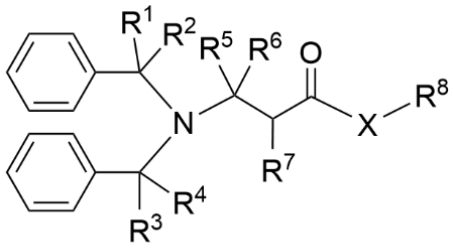
CLAIMS

1. A coalescing agent when used in a coating formulation that is substantially free from volatile organic compounds (VOCs), the coalescing agent comprising one or more amine compounds represented by general formula (I):



(I)

wherein

X is selected from O and NH;

R^1, R^2, R^3 and R^4 are each independently selected from H, alkyl and alkenyl;

R^5, R^6 and R^7 are H;

R^8 is selected from alkyl, alkenyl, cycloalkyl, cycloalkenyl, hydroxyalkyl, alkyloxyalkyl, $(alkyloxy)_n alkyl$ where $n \geq 1$, alkylacrylate, alkyl(meth)acrylate, alkylacrylamide, alkylamine or $(alkyloxy)_m alkyl–O–C(=O)–alkylamine$ where $m \geq 0$ and wherein one or more of the H atoms is/are optionally replaced by hydroxy, alkoxy, hydroxyalkyl, halogen, haloalkyl, cyano, cyanoalkyl and nitro.

2. The coalescing agent of claim 1, wherein R^8 is selected from alkyl, alkenyl, cycloalkyl, cycloalkenyl, hydroxyalkyl, alkyloxyalkyl, $(alkyloxy)_n alkyl$ where $n \geq 1$, alkylacrylate, alkyl(meth)acrylate or alkylacrylamide.

3. The coalescing agent of claim 1, wherein the amine compound has a boiling point that is more than about 250°C.

4. The coalescing agent of any one of the preceding claims, wherein R^1, R^2, R^3 and R^4 are each independently selected from the group consisting of H, linear or branched (C_1-C_{10})-alkyl and linear or branched (C_1-C_{10})-alkenyl.

5. The coalescing agent of any one of the preceding claims, wherein R^8 is selected from linear or branched (C_1-C_{30})-alkyl, linear or branched (C_2-C_{30})-alkenyl, (C_3-C_{30})-cycloalkyl, (C_3-C_{30})-cycloalkenyl, linear or branched hydroxy-(C_1-C_{30})-alkyl, linear or branched (C_1-C_{30})-alkyl-oxy-(C_1-C_{30})-alkyl, linear or branched [(C_1-C_{30})-alkyl-oxy]$_n$-(C_1-C_{30})-alkyl where $n \geq 1$, (C_1-C_{30})-alkyl-acrylate, (C_1-C_{30})-alkyl-(meth)acrylate, (C_1-C_{30})-alkyl-acrylamide, linear or branched (C_1-C_{30})-alkylamine, or [(C_1-C_{30})-alkyl-oxy)$_m$-(C_1-C_{30})-alkyl–O–C(=O)–(C_1-C_{30})-alkylamine where $m \geq 0$.

6. The coalescing agent of claim 2, wherein R^8 is selected from linear or branched (C_1-C_{30})-alkyl, linear or branched (C_2-C_{30})-alkenyl, (C_3-C_{30})-cycloalkyl, (C_3-C_{30})-cycloalkenyl, linear or branched hydroxy-(C_1-C_{30})-alkyl, linear or branched (C_1-C_{30})-alkyl-oxy-(C_1-C_{30})-alkyl, linear or branched [(C_1-C_{30})-alkyl-oxy]$_n$-(C_1-C_{30})-alkyl where $n \geq 1$, (C_1-C_{30})-alkyl-acrylate, (C_1-C_{30})-alkyl-(meth)acrylate or (C_1-C_{30})-alkyl-acrylamide.

7. The coalescing agent of any one of the preceding claims, wherein R^8 is selected from one of the following:

–R^9–OH;

–R^{10};

–(R^{11}–O)$_n$–R^{12};

–R^{13}–O–C(=O)–C(CH_3)=CH_2;

–R^{14}(OH)–R^{15}–O–C(=O)–C(CH_3)=CH_2;

–R^{16}–NR^xR^y; or

–(R^{17}–O)$_m$–R^{18}–O–C(=O)–R^{19}–NR^xR^y,

where $n \geq 1$, $m \geq 0$, R^9 to R^{19} are each alkyl, and where R^x and R^y are each independently selected from H, alkyl, alkenyl, cycloalkyl, cycloalkenyl, aryl and alkylaryl.

8. The coalescing agent of claim 2, wherein R^8 is selected from one of the following:

$–R^9–OH$;

$–R^{10}$;

$–(R^{11}–O)_n–R^{12}$;

$–R^{13}–O–C(=O)–C(CH_3)=CH_2$; or

$–R^{14}(OH)–R^{15}–O–C(=O)–C(CH_3)=CH_2$,

where $n \geq 1$ and R^9 to R^{15} are each alkyl.

9. The coalescing agent of claim 2, wherein R^8 is (i) hydroxyalkyl selected from the group consisting of hydroxymethyl, hydroxyethyl, 2-hydroxyethyl hydroxypropyl, 2-hydroxypropyl, hydroxybutyl, hydroxypentyl and hydroxyhexyl; (ii) $(alkyloxy)_n$alkyl selected from the group consisting of methoxymethyl, methoxyethyl, methoxypropyl, methoxybutyl, ethoxymethyl, ethoxyethyl, ethoxypropyl, ethoxybutyl, propoxymethyl, propoxyethyl, propoxypropyl, propoxybutyl, methoxymethoxymethyl, methoxymethoxyethyl, methoxymethoxypropyl, methoxymethoxybutyl, ethoxyethoxymethyl, ethoxyethoxyethyl, ethoxyethoxypropyl, ethoxyethoxybutyl, propoxypropoxymethyl, propoxypropoxyethyl, propoxypropoxypropyl, propoxypropoxybutyl, methoxymethoxymethoxymethyl, methoxymethoxymethoxyethyl, methoxymethoxymethoxypropyl, methoxymethoxymethoxybutyl, ethoxyethoxyethoxymethyl, ethoxyethoxyethoxyethyl, ethoxyethoxyethoxypropyl, ethoxyethoxyethoxybutyl, propoxypropoxypropoxymethyl, propoxypropoxypropoxyethyl, propoxypropoxypropoxypropyl and propoxypropoxypropoxybutyl; (iii) alkyl(meth)acrylate selected from the group consisting of methyl (meth)acrylate, ethyl (meth)acrylate, propyl (meth)acrylate, isopropyl (meth)acrylate, n-butyl (meth)acrylate, isobutyl (meth)acrylate, 3-methylbutyl (meth)acrylate, amyl (meth)acrylate, neopentyl (meth)acrylate, hexyl (meth)acrylate, cyclohexyl (meth)acrylate, heptyl (meth)acrylate, n-

octyl (meth)acrylate, ethylhexyl (meth)acrylate and decyl (meth)acrylate; or (iv) alkyl(meth)acrylate substituted with hydroxy that is selected from the group consisting of hydroxymethyl (meth)acrylate, hydroxyethyl (meth)acrylate, hydroxypropyl (meth)acrylate and hydroxybutyl (meth)acrylate.

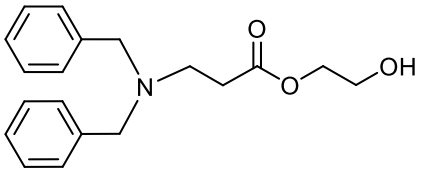
10. The coalescing agent of any one of the preceding claims, wherein R^1, R^2, R^3 and R^4 are all H atoms.

11. The coalescing agent of any one of the preceding claims, wherein the amine compound comprises more than twelve carbon atoms per basic nitrogen atom.

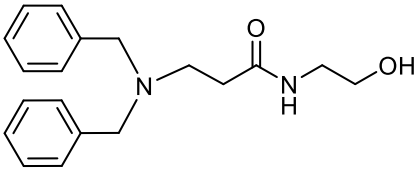
12. The coalescing agent of any one of the preceding claims, wherein the coalescing agent is configured to spontaneously react with a polymer in a coating composition during/upon drying to form a coating layer.

13. The coalescing agent of claim 12, wherein the coalescing agent is configured to form a chemical interaction with the polymer during/upon drying, wherein the chemical interaction is at least one of an ionic interaction or a covalent interaction.

