

Analysis of the effectiveness of chemical sand consolidation for sand production control in the "DNA" well

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Article Info

Article history:

Received Jun 12th, 2026

Revised Aug 20th, 2026

Accepted Aug 26th, 2026

Keyword:

chemical sand consolidation;
furan resin; permanent coiled
tubing gas lift; sand control;
unconsolidated sandstone.

ABSTRACT

This study evaluated the technical effectiveness of chemical sand consolidation (SCON) using furan resin for controlling sand production in the "DNA" Well, Mutiara Field, East Kalimantan. The well produces from an unconsolidated sandstone reservoir with a porosity of 30% and a permeability of 1050 mD and is operated using a Permanent Coiled Tubing Gas Lift system. Secondary data comprising reservoir properties, wireline logs, treatment records, daily production rates, choke settings, operating hours, and sand-monitoring records were analyzed over comparable periods before and after treatment. Effectiveness was evaluated based on changes in detected sand production, oil and gas rates, choke opening, operating hours, and production stability. Following SCON treatment, no detectable sand production was recorded during the [duration]-day monitoring period. The oil rate changed from [before] BOPD to 200–360 BOPD, the choke opening increased from [before] to [after], and operating time increased from [before] to 24 hours per day. These results indicate that furan-resin SCON improved operational stability under the evaluated well conditions. However, the absence of direct measurements of formation strength and post-treatment permeability limits conclusions regarding the treatment's geomechanical effects

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INTRODUCTION

Sand production is a common problem in oil and gas wells completed in weakly consolidated or unconsolidated sandstone formations. It occurs when the forces generated by reservoir depletion and fluid flow exceed the mechanical strength of the formation, causing sand grains to detach and migrate toward the wellbore. If it is not adequately controlled, produced sand may erode downhole and surface equipment, accumulate in the wellbore and flowlines, restrict fluid flow, increase well-maintenance frequency, and reduce production continuity (Alakbari et al., 2020; Deng et al., 2022).

One of the widely applied chemical methods for controlling sand production is Chemical Sand Consolidation (SCON). This method involves injecting a resin-based consolidating agent into the near-wellbore formation to strengthen the contact between individual sand grains. During the curing process, the resin forms grain-to-grain bonds that increase formation cohesion and mechanical stability while maintaining interconnected pore spaces for hydrocarbon flow. Compared with mechanical sand-control methods, such as sand screens and gravel packs, SCON offers several operational advantages under certain well conditions. It does not require the installation of additional downhole equipment, involves relatively limited modification of the existing completion system, and may be applied selectively to the sand-producing interval. When the resin concentration, injection volume, placement technique, and curing conditions are properly designed, the treatment can control sand migration without causing excessive reduction in formation permeability (Hadi et al., 2019).

Nevertheless, the success of SCON depends strongly on reservoir and operational characteristics, including formation mineralogy, grain-size distribution, clay content, porosity, permeability, reservoir temperature, fluid saturation, and the compatibility of the resin with formation fluids. Improper chemical placement or excessive resin concentration may block pore throats, reduce injectivity, and impair well productivity. Conversely, incomplete resin placement may produce insufficient bonding and allow sand production to recur. Abidiy et al. (2022) reported that a properly designed SCON treatment successfully improved formation strength and eliminated observable sand production, demonstrating its potential as an alternative to conventional mechanical sand-control

systems. However, most previous studies have focused on conventional well-completion and production systems. Evidence regarding the application of SCON in wells operated using a Permanent Coiled Tubing Gas Lift (PCTGL) system remains limited. In such wells, treatment performance must be evaluated not only from the reduction in sand production but also from changes in choke opening, gas-lift injection rate, wellhead pressure, production rate, operating hours, and overall production stability. Therefore, an integrated evaluation of reservoir characteristics, SCON operational parameters, and production performance before and after treatment is required to determine the technical suitability and effectiveness of SCON in PCTGL-operated wells.

The "DNA" Well, located in the Mutiara Field operated by PT Pertamina Hulu Sanga Sanga, is completed in an unconsolidated sandstone reservoir with a porosity of 30%, a permeability of 1050 mD, and a PCTGL production system. Before treatment, the well experienced sand production that restricted the choke opening and resulted in unstable production performance. Consequently, Chemical Sand Consolidation using furan resin was selected as the most appropriate sand control method based on the reservoir characteristics.

