -C_1-C_7 alkyl NR^3R^4, wherein each R^3 and R^4 are selected from -H, -OH, -halo, -C_1-C_7 alkyl, -C_1-C_7 alkyl-OH, -C(O)OH, -C(O)-H, or -C(O)-(C_1-C_7 alkyl),

preferably, the carboxylic acid containing compound of Formula I is selected from acetic acid, citric acid and glycolic acid or a combination thereof;

the complex being suitable for use in recovering water from a solvent, wherein water is released from the solvent upon migration of the composition through the solvent, the released water forming an immiscible aqueous layer with the solvent

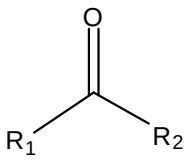
and wherein the solvent comprises:

a) at least one tertiary amine containing compound, ~~preferably at least one secondary or tertiary amine or a combination thereof,~~

b) at least one enolisable carbonyl, and

c) water.

~~10~~8 The complex as claimed in claim ~~9~~7, wherein the solvent comprises at least one enolisable carbonyl of Formula II



Formula II

wherein

a) R_1 and R_2 are independently selected from a -C_1-C_7 alkyl or a -C_3-C_7 monocyclic or a phenyl; or

b) one of R_1 or R_2 is selected from a -O-(C_1-C_7 alkyl) and the other is selected from a -C_1-C_7 alkyl, or

c) R_1 and R_2 together, with the carbonyl of Formula I, form a 3-15 membered monocyclic ketone or a 3-15 membered monocyclic heterocyclic ketone or acetephenone; and

wherein if R_1 is -C1-C7 alkyl, R_1 may be optionally substituted with one or more substituents selected from -OH, -C1-C7 alkyl, -(C1-C7 alkyl)-OH, -NH2, -NH(C1-C7 alkyl),-N(C1-C7 alkyl)2, -C(O)OH; -C(O)-H, or -C(O)-(C1-C7 alkyl); and

wherein preferably, the enolisable carbonyl of Formula II is 2-butanone.

~~11~~ 9 The complex as claimed in ~~any one of claims~~ claim 7 or 8 ~~9 or 10~~, wherein the molar ratio of the at least one amine or ammonium salt containing compound to the at least one carboxylic acid containing compound or an alkylsulfonic acid; or a combination thereof, is selected from

(a) ~~about~~ 1:99 or 99:1;

(b)~~.~~ ~~about~~ 1:50 or 50:1;

(c) ~~about~~ 1:10 or 10:1;

