Screenless sand control offers new opportunities

Harvey Fitzpatrick, Halliburton Energy Services

METHODS OF SAND control completions will vary significantly from area to area, reservoir to reservoir and even from well to well due to highly variable reservoir and well conditions as well as operator preference and the operator's confidence in a particular method. The increased use of screenless sand control completions in high permeability wells that are prone to sand production has caused a number of operators to re-think their completion strategy and opened some new opportunities through more effective screenless sand control options.

Presently, most frac pack treatments are performed using screens to provide mechanical support to the proppant pack to prevent flow back during production. This configuration is a carry over from more conventional gravel pack treatments for sand control. Pack stability provided by the screen is a necessary part of the completion to help ensure the long-term productivity of the well.

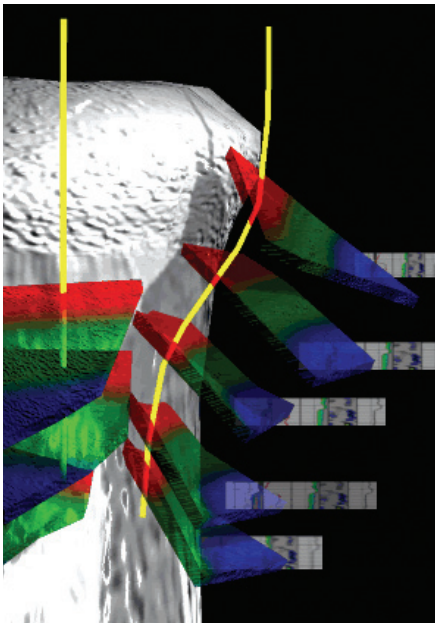
Many operators, however, agree that significant benefits could be realized if frac pack treatments can be successful in preventing sand production without the use of screens.

They include reduced completion cost, economic production of secondary more marginal reservoirs, reduced drilling and well construction costs through the use of slimhole drilling, and maintaining full wellbore access for workovers or recompletions.

In reviewing the potential for screenless treatments to control sand production, some potential advantages and disadvantages have been summarized as follows:

Potential Advantages:

- Reduced rig time for completion operations;
- More rig-less capabilities for completing and re-completing wells;
- Full wellbore access can be maintained;
- Completions are more workover/recompletion friendly;
- Minimize loss of completion fluids into the formation;
- Improved flexibility for job scheduling and planning;
- More accessibility to the reserves in by-passed reservoirs;
- Potential to reduce drilling and well construction costs by utilizing slim hole completions;
- Lower overall cost compared to conventional sand control completions;
- Completions can be compatible with coiled tubing or snubbing operations.



Screenless sand control helps allow better wellbore access than screen based completions. Multiple completions or recompletion of stacked pay zones can be facilitated by open wellbore access.

Potential Disadvantages:

- Higher risk of completion failure resulting in sand production;
- Risk is dependent upon workover cost, rig availability and cost of lost production;
- Difficult to apply to long production intervals and highly deviated wells;
- Remedial treatments using HF acid may weaken the consolidated proppant pack and the formation matrix resulting in a premature failure and sand production;
- Any open or untreated perforations represent a weak point in the completion meaning that special consideration must be given to treating every single perforation.

SCREENLESS SAND CONTROL

A screenless sand control method can overcome risks posed by wellbore restrictions, both during treatment application and production. Resin consolidation completions are also relatively low-cost and simple to perform, and, in many cases, can be installed with a coiled tubing unit, eliminating the need for a workover rig.

More importantly, coating formation sand and fines with resin not only helps immobilize formation materials, it can also dramatically increase the mechanical strength of the formation, making the formation much less susceptible to stress-induced failure. This can create a more stable wellbore that allows sand-free production for longer periods of time.

