CLAIMS

What is claimed is:

1. A well treatment composite comprising a well treatment agent and calcined porous metal oxide wherein the porosity and permeability of the calcined porous metal oxide is such that the well treatment agent is adsorbed into the interstitial spaces of the porous metal oxide and further wherein:

(a) the surface area of the calcined porous metal oxide is between from about 1 m^2/g to about 10 m^2/g;

(b) the diameter of the calcined porous metal oxide is between from about 0.1 to about 3 mm; and

(c) the pore volume of the calcined porous metal oxide is between from about 0.01 to about 0.10 g/cc.

2. The well treatment composite of claim 1 which contains between from about 1 to about 50 weight percent of the well treatment agent.

3. The well treatment composite of claim 1, wherein the adsorbent further contains silica.

4. The well treatment composite of claim 1, wherein the well treatment agent is selected from the group consisting of scale inhibitors, corrosion inhibitors, paraffin inhibitors, salt inhibitors, gas hydrate inhibitors, asphaltene inhibitors, oxygen scavengers, biocides, foaming agent, emulsion breakers and surfactants and mixtures thereof.

5. The well treatment composite of claim 1, wherein the calcined porous alumina is alpha/delta theta alumina or alpha alumina.

6. A well treatment composite for introduction into a subterranean formation, the well treatment composite comprising a well treatment agent and calcined porous metal oxide wherein the porosity and permeability of the calcined porous alumina is such that the well treatment agent is absorbed into the interstitial spaces of the porous alumina and further wherein the well treatment agent is capable of being desorbed at a generally constant rate over an extended period of time in the formation fluid contained in the subterranean formation.

7. The well treatment composite of claim 6, wherein the alumina has been calcined at temperatures greater than or equal to 1200° C.

8. The well treatment composite of claim 7, wherein the alumina has been calcined at temperatures greater than or equal to 1400° C.

9. The well treatment composite of claim 6, wherein the porous metal oxide is alumina.

10. The well treatment composite of claim 6, wherein the well treatment agent is water soluble.

11. The well treatment composite of claim 6, wherein the well treatment agent is hydrocarbon soluble.

12. The well treatment composite of claim 6 which contains between from about 1 to about 50 weight percent of the well treatment agent.

13. The well treatment composite of claim 6, wherein the adsorbent further contains silica.

14. The well treatment composite of claim 6, wherein at least one of the following prevail:

(a) the surface area of the calcined porous metal oxide is between from about 1 m^2/g to about 10 m^2/g;

(b) the diameter of the calcined porous metal oxide is between from about 0.1 to 3 mm; and

(c) the pore volume of the calcined porous metal oxide is between from about 0.01 to about 0.10 cc/g;

(d) the bulk density of the composite is between from about 75 to about 150 lb/ft^3;

(e) the specific gravity of the well treatment composite is less than or equal to 3.75 g/cc.

15. The well treatment composite of claim 14, wherein the calcined porous metal oxide is alumina.

16. A proppant comprising the well treatment composite of claim 6, wherein no greater than 15% of the proppant is crushed at closure stresses of 10,000 psi when the composite contains 10 weight percent of well treatment agent.

17. A well treatment composition comprising the well treatment composite of claim 6 and a proppant.

18. A well treatment composition comprising the proppant of claim 17 and at least one other proppant.

19. The well treatment composition of claim 18 comprising between from about 1 to about 99% by weight of said at least one other proppant.

20. A method of treating a subterranean formation penetrated by a wellbore which comprises pumping into the wellbore a well treatment fluid comprising the composite of claim 6.

21. The method of claim 20, which comprises subjecting the formation to hydraulic fracturing by pumping the well treatment fluid into the wellbore at a pressure sufficient to initiate or enlarge a fracture.

22. The method of claim 21, further comprising introducing well treatment agent into the wellbore after at least a portion of the well treatment agent on the composite has been depleted in order to recharge or reactivate the calcined porous metal oxide of the composite.

23. A method of stimulating a subterranean formation which comprises pumping into the formation a well treatment fluid comprising the composite of claim 6.

24. A method of treating a subterranean formation which comprises introducing into the subterranean formation or a wellbore penetrating a subterranean formation the composite of claim 6 wherein the crush strength of the well treatment composite containing 10% by weight of well treatment agent at 10,000 psi is substantially the same as the crush strength of the porous metal oxide without the well treatment agent.

25. A method of inhibiting or controlling the rate of release of a well treatment agent in a subterranean formation or in a wellbore by introducing into the formation or wellbore the composite of claim 6, wherein the composite has a lifetime, from a single treatment, of at least six months.