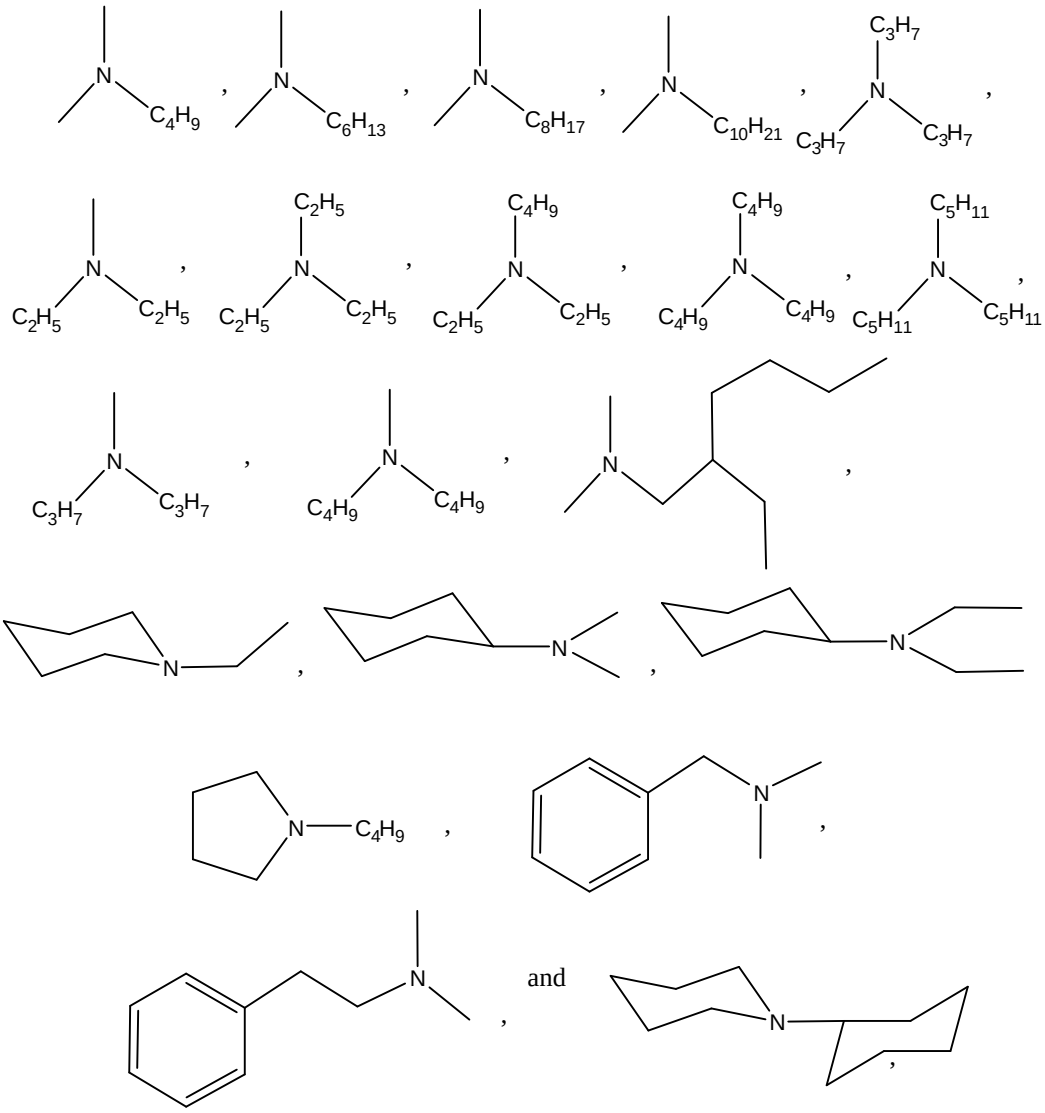
(d) ~~about~~ 1:5 or 5:1;

(e) ~~about~~ 1:3 or 3:1;

(f) ~~about~~ 1:2 or 2:1; and

(g) ~~about~~ 1:1.

~~12~~10 The complex as claimed in any of claims ~~9~~ 7 to ~~11~~ 9 wherein the solvent includes at least one ~~amine containing compound, which amine may be the same or different from the amine containing compound in the complex, preferably the at least one amine containing compound of the complex or solvent is selected from a conjugated, aliphatic, asymmetric or cyclic tertiary amine, more preferably the amine containing compound is a~~ tertiary amine containing compound selected from the following:



more preferably, the tertiary amine containing compound is selected from a $N(C_1\text{-}C_7\ alkyl)_3$, $N(C_1\text{-}C_4\ alkyl)_3$, $N(C_2\ alkyl)_3$ (triethylamine) or ethylpiperidine.

~~13~~11 The complex as claimed in any one of claims ~~9~~ 7 to ~~12~~10, wherein the molar ratio of the at least one tertiary amine containing compound to the one or more enolisable carbonyls of Formula II are present in a ratio of ~~about~~

(a) ~~about~~ 1:99 or 99:1;

(b)~~. about~~ 1:50 or 50:1;

(c) ~~about~~ 1:10 or 10:1;

(d) ~~about~~ 1:5 or 5:1;

(e) ~~about~~ 1:3 or 3:1;

(f) ~~about~~ 1:2 or 2:1; or

(g) ~~about~~ 1:1.

~~14~~12 The complex as claimed in any one of claims ~~9~~ 7 to ~~13~~11, wherein the at least one amine or ammonium salt containing compound and at least one carboxylic acid containing compound or an alkylsulfonic acid; or a combination thereof, is irreversibly protonated.

~~15~~13 A method of recovering water from a solvent, the method including the steps of:

a. contacting the solvent drying composition for use in recovering water from a solvent, the composition comprising a composition as claimed in any one of claims 1 to ~~8~~6; or
b. contacting the solvent with a complex composition as claimed in any one of claims ~~9~~ 7 to ~~14~~12; and

allowing the migration of the complex composition through the solvent, whereupon the water is released from the solvent forming an immiscible aqueous layer with the solvent

wherein the method optionally includes the step of separating the recovered water from the immiscible solvent layer.

~~16~~14 The method as claimed in claim ~~15~~13, wherein the method includes the step of contacting the solvent with either:

a. one or more drying compositions as claimed in any one of claims 1 to 6, or
b. one or more complex compositions as claimed in any one of claims 7 to 12;

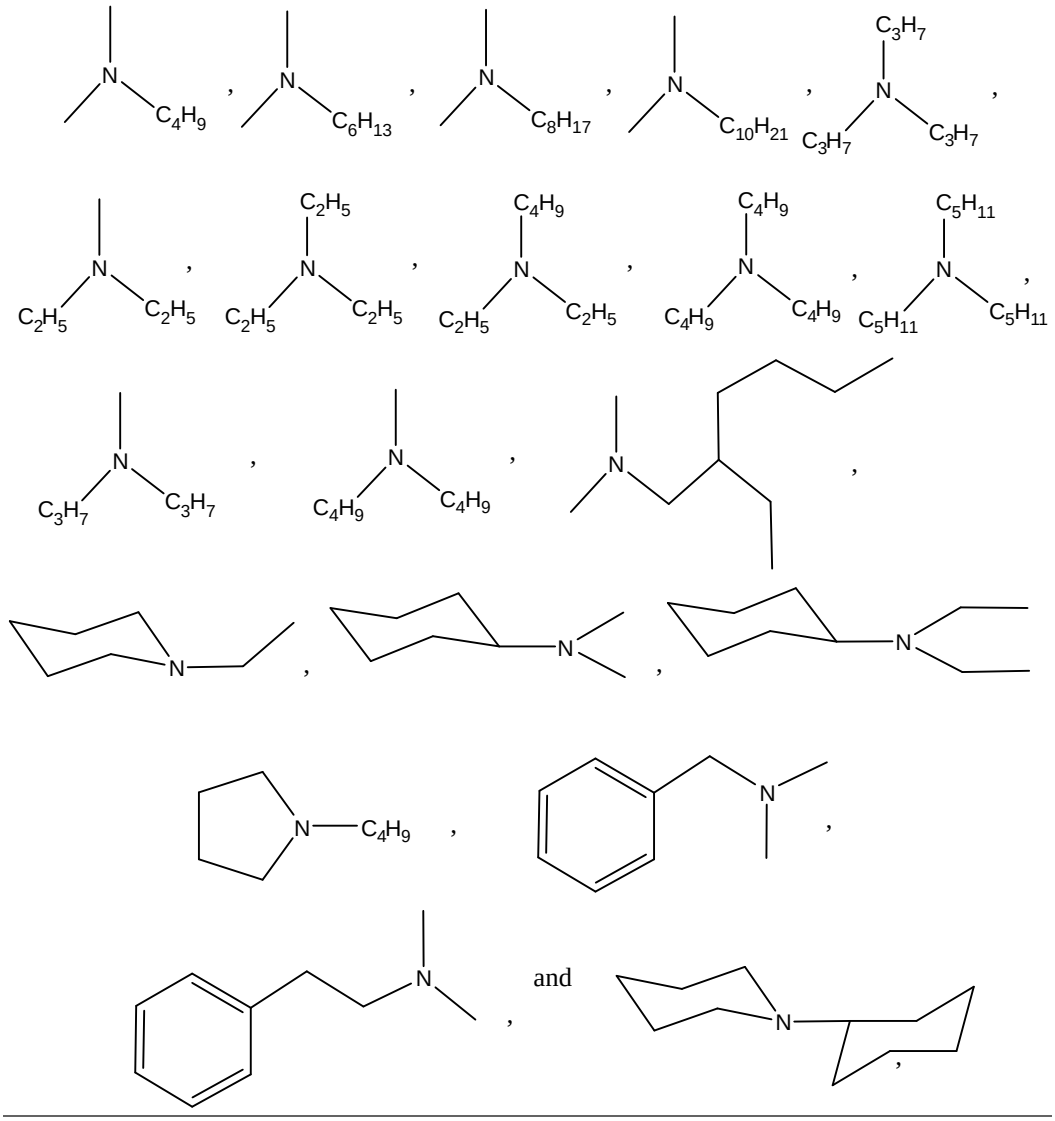
preferably the solvent is contacted with the one or more solvent drying compositions or the one or more complex compositions iteratively to iteratively release water therefrom,