Successfully controlling sand production with curable resin methods requires that the consolidation fluid is placed uniformly throughout the entire production interval. This task is made more difficult, especially in formations with layers exhibiting variable permeability, because resins generally have much higher viscosities than other fluids typically injected into the wellbore. The longer the producing interval the more difficult it is to ensure that all parts of the reservoir are fully treated.

Lower viscosity resin systems designed to improve the certainty of reaching the extremities of the reservoir have used external catalysts to initiate hardening of the consolidation fluid, raising the additional issue of helping ensure the catalyst reaches all parts of the reservoir coated by resin.

FORMATION STABILIZATION

Halliburton has developed a new near well-bore sand consolidation system that can enable producers to take advantage of the economics of through-tubing capabilities while offering significant improvements over older sand consolidation systems.

The heart of the system is a low-viscosity, internally-catalyzed epoxy resin consolidating fluid that can penetrate deeper into the reservoir than conventional resins, even into layers with variable

permeability. The consolidation fluid's properties cause it to be attracted to formation grains, which can allow it to coat the grains uniformly with a thin film of treatment. In lab tests, field trials and initial commercial applications, this service demonstrated the ability to reliably consolidate sands with significant clay content while achieving high returned permeability and providing more resistance to stress-induced failure.

A treatment begins with a brine preflush followed by a mutual solvent preflush, both of which help prepare the formation for the consolidation treatment and improve the retention of reservoir permeability. Next, the consolidation fluid is pumped into the reservoir where it penetrates into rock pore spaces and coats the grain surfaces.

Finally, a brine post-flush fluid is pumped to help ensure the formation permeability is not reduced by displacing the consolidation fluid from the pores and leaving a thin film on formation grains but retaining a concentration at the grain-to-grain contact points. As a result, high consolidation strength can be attained more uniformly across more of the pay interval without significant loss of reservoir permeability.

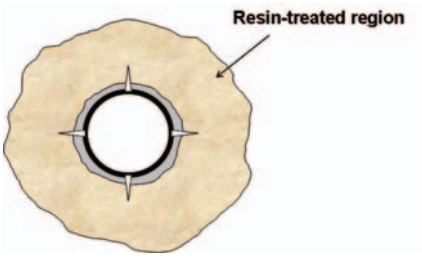
Because the treatment can be placed either with jointed tubing and a service packer, with coiled tubing, or through production tubulars, the sand consolidation system can be applied to new wells, to recomplete existing sand producing intervals, or to complete previously untapped pay zones in existing wells. That means the operator can have access to new reserves without the expense of a rig-based workover.

The ability of the system to strengthen near-wellbore areas by bonding together formation materials that otherwise could be produced, coupled with its ease of handling and flexibility of placement, makes it an excellent choice for problem zones such as formations that begin producing sand after an initial period of sand-free production, or for initiating production from intervals behind pipe.

STABILIZE-AND-FRAC METHOD

Experience shows that pay zones with low permeability or highly variable permeability contrasts are not good candidates for sand control using near-wellbore stabilization.

That holds true for zones that have



Near-wellbore consolidation stabilizes the formation to help prevent sand and fines production. Testing with reservoir core material shows that the consolidated region can maintain more than 85% of its original permeability.

become severely destabilized near the wellbore as a result of pretreatment sand production or drilling practices not appropriate for sand control completions. Severe near-wellbore damage can hamper placement of treatment fluids and cause poor post-treatment production rates, while plugged perforations are capable of accepting only limited consolidation treatment material, resulting in a weakly stabilized near-wellbore formation.

Halliburton has addressed these issues by developing a stabilization and fracture stimulation service that combines the near well bore stabilization service with a tip screen-out screenless frac pack treatment incorporating a liquid resin system (LRS) proppant coating service.

In the process, the near-welbore stabilization service brine preflush, mutual solvent preflush, and consolidation fluid are pumped into the targeted formation just as in the sand consolidation method. Then, instead of pumping the consolidation service brine post-flush fluid into the interval, the zone is frac packed using proppant coated via the LRS proppant coating service. This adheres the proppant gains together, forming a stable pack in the fracture and propping open the relatively short, wide fracture created by the tip screen-out frac pack treatment.