26. A sand control method for a wellbore penetrating a subterranean formation, comprising:

introducing into the wellbore a slurry of the well treatment composite of claim 6 and a carrier fluid;

placing the composite adjacent the subterranean formation to form a fluid-permeable pack capable of reducing or substantially preventing the passage of formation particles from the subterranean formation into the wellbore while allowing passage of formation fluids from the subterranean formation into the wellbore.

27. The method of claim 26, further comprising placing a screen into the wellbore pre-packed with the well treatment composite.

Claims

1. A well treatment composite comprising a well treatment agent and calcined porous metal oxide wherein the porosity and permeability of the calcined porous metal oxide is such that the well treatment agent is adsorbed onto the calcined porous metal oxide or absorbed into the interstitial spaces of the porous metal oxide and further wherein:

   (a) the surface area of the calcined porous metal oxide is between from about 1 m^2/g to about 10 m^2/g;

   (b) the diameter of the calcined porous metal oxide is between from about 0.1 to about 3 mm; and

   (c) the pore volume of the calcined porous metal oxide is between from about 0.01 to about 0.10 cc/g.

2. The well treatment composite of claim 1, wherein the composite contains between from about 1 to about 50 weight percent of the well treatment agent.

3. The well treatment composite of claim 1, wherein the porous metal oxide constitutes an adsorbent for the well treatment agent and wherein the adsorbent further contains silica.

4. The well treatment composite of claim 1, wherein the well treatment agent is selected from the group consisting of scale inhibitors, corrosion inhibitors, paraffin inhibitors, salt inhibitors, gas hydrate inhibitors, asphaltene inhibitors, oxygen scavengers, biocides, foaming agent, emulsion breakers and surfactants and mixtures thereof.

5. The well treatment composite of claim 9, wherein the calcined porous alumina is alpha/delta theta alumina or alpha alumina.

6. A well treatment composite for introduction into a subterranean formation, the well treatment composite comprising a water soluble or hydrocarbon soluble well treatment agent and calcined porous alumina wherein the porosity and permeability of the calcined porous alumina is such that the well treatment agent is adsorbed onto the surface of the calcined porous alumina or absorbed into the interstitial spaces of the calcined porous alumina and further wherein the well treatment composite contains between from about 1 to about 50 weight percent of the well treatment agent which is capable of being desorbed at a generally constant rate over an extended period of time in the formation fluid contained in the subterranean formation.

7. The well treatment composite of claim 6, wherein the alumina has been calcined at temperatures greater than or equal to 1200^0 C.

8. The well treatment composite of claim 7, wherein the alumina has been calcined at temperatures greater than or equal to 1400^{0} C.

9. The well treatment composite of claim 1, wherein the porous metal oxide is alumina.

10. The well treatment composite of claim 1, wherein the well treatment agent is water soluble.

11. The well treatment composite of claim 1, wherein the well treatment agent is hydrocarbon soluble.

12. The well treatment composite of claim 6, wherein the calcined porous alumina constitutes an adsorbent for the well treatment agent and wherein the adsorbent further contains silica.

13. The well treatment composite of claim 6, wherein:

(d) the surface area of the calcined porous metal oxide is between from about 1 m^2/g to about 10 m^2/g;

(e) the diameter of the calcined porous metal oxide is between from about 0.1 to 3 mm;

(f) the pore volume of the calcined porous metal oxide is between from about 0.01 to about 0.10 cc/g;

(g) the bulk density of the composite is between from about 75 to about 150 lb/ft^3; and

(h) the specific gravity of the well treatment composite is less than or equal to 3.75 g/cc.

14. The well treatment composite of claim 19, wherein the calcined porous metal oxide is alumina.

15. A proppant comprising the well treatment composite of claim 1, wherein no greater than 15% of the proppant is crushed at closure stresses of 10,000 psi when the composite contains 10 weight percent of well treatment agent.

16. A well treatment composition comprising the well treatment composite of claim 6 and a proppant.

17. A well treatment composition comprising the well treatment composite of claim 1 and at least one proppant, wherein the well treatment composite contains between from about 1 to about 50 weight percent of the well treatment agent.

18. The well treatment composition of claim 17, wherein the porous metal oxide of the well treatment composite is alumina.

19. The method of claim 4, wherein the well treatment agent is a scale inhibitor, corrosion inhibitor, paraffin inhibitor, salt inhibitor, gas hydrate inhibitor, asphaltene inhibitor or mixture thereof.