more preferably one or more solvents are contacted with the one or more solvent drying compositions or the one or more complex compositions iteratively in a counter-current process.

~~17~~15 A process for using a solvent drying composition to recover water from a solvent, the composition comprising a complex of:

a.

at least one amine or ammonium salt containing compound; ~~preferably the at least one amine containing compound is a secondary or tertiary amine containing compound~~ or a combination thereof; wherein the at least one amine containing compound is a tertiary amine containing compound selected from the following:



more preferably, the tertiary amine containing compound is selected from a $N(C_1\text{-}C_7\ alkyl)_3$, $N(C_1\text{-}C_4\ alkyl)_3$, $N(C_2\ alkyl)_3$ (triethylamine) or ethylpiperidine; and

~~a. and~~

b. at least one carboxylic acid containing compound or an alkylsulfonic acid, preferably is~~o~~ethionic acid; or a combination thereof,

wherein in use the water is released from the solvent upon migration of the composition through the solvent, the released water forming an immiscible aqueous layer with the solvent,
the process comprising the steps of:

1) bringing the solvent drying composition into contact with the solvent to release the water from the solvent upon migration of the composition through the solvent, the released water and solvent drying composition forming an immiscible aqueous layer with the solvent,

2) recovering the solvent drying composition from the immiscible aqueous layer, and optionally

3) recovering the solvent.

~~18~~16 The process as claimed in claim ~~17~~ 15 wherein the recovered solvent drying composition is recycled for use in a further solvent drying process, preferably the process of recovering the solvent drying composition is a continuous recovery process.

~~19~~17 The process as claimed in ~~any one of claims~~claim ~~17~~ 15 ~~to 18~~or claim 16 wherein the step of recovering the solvent drying solution is achieved by one or more of the following techniques, membrane distillation, pervaporation, osmosis, pressure driven membrane processes, osmotically driven membrane processes, osmotically assisted pressure driven membrane processes, pressure assisted osmotically driven membrane processes, filtration, mechanical vapor recompression, evaporation based processes, water specific reactant, or crystallisation techniques or the like, preferably a pressure assisted osmosis technique.

~~20~~18 The process as claimed in any one of claims ~~17~~ 15 to ~~19~~ 17 wherein the process includes a coalescence step to recover the solvent drying composition from the immiscible aqueous layer with the solvent, preferably an electrostatic coalescer is used for the coalescence step.

~~21~~19 The process as claimed in any one of claims ~~17~~ 15 to ~~20~~ 18 wherein the -carboxylic acid containing compound of Formula I is selected from acetic acid, citric acid and glycolic acid or a combination thereof;

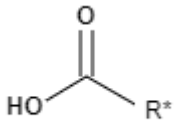
preferably the carboxylic acid containing compound is a metal salt -carboxylic acid complex;

preferably the metal salt-carboxylic acid complex is selected from one or more of the following: metal salts having a valency of less than or the same as 6, Na salts, Fe (II) salts, Fe (III) salts, Cu (II) salts, Al(II) salts, Al(III) salts, Sr (II) salts, Li salts and Ag salts, more preferably the metal salt is selected from one or more of the following: NaCl, $NaCO_3$, $SrCl_2$, $AlCl_3$, $FeCl_3$, $Fe(NO_3)_3$, $Fe_2(SO_4)_3$, $CuCl_2$, $CuSO_4$, $Cu(OH)_2$, AgF, AgCl and AgBr; and

preferably the carboxylic acid is selected from one or more of the following, glycolic acid, citric acid, tartaric acid, poly(acrylic acid-co-maleic acid, poly acrylic acid, sarcosine, acetic acid, carbonic acid and formic acid.

~~22~~20 The process as claimed in any one of claims ~~17~~ 15 to ~~21~~19, the at least one carboxylic acid containing compound is selected from one or more of the following:

a) a compound of Formula I,



Formula I

wherein R* is selected from, -C_1-C_7 alkyl-OH, -C_1-C_7 alkyl, -C_1-C_7 alkyl-NH_2, -C_1-C_7 alkyl-NHR^3 and -C_1-C_7 alkyl NR^3R^4, wherein each R^3 and R^4 are selected from -H, -OH, -halo, -C_1-C_7 alkyl, -C_1-C_7 alkyl-OH, -C(O)OH, -C(O)-H, or -C(O)-(C_1-C_7 alkyl); and

b) a polymer containing one or more carboxylic acid groups

preferably the carboxylic containing compound of Formula I is selected from acetic acid, citric acid and glycolic acid or a combination thereof.

~~23~~21 The process as claimed in any one of claims ~~17~~ 15 to ~~22~~20, wherein the molar ratio of the at least amine or ammonium salt containing compound to the at least one carboxylic acid containing compound or an alkylsulfonic acid or a combination thereof; is selected from

(a) ~~about~~ 1:99 or 99:1;

(b)~~.~~ ~~about~~ 1:50 or 50:1;

(c) ~~about~~ 1:10 or 10:1;

(d) ~~about~~ 1:5 or 5:1;

(e) ~~about~~ 1:3 or 3:1;

(f) ~~about~~ 1:2 or 2:1; and

(g) ~~about~~ 1:1.

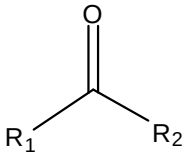
~~24~~22 The process as claimed in any one of claims ~~17~~ 15 to ~~23~~ 21 wherein the complex comprising:

a) at least one amine or ammonium salt containing compound and

b) at least one carboxylic acid containing compound or an alkylsulfonic acid; or a combination thereof,

is irreversibly protonated.

~~25~~23 The process as claimed in claim ~~17~~ 15 to ~~24~~ 22 wherein the solvent comprises at least one enolisable carbonyl of Formula II,