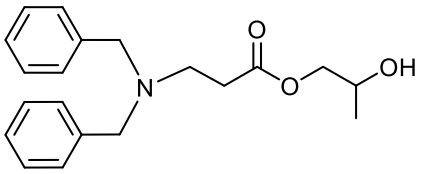
14. The coalescing agent of claim 2, wherein the amine compound is selected from the following compounds **(1)** to **(8)**:



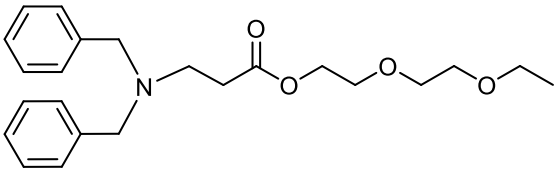
(1)



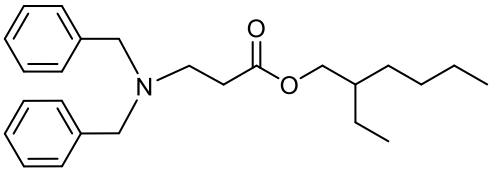
(5)



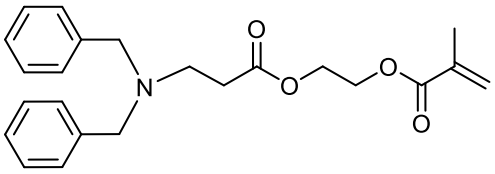
(2)



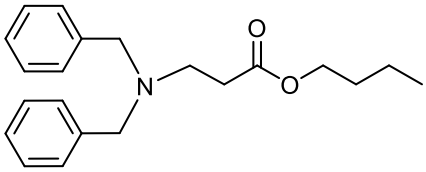
(6)



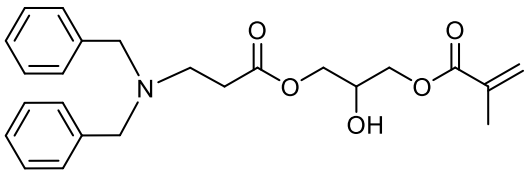
(3)



(7)

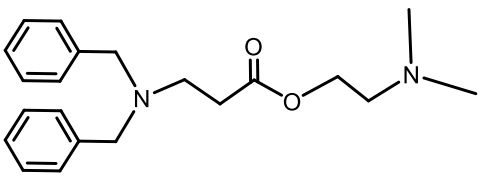


(4)

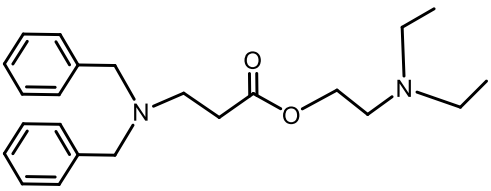


(8)

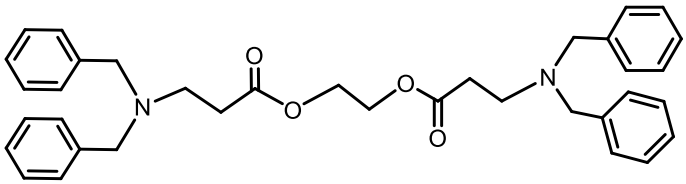
15. The coalescing agent of claim 1, wherein the amine compound is selected from the following compounds **(9)** to **(12)**:



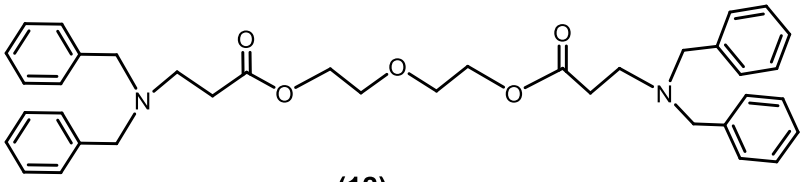
(9)



(10)

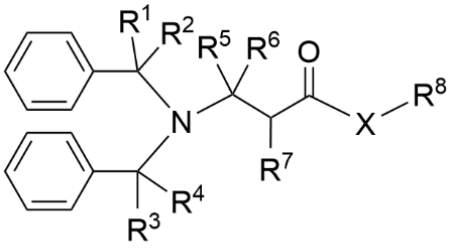


(11)



(12)

16. A coalescing agent for a coating formulation that is substantially free from volatile organic compounds (VOCs), the coalescing agent comprising one or more amine compounds represented by general formula (I):



(I)

wherein

X is selected from O and NH;

R^1, R^2, R^3 and R^4 are each independently selected from H, alkyl and alkenyl;

R^5, R^6 and R^7 are H; and

R^8 is (i) hydroxyalkyl selected from the group consisting of hydroxymethyl, hydroxyethyl, 2-hydroxyethyl hydroxypropyl, 2-hydroxypropyl, hydroxybutyl, hydroxypentyl and hydroxyhexyl; (ii) $(alkyloxy)_n$alkyl selected from the group consisting of methoxymethyl, methoxyethyl, methoxypropyl, methoxybutyl, ethoxymethyl, ethoxyethyl, ethoxypropyl, ethoxybutyl, propoxymethyl, propoxyethyl, propoxypropyl, propoxybutyl, methoxymethoxymethyl, methoxymethoxyethyl, methoxymethoxypropyl, methoxymethoxybutyl, ethoxyethoxymethyl, ethoxyethoxyethyl, ethoxyethoxypropyl, ethoxyethoxybutyl, propoxypropoxymethyl, propoxypropoxyethyl,

propoxypropoxypropyl, propoxypropoxybutyl, methoxymethoxymethoxymethyl, methoxymethoxymethoxyethyl, methoxymethoxymethoxypropyl, methoxymethoxymethoxybutyl, ethoxyethoxyethoxymethyl, ethoxyethoxyethoxyethyl, ethoxyethoxyethoxypropyl, ethoxyethoxyethoxybutyl, propoxypropoxypropoxymethyl, propoxypropoxypropoxyethyl, propoxypropoxypropoxypropyl and propoxypropoxypropoxybutyl; (iii) alkyl(meth)acrylate selected from the group consisting of methyl (meth)acrylate, ethyl (meth)acrylate, propyl (meth)acrylate, isopropyl (meth)acrylate, n-butyl (meth)acrylate, isobutyl (meth)acrylate, 3-methylbutyl (meth)acrylate, amyl (meth)acrylate, neopentyl (meth)acrylate, hexyl (meth)acrylate, cyclohexyl (meth)acrylate, heptyl (meth)acrylate, n-octyl (meth)acrylate, ethylhexyl (meth)acrylate and decyl (meth)acrylate; or (iv) alkyl(meth)acrylate substituted with hydroxy that is selected from the group consisting of hydroxymethyl (meth)acrylate, hydroxyethyl (meth)acrylate, hydroxypropyl (meth)acrylate and hydroxybutyl (meth)acrylate.

17. A coating composition comprising one or more coalescing agent(s) of any one of the preceding claims and one or more polymer(s) configured to spontaneously react with the coalescing agent(s) during/upon drying of the coating composition to form a coating layer.

18. The coating composition of claim 17, wherein the polymer comprises one or more acid group(s) and/or salts thereof selected from carboxylic acids (–C(=O)OH)), sulfonic acids (–$S(=O)_2OH$), phosphonic acids (–$P(=O)(OH)_2$), amine neutralized carboxylic acids, amine neutralized sulfonic acids, amine neutralized phosphonic acids, carboxylic acid-amine salts, sulfonic acid-amine salts and phosphonic acid-amine salts.

19. The coating composition of claim 18, wherein the carboxylic acids and derivatives thereof comprises acrylic acid and derivatives thereof; methacrylic acid and derivatives thereof; maleic acid and derivatives thereof; itaconic acid and derivatives thereof and combinations thereof.

20. The coating composition of any one of claims 17 to 19, wherein the amount of the coalescing agent in the composition is from 0.2 wt% to 20.0 wt% of the composition.

21. The coating composition of any one of claims 17 to 20, wherein the coating composition is substantially devoid of volatile organic compounds (VOCs).

22. The coating composition of any one of claims 17 to 21, wherein the coating composition is a water-based coating composition.

23. The coating composition of any one of claims 17 to 22, wherein the coating composition is a water-based paint coating composition.

24. A coating layer comprising one or more coalescing agent(s) of any one of claims 1 to 16 chemically coupled to one or more polymer(s) via at least one of an ionic interaction or a covalent interaction.

25. The coating layer of claim 24, wherein the layer has one or more of the following properties: odourless, non-tacky, non-sticky, substantially colourless in solution, substantially insoluble in water, substantially do not blister in water, substantially do not delaminate in water, chemically and/or physically stable, excellent resistance towards natural exposure/weathering and substantially inert towards ultraviolet (UV) light.