In addition, the sand consolidation service strengthens the near-wellbore area and helps ensure that sand and fines are bonded together and stay in place. The tip screen-out frac pack enhanced with LRS coating helps achieve good conductivity between the formation and wellbore and adheres grains of proppant to one another to form a stable, durable proppant bed. The end result can be high production rates from formations that producers, in many instances, considered too costly, too complex, or too marginal to justify development and completion.

RIGLESS COMPLETIONS

Recent technological advancements in coiled tubing-deployed sand control completions can help provide operators additional, relatively low cost production quickly.

Many operators are taking advantage of new through-tubing completion techniques for sand control that replace comparable rig-based functions. The reduced costs of coiled tubing operations makes it possible to economically produce marginal pays in existing wells that otherwise would not be recovered.

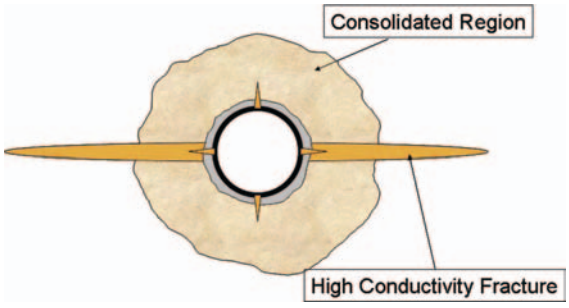
Using coiled tubing during the completion phase of new wells and recompletion or workover procedures on existing wells simplifies rig scheduling and carries a lower daily rate for offshore operations. A service package that includes slickline, logging, coiled tubing, and sand control services can provide all the capabilities needed for a rig-less sand control completion. Equipment and operations can be based on an existing platform, or a lift boat can serve as a work platform when extra space is required.

Completions on wells with multiple pay zones can be configured to take advantage of rig-less intervention at a later date. Ten or more recompletions can be performed on a single well without requiring a rig. The technique involves plugging off the existing depleted zone, perforating the new interval, and performing the screenless sand control treatment.

CASE HISTORIES

An application of the sand consolidation service in about 4 ft of gas pay in a notorious sand-producing formation in the Gulf of Mexico enabled a producer to recover incremental reserves worth more than 10 times the cost of the sand consolidation service, netting a profit of 2-3 times the total cost of the completion. By the time one-third of the incremental reserves had been produced, the well had already begun producing water from the reservoir. Typically, in this area a flowing connate water phase would have caused the well to begin producing sand when it came into contact with the pay zone. Therefore, it is reasonable to assume that only one-third the volume of incremental reserves would have been recovered if not for the near-wellbore sand consolidation service.

In California, an operator began producing sand from open-hole pays in two wells after tip screen-out frac pack completions in an area that had routinely utilized screenless frac packs with success. In response to the customer's challenge, Halliburton used the near-wellbore consolidation service to stabilize the exposed open holes in both wells near wellbore, then stimulated the reservoir following the consolidation treatment with a tip screen-out frac pack using LSR service coated proppant. Both wells treated using this procedure produced sand-free at unrestricted production rates. An additional ten wells in the field were subsequently treated with the near-wellbore consolidate and frac service.



Near-wellbore consolidation and frac stimulation helps stabilize the formation at the wellbore to minimize sand and fines movement. A tip screen-out frac stimulation using the LSR system proppant coating improves connectivity of the wellbore to the reservoir for improved productivity. The LSR proppant coating stabilizes the proppant bed to prevent proppant movement and reduce loss of conductivity by fines plugging.

The average monthly production of these wells increased 28% while the average frequency of workovers caused by sand production was reduced by a factor of more than 20.

The application demonstrated that a combination of near-wellbore stabilization and fracture simulation can achieve and maintain economic production rates and eliminate sand production in an area where either method alone failed in similar wells. ■