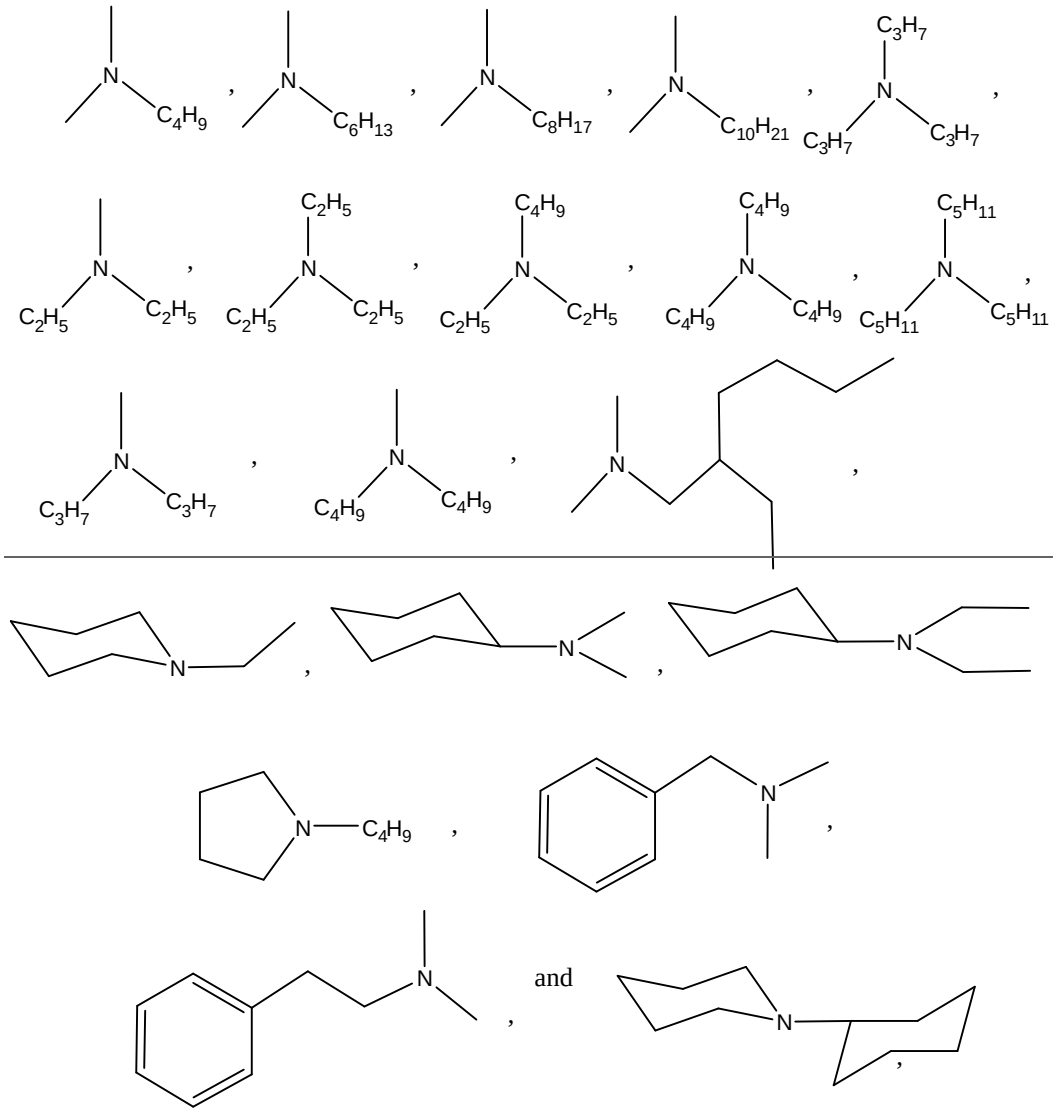
Formula II

a. wherein R_1 and R_2 are independently selected from a -C_1-C_7 alkyl or a -C_3-C_7 monocyclic; or
b. one of R_1 or R_2 is selected from a -O-(C_1-C_7 alkyl) and the other is selected from a -C_1-C_7 alkyl, or
c. R_1 and R_2 together, with the carbonyl of Formula II, form a 3-15 membered monocyclic ketone or a 3-15 membered monocyclic heterocyclic ketone or acetophenone

wherein if R_1 is -C1-C7 alkyl, R_1 may be optionally substituted with one or more substituents selected from -OH, -C1-C7 alkyl, -(C1-C7 alkyl)-OH, -NH2, -NH(C1-C7 alkyl),-N(C1-C7 alkyl)2, -C(O)OH; -C(O)-H, or -C(O)-(C1-C7 alkyl); and

wherein preferably, the enolisable carbonyl of Formula II is 2-butanone.

~~26 The process as claimed in any of claims 17 to 25 wherein the solvent includes at least one amine containing compound, which amine may be the same or different from the amine containing compound in the complex, preferably wherein the at least one amine containing compound of the complex or solvent is selected from a conjugated, aliphatic, asymmetric or cyclic tertiary amine, more preferably the amine containing compound is a tertiary amine containing compound selected from the following:~~



~~more preferably, the tertiary amine containing compound is selected from a $N(C_1$-C_7 alkyl)$_3$, $N(C_1$-C_4 alkyl)$_3$, $N(C_2$ alkyl)$_3$ (triethylamine) or ethylpiperidine.~~

~~27~~24 The process as claimed in any one of claims ~~17~~ 15 to ~~26~~23, wherein the molar ratio of the at least one tertiary amine containing compound to the one or more enolisable carbonyls of Formula II are present in a ratio of

a) ~~about~~ 1:99 or 99:1;

(b)~~.~~ ~~about~~ 1:50 or 50:1;

(c) ~~about~~ 1:10 or 10:1;

(d) ~~about~~ 1:5 or 5:1;

(e) ~~about~~ 1:3 or 3:1;

(f) ~~about~~ 1:2 or 2:1; and

(g) ~~about~~ 1:1.