Claims

1. A process for the purification of water and/or dewatering of sludges and/or sediments, comprising the following steps of:

a) providing water to be purified and/or sludge and/or sediment to be dewatered comprising impurities;

b) providing at least one surface-treated calcium carbonate, wherein at least 1 % of the accessible surface area of the calcium carbonate is covered by a coating comprising at least one cationic polymer,

c) providing at least one phyllosilicate, and

d) contacting the water and/or sludge and/or sediment of step a) with the at least one surface-treated calcium carbonate of step b) and the at least one phyllosilicate of step c) for obtaining a composite material comprising the at least one surface-treated calcium carbonate, the at least one phyllosilicate and impurities.

2. The process according to claim 1, wherein the water and/or sludge and/or sediment of step a) is selected from industrial waste water, drinking water, urban waste water, sludge such as harbour sludge, river sludge, coastal sludge or digested sludge, waste water or process water from breweries or other beverage industries, waste water or process water in the paper industry, colour-, paints-, or coatings industry, agricultural waste water, slaughterhouse waste water, leather industry waste water and leather tanning industry.

3. The process according to claims 1 or 2, wherein the at least one surface-treated calcium carbonate of step b) comprises ground calcium carbonate and/or

precipitated calcium carbonate and/or surface-modified calcium carbonate, preferably surface-modified calcium carbonate or ground calcium carbonate.

4. The process according to any one of claims 1 to 3, wherein the source of ground calcium carbonate (GCC) is selected from marble, chalk, calcite, dolomite, limestone and mixtures thereof and/or the precipitated calcium carbonate (PCC) is selected from one or more of the aragonitic, vaterític and calcitic mineralogical crystal forms.

5. The process according to any one of claims 1 to 4, wherein the coating of the at least one surface-treated calcium carbonate comprises at least one cationic polymer

a) having a positive charge density in the range of 1 mEq/g and 15 mEq/g, more preferably in the range of 2.5 mEq/g and 12.5 mEq/g and most preferably in the range of 5 µEq/g and 10 mEq/g,
and/or

b) in which at least 60 % of the monomer units have a cationic charge, preferably at least 70 %, more preferably at least 80 %, even more preferably at least 90 % and most preferably equal to 100 %,
and/or

c) having a weight average molecular weight M_w of below 1,000,000 g/mole, more preferably from 50,000 to 750,000 g/mole, even more preferably from 50,000 to 650,000 g/mole and most preferably from 100,000 to 300,000 g/mole,
and/or

d) being a homopolymer based on monomer units selected from the group consisting of diallyldialkyl ammonium salts; tertiary and quaternized amines; quaternized imines; acrylamide; methacrylamide; N,N-dimethyl acrylamide; acrylic acid; methacrylic acid; vinylsulfonic acid; vinyl pyrrolidone; hydroxyl

ethyl acrylate; styrene; methyl methacrylate and vinyl acetate, preferably diallyldialkyl ammonium salts and acrylic acid,

or

c) being a copolymer based on monomer units selected from diallyldialkyl ammonium salts and methacrylic acid and comonomer units selected from the group consisting of acrylamide; methacrylamide; N,N-dimethyl acrylamide; acrylic acid; methacrylic acid; vinylsulfonic acid; vinyl pyrrolidone; hydroxyl ethyl acrylate; styrene; methyl methacrylate; vinyl acetate and mixtures thereof, preferably the monomer units are selected from diallyldialkyl ammonium salts and methacrylic acid and comonomer units selected from acrylamide and acrylic acid.

6. The process according to any one of claims 1 to 5, wherein at least 10 % of the accessible surface area of the calcium carbonate is covered by a coating comprising a cationic polymer, preferably at least 20 % of the accessible surface area, more preferably at least 30 %, even more preferably at least 40 % and most preferably at least 50 % of the accessible surface area.

7. The process according to any one of claims 1 to 6, wherein the at least one phyllosilicate is bentonite, preferably bentonite comprising clay minerals selected from montmorillonites and concomitant minerals selected from the group comprising quartz, mica, kaolinite, feldspar, pyrite, calcite, cristobalite and mixtures thereof.

8. The process according to any one of claims 1 to 7, wherein contacting step d) is carried out by adding the at least one phyllosilicate of step c) to the water and/or sludge and/or sediment of step a) before and/or during and/or after adding the at least one surface-treated calcium carbonate of step b) to the water and/or sludge and/or sediment of step a).

9. The process according to any one of claims 1 to 8, wherein contacting step d) is carried out by adding a mixture comprising the at least one surface-treated calcium carbonate of step b) and the at least one phyllosilicate of step c) to the water and/or sludge and/or sediment of step a).