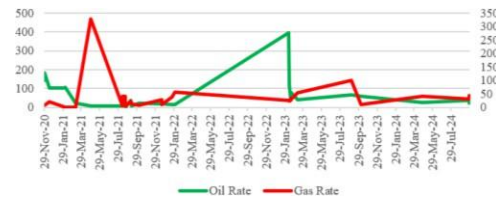
This study aims to analyze the suitability of Chemical Sand Consolidation for the reservoir characteristics and to evaluate its effectiveness in controlling sand production in the "DNA" Well. The novelty of this research lies in evaluating the application of SCON by integrating reservoir characteristics, the PCTGL production system, and production performance before and after treatment, providing a technical reference for selecting appropriate sand control methods in reservoirs with similar conditions.

RESEARCH METHODS

1. **Research Design.** This study employed a descriptive quantitative approach using a case study to evaluate the effectiveness of the Chemical Sand Consolidation (SCON) method in controlling sand production in the "DNA" Well. The evaluation was conducted by comparing the well conditions before and after the treatment based on reservoir characteristics, production performance, and SCON operational results.
2. **Research Subject and Object.** The object of this study was the "DNA" Well located in the Mutiara Field, operated by PT Pertamina Hulu Sanga Sanga, East Kalimantan. The well is completed in an unconsolidated sandstone reservoir with a porosity of 30%, a permeability of 1050 mD, a reservoir temperature of 137°F, and a Permanent Coiled Tubing Gas Lift (PCTGL) production system, making it highly susceptible to sand production.
3. **Data Collection Technique.** This study used secondary data obtained from PT Pertamina Hulu Sanga Sanga, including reservoir characteristics, wireline logging data, production data before and after treatment, Chemical Sand Consolidation operational data, and well operation reports.
4. **Research Instruments.** Data processing and analysis were carried out using Microsoft Excel and Microsoft Word, supported by scientific literature, including journal articles, books, industry standards, and company technical documents related to Chemical Sand Consolidation and sand control.
5. **Data Analysis Technique.** The data analysis consisted of several stages: (1) identifying the causes of sand production based on reservoir characteristics and the production system; (2) evaluating the suitability of the Chemical Sand Consolidation method for the reservoir conditions; (3) analyzing the SCON treatment process using furan resin through the preflush, main treatment, and overflush stages; (4) comparing the well performance before and after treatment based on oil rate, gas rate, running hours, choke opening, and sand production; and (5) interpreting the results to evaluate the effectiveness of Chemical Sand Consolidation in improving formation stability and maintaining the production performance of the "DNA" Well.

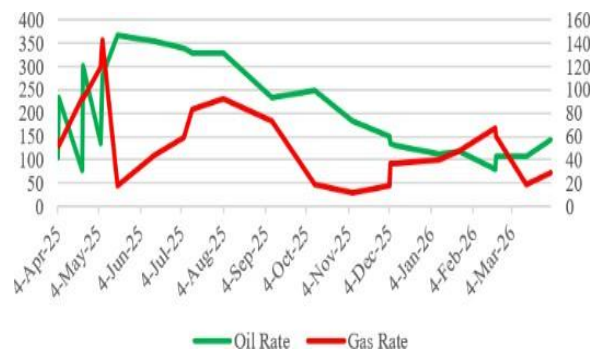
RESULTS AND DISCUSSION

The effectiveness of the Chemical Sand Consolidation method was evaluated by comparing the well production performance before and after the treatment.



Picture 1 Production Rate Before SCON

Before the treatment, sand production required the *choke* opening to be restricted, leading to reduced oil production and unstable well operating hours. This condition indicates that sand production not only threatened the integrity of production equipment but also limited the well's production performance.



Picture 2 Production Rate After SCON

Following the Chemical Sand Consolidation (SCON) treatment using furan resin, grain-to-grain bonding was successfully formed, improving formation stability and preventing sand migration into the wellbore. The evaluation results showed that the oil production rate stabilized at 200–360 BOPD, while the gas production rate ranged from 0–100 MMSCFD. In addition, the well operated continuously for 24 hours per day without any evidence of sand production, allowing the choke opening to be increased to optimize production.

The improvement in post-treatment production performance suggests that the furan-resin treatment enhanced near-wellbore formation stability by establishing grain-to-grain bonding among unconsolidated sand particles. This bonding mechanism is expected to increase the cohesion of the treated interval and reduce the detachment and migration of sand grains into the wellbore. As a result, no further sand production was detected during the post-treatment observation period, allowing the well to operate continuously for 24 hours per day. The improved formation stability also enabled the choke opening to be increased without renewed sand production. A larger choke opening reduced flow restriction and supported more continuous fluid movement from the reservoir to the surface while minimizing the potential for erosion, blockage, and damage to production equipment caused by entