CLAIMS

What is claimed is:

1. A method of treating a loss zone during drilling or running casing, the method comprising the steps of:

encountering a loss zone in a bore hole during drilling or running casing; and

pumping a thixotropic cement system into the loss zone, wherein the thixotropic cement system is a gel capable of gelling, breaking when sheared, and building back shear strength after shearing is removed;

wherein the method further comprises:

determining a rheology model of the thixotropic cement system, wherein the rheology model comprises a relationship between shear rate and viscosity during the flow regime and a relationship between gel strength and time during the quasi-static or no-flow regime, wherein the step of determining a rheology model of the thixotropic cement system comprises the steps of determining a required minimum gel strength of the thixotropic cement system and determining an amount of time needed to reach the required minimum gel strength;

determining a maximum gel strength of the thixotropic cement system;

determining an amount of time needed to reach the maximum gel strength of the thixotropic cement system;

determining a maximum pressure output of a pump;

determining a required pressure level needed to circulate the thixotropic cement system;

determining whether the thixotropic cement system can be recirculated before the maximum gel strength is reached;

determining a volume of the thixotropic cement system required to fill the loss zone; and

designing and testing the thixotropic cement system to confirm adherence to the determined rheology model.

2. The method of claim 1, wherein the thixotropic cement system is gelling, breaking when sheared, and building back shear strength after shearing is removed is repeatable.

3. The method of claim 1, wherein the minimum gel strength is a point at which the thixotropic cement system in the bore hole does not experience flow due to hydrostatic column pressure above the loss zone.

4. The method of claim 1, wherein the maximum gel strength is a point at which the thixotropic cement system cannot be recirculated in a drill string or bore hole.

5. The method of claim 1, wherein the step of determining the volume of the thixotropic cement system required to fill the loss zone comprises the steps of:

measuring a volumetric loss rate of drilling fluid in the bore hole; and

estimating a fracture geometry and dimensions of the loss zone.

6. The method of claim 1, further comprising the step of determining whether the thixotropic cement system may be pumped through a bottom hole assembly of a drilling rig before pumping the thixotropic cement system into the loss zone.

7. The method of claim 6, further comprising the step of determining whether tripping is possible before pumping the thixotropic cement system into the loss zone.

8. The method of claim 7, further comprising the step of estimating a tripping time before pumping the thixotropic cement system into the loss zone; and estimating an amount of time necessary to swap out a cement pump for a rig pump before pumping the thixotropic cement system into the loss zone.

9. The method of claim 8, further comprising estimating a maximum down time allowable before the thixotropic cement system reaches the maximum gel strength before pumping the thixotropic cement system into the loss zone.

10. The method of claim 9, further comprising incorporating the maximum down time allowable into the rheology model.

11. The method of claim 1, further comprising determining acid solubility of thixotropic cement system:

stopping flow of the thixotropic cement system once it has filled the loss zone; and determining whether a plug formed by the thixotropic cement system is permanent.

12. The method of claim 11, further comprising the steps of: stopping drilling operations after the step of encountering the loss zone, and resuming drilling operations and pumping the thixotropic cement system; and

dissolving the thixotropic cement system with acid.

13. A method of treating loss zones with a thixotropic cement system during drilling or running casing, the method comprising the steps of:

pumping thixotropic cement system into a loss zone through a bore hole;

stopping pumping of the thixotropic cement system for a period of time to allow the thixotropic cement system to set in the loss zone; and

treating the thixotropic cement system with an acid in order to dissolve at least a portion of the thixotropic cement system.

14. A method of treating loss zones in a bore hole during drilling or running casing with a thixotropic cement system, the method comprising the steps of:

drilling until encountering a loss zone;

measuring a volumetric loss rate of the drilling fluid in the bore hole;

estimating a fracture geometry and dimensions of the loss zone;

measuring a depth of the loss zone;

measuring an annular fluid density;

estimating an annular hydrostatic pressure above the loss zone;

estimating a minimum gel strength of a thixotropic cement system using a rheology model, wherein the rheology model comprises a relationship between shear rate and viscosity during the flow regime and a relationship between gel strength and time during the

quasi-static or no-flow regime, wherein the minimum gel strength is the point at which the thixotropic cement system in the bore hole does not experience flow due to hydrostatic column pressure above the loss zone;

estimating a thixotropic cement system column length in the loss zone;

estimating a maximum pump pressure;

estimating a maximum allowed pressure for recirculation per unit length of the thixotropic cement system column;

estimating the maximum allowed gel strength using the rheology model;

estimating a time to reach the maximum allowed gel strength using the rheology model; and pumping the thixotropic cement system to the loss zone.

15. The method of claim 14, further comprising the step of determining whether the thixotropic cement system may be pumped directly through a bottom hole assembly or if tripping is required.

16. The method of claim 15, further comprising the step of estimating the pressure for recirculation per unit length of cement.

17. The method of claim 16, further comprising the step of determining whether residual thixotropic cement system after a maximum allowable down time with attained gel strength can be circulated back out of the bore hole after treating the loss zone.

18. The method of claim 17, wherein the step of determining whether the residual thixotropic cement system with attained gel strength can be circulated back out of the bore hole after treating the loss zone comprises the steps of:

designing a thixotropic cement system system with the desired rheological behavior;

confirming the rheology readings;

performing an on-off test of the cement to confirm whether the treatment fluid will regain sufficient viscosity after circulation is stopped; and

performing acid solubility tests on the cement.

19. The method of claim 17, further comprising the steps of: determining whether the thixotropic cement system can be pumped using the rig pump;

determining a time needed to swap the rig pump and a cement pump;

estimating a tripping time;

pumping the thixotropic cement system into the loss zone;

allowing the thixotropic cement system to enter a quasi-static or no flow period; and pumping the thixotropic cement system into the loss zone.