10. The process according to any one of claims 1 to 9, wherein contacting step d) is carried out by adding the at least one surface-treated calcium carbonate of step b) and the at least one phyllosilicate of step c) to the water and/or sludge and/or sediment of step a) in a weight ratio of the at least one surface-treated calcium carbonate : the at least one phyllosilicate from 10:1 to 1:10, more preferably from 5:1 to 1:5 and even more preferably from 2:1 to 1:2.

11. The process according to any one of claims 1 to 10, wherein contacting step d) is carried out by at least partially covering the surface of the water and/or sludge and/or sediment to be treated of step a) with the at least one surface-treated calcium carbonate of step b) and the at least one phyllosilicate of step c) and/or mixing the water and/or sludge and/or sediment to be treated of step a) with the at least one surface-treated calcium carbonate of step b) and the at least one phyllosilicate of step c).

12. Use of a combination of a phyllosilicate and a surface-treated calcium carbonate for water purification and/or dewatering of sludges and/or sediments, wherein at least 1 % of the accessible surface area of the calcium carbonate is covered by a coating comprising at least one cationic polymer.

13. Use of a combination of a phyllosilicate and a surface-treated calcium carbonate for reducing the amount of polymeric flocculation aids in water and/or

sludges and/or sediments, wherein at least 1 % of the accessible surface area of the calcium carbonate is covered by a coating comprising at least one cationic polymer.

14. The use according to any one of claims 12 or 13, wherein the surface-treated calcium carbonate comprises ground calcium carbonate and/or precipitated calcium carbonate and/or surface-modified calcium carbonate, preferably surface-modified calcium carbonate or ground calcium carbonate.

15. The use according to any one of claims 12 to 14, wherein the coating of the surface-treated calcium carbonate comprises at least one cationic polymer

a) having a positive charge density in the range of 1 mEq/g and 15 mEq/g, more preferably in the range of 2.5 mEq/g and 12.5 mEq/g and most preferably in the range of 5 mEq/g and 10 mEq/g,
and/or

b) in which at least 60 % of the monomer units have a cationic charge, preferably at least 70 %, more preferably at least 80 %, even more preferably at least 90 % and most preferably equal to 100 %,
and/or

c) having a weight average molecular weight M_w of below 1,000,000 g/mole, more preferably from 50,000 to 750,000 g/mole, even more preferably from 50,000 to 650,000 g/mole and most preferably from 100,000 to 300,000 g/mole,
and/or

d) being a homopolymer based on monomer units selected from the group consisting of diallyldialkyl ammonium salts; tertiary and quaternized amines; quaternized imines; acrylamide; methacrylamide; N,N-dimethyl acrylamide; acrylic acid; methacrylic acid; vinylsulfonic acid; vinyl pyrrolidone; hydroxyl

ethyl acrylate; styrene; methyl methacrylate and vinyl acetate, preferably diallyldialkyl ammonium salts and acrylic acid,

or

e) being a copolymer based on monomer units selected from diallyldialkyl ammonium salts and methacrylic acid and comonomer units selected from the group consisting of acrylamide; methacrylamide; N,N-dimethyl acrylamide; acrylic acid; methacrylic acid; vinylsulfonic acid; vinyl pyrrolidone; hydroxyl ethyl acrylate; styrene; methyl methacrylate; vinyl acetate and mixtures thereof, preferably the monomer units are selected from diallyldialkyl ammonium salts and methacrylic acid and comonomer units selected from acrylamide and acrylic acid.

16. The use according to any one of claims 12 to 15, wherein at least 10 % of the accessible surface area of the calcium carbonate is covered by a coating comprising a cationic polymer, preferably at least 20 % of the accessible surface area, more preferably at least 30 %, even more preferably at least 40 % and most preferably at least 50 % of the accessible surface area.

17. The use according to any one of claims 12 to 16, wherein the phyllosilicate is bentonite, preferably bentonite comprising clay minerals selected from montmorillonites and concomitant minerals selected from the group comprising quartz, mica, kaolinite, feldspar, pyrite, calcite, cristobalite and mixtures thereof.

18. The use according to any one of claims 12 to 17, wherein the weight ratio of the surface-treated calcium carbonate : the phyllosilicate is from 10:1 to 1:10, more preferably from 5:1 to 1:5 and even more preferably from 2:1 to 1:2.

19. A composite material comprising at least one surface-treated calcium carbonate, at least one phyllosilicate and impurities obtainable by the process according to any one of claims 1 to 11.

Claims

1. A process for the purification of water and/or dewatering of sludges and/or sediments, comprising the following steps of:

a) providing water to be purified and/or sludge and/or sediment to be dewatered comprising impurities;

b) providing at least one surface-treated calcium carbonate, wherein at least 1 % of the accessible surface area of the calcium carbonate is covered by a coating comprising at least one cationic polymer, wherein the at least one cationic polymer is present in the coating in an amount of 0.2 wt.-% to 10 wt.-%, based on the dry weight of the calcium carbonate,

c) providing at least one phyllosilicate, wherein the phyllosilicate is bentonite with a montmorillonites content of at least 50.0 wt.-%, based on the total weight of the bentonite, and

d) contacting the water and/or sludge and/or sediment of step a) with the at least one surface-treated calcium carbonate of step b) and the at least one phyllosilicate of step c) for obtaining and removing a composite material comprising the at least one surface-treated calcium carbonate, the at least one phyllosilicate and impurities, wherein contacting step d) is carried out by adding the at least one phyllosilicate of step c) to the water and/or sludge and/or sediment of step a) before adding the at least one surface-treated calcium carbonate of step b) to the water and/or sludge and/or sediment of step a) and/or by adding a mixture comprising the at least one surface-treated calcium carbonate of step b) and the at least one phyllosilicate of step c) to the water and/or sludge and/or sediment of step a).

2. The process according to claim 1, wherein the water and/or sludge and/or sediment of step a) is selected from industrial waste water, drinking water, urban waste water, sludge such as harbour sludge, river sludge, coastal sludge or digested sludge, waste water or process water from breweries or other beverage industries, waste water or process water in the paper industry, colour-, paints-, or coatings industry, agricultural waste water, slaughterhouse waste water, leather industry waste water and leather tanning industry.

3. The process according to claims 1 or 2, wherein the at least one surface-treated calcium carbonate of step b) comprises ground calcium carbonate and/or precipitated calcium carbonate and/or surface-modified calcium carbonate, preferably surface-modified calcium carbonate or ground calcium carbonate.

4. The process according to any one of claims 1 to 3, wherein the source of ground calcium carbonate (GCC) is selected from marble, chalk, calcite, dolomite, limestone and mixtures thereof and/or the precipitated calcium carbonate (PCC) is selected from one or more of the aragonitic, vateritic and calcitic mineralogical crystal forms.

5. The process according to any one of claims 1 to 4, wherein the coating of the at least one surface-treated calcium carbonate comprises at least one cationic polymer

a) having a positive charge density in the range of 1 mEq/g and 15 mEq/g, more preferably in the range of 2.5 mEq/g and 12.5 mEq/g and most preferably in the range of 5 μEq/g and 10 mEq/g,
and/or

b) in which at least 60 % of the monomer units have a cationic charge, preferably at least 70 %, more preferably at least 80 %, even more preferably at least 90 % and most preferably equal to 100 %,
and/or

c) having a weight average molecular weight M_w of below 1,000,000 g/mole, more preferably from 50,000 to 750,000 g/mole, even more preferably from 50,000 to 650,000 g/mole and most preferably from 100,000 to 300,000 g/mole,

and/or

d) being a homopolymer based on monomer units selected from the group consisting of diallyldialkyl ammonium salts; tertiary and quaternized amines; quaternized imines; acrylamide; methacrylamide; N,N-dimethyl acrylamide; acrylic acid; methacrylic acid; vinylsulfonic acid; vinyl pyrrolidone; hydroxyl ethyl acrylate; styrene; methyl methacrylate and vinyl acetate, preferably diallyldialkyl ammonium salts and acrylic acid,

or

e) being a copolymer based on monomer units selected from diallyldialkyl ammonium salts and methacrylic acid and comonomer units selected from the group consisting of acrylamide; methacrylamide; N,N-dimethyl acrylamide; acrylic acid; methacrylic acid; vinylsulfonic acid; vinyl pyrrolidone; hydroxyl ethyl acrylate; styrene; methyl methacrylate; vinyl acetate and mixtures thereof, preferably the monomer units are selected from diallyldialkyl ammonium salts and methacrylic acid and comonomer units selected from acrylamide and acrylic acid.

6. The process according to any one of claims 1 to 5, wherein at least 10 % of the accessible surface area of the calcium carbonate is covered by a coating comprising a cationic polymer, preferably at least 20 % of the accessible surface area, more preferably at least 30 %, even more preferably at least 40 % and most preferably at least 50 % of the accessible surface area.

7. The process according to any one of claims 1 to 6, wherein the bentonite comprises concomitant minerals selected from the group comprising quartz, mica, kaolinite, feldspar, pyrite, calcite, cristobalite and mixtures thereof.

8. The process according to any one of claims 1 to 7, wherein contacting step d) is carried out by adding the at least one surface-treated calcium carbonate of step b) and the at least one phyllosilicate of step c) to the water and/or sludge and/or sediment of step a) in a weight ratio of the at least one surface-treated calcium carbonate : the at least one phyllosilicate from 10:1 to 1:10, more preferably from 5:1 to 1:5 and even more preferably from 2:1 to 1:2.

9. The process according to any one of claims 1 to 8, wherein contacting step d) is carried out by at least partially covering the surface of the water and/or sludge and/or sediment to be treated of step a) with the at least one surface-treated calcium carbonate of step b) and the at least one phyllosilicate of step c) and/or mixing the water and/or sludge and/or sediment to be treated of step a) with the at least one surface-treated calcium carbonate of step b) and the at least one phyllosilicate of step c).

10. Use of a combination of a phyllosilicate and a surface-treated calcium carbonate for water purification and/or dewatering of sludges and/or sediments, wherein at least 1 % of the accessible surface area of the calcium carbonate is covered by a coating comprising at least one cationic polymer, wherein the at least one cationic polymer is present in the coating in an amount of 0.2 wt.-% to 10 wt.-%, based on the dry weight of the calcium carbonate, wherein the phyllosilicate is bentonite with a montmorillonites content of at least 50.0 wt.-%, based on the total weight of the bentonite.

11. Use of a combination of a phyllosilicate and a surface-treated calcium carbonate for reducing the amount of polymeric flocculation aids in water and/or sludges and/or sediments, wherein at least 1 % of the accessible surface area of the calcium carbonate is covered by a coating comprising at least one cationic polymer, wherein the at least one cationic polymer is present in the coating in an amount of

0.2 wt.-% to 10 wt.-%, based on the dry weight of the calcium carbonate, wherein the phyllosilicate is bentonite with a montmorillonites content of at least 50.0 wt.-%, based on the total weight of the bentonite.

12. The use according to any one of claims 10 or 11, wherein the surface-treated calcium carbonate comprises ground calcium carbonate and/or precipitated calcium carbonate and/or surface-modified calcium carbonate, preferably surface-modified calcium carbonate or ground calcium carbonate.

13. The use according to any one of claims 10 to 12, wherein the coating of the surface-treated calcium carbonate comprises at least one cationic polymer

a) having a positive charge density in the range of 1 mEq/g and 15 mEq/g, more preferably in the range of 2.5 mEq/g and 12.5 mEq/g and most preferably in the range of 5 mEq/g and 10 mEq/g,

and/or

b) in which at least 60 % of the monomer units have a cationic charge, preferably at least 70 %, more preferably at least 80 %, even more preferably at least 90 % and most preferably equal to 100 %,

and/or

c) having a weight average molecular weight M_w of below 1,000,000 g/mole, more preferably from 50,000 to 750,000 g/mole, even more preferably from 50,000 to 650,000 g/mole and most preferably from 100,000 to 300,000 g/mole,

and/or

d) being a homopolymer based on monomer units selected from the group consisting of diallyldialkyl ammonium salts; tertiary and quaternized amines; quaternized imines; acrylamide; methacrylamide; N,N-dimethyl acrylamide; acrylic acid; methacrylic acid; vinylsulfonic acid; vinyl pyrrolidone; hydroxyl ethyl acrylate; styrene; methyl methacrylate and vinyl acetate, preferably diallyldialkyl ammonium salts and acrylic acid,

or

e) being a copolymer based on monomer units selected from diallyldialkyl ammonium salts and methacrylic acid and comonomer units selected from the group consisting of acrylamide; methacrylamide; N,N-dimethyl acrylamide; acrylic acid; methacrylic acid; vinylsulfonic acid; vinyl pyrrolidone; hydroxyl ethyl acrylate; styrene; methyl methacrylate; vinyl acetate and mixtures thereof, preferably the monomer units are selected from diallyldialkyl ammonium salts and methacrylic acid and comonomer units selected from acrylamide and acrylic acid.

14. The use according to any one of claims 10 to 13, wherein at least 10 % of the accessible surface area of the calcium carbonate is covered by a coating comprising a cationic polymer, preferably at least 20 % of the accessible surface area, more preferably at least 30 %, even more preferably at least 40 % and most preferably at least 50 % of the accessible surface area.

15. The use according to any one of claims 10 to 14, wherein the bentonite comprises concomitant minerals selected from the group comprising quartz, mica, kaolinite, feldspar, pyrite, calcite, cristobalite and mixtures thereof.

16. The use according to any one of claims 10 to 15, wherein the weight ratio of the surface-treated calcium carbonate : the phyllosilicate is from 10:1 to 1:10, more preferably from 5:1 to 1:5 and even more preferably from 2:1 to 1:2.

17. A composite material comprising at least one surface-treated calcium carbonate, at least one phyllosilicate and impurities obtainable by the process according to any one of claims 1 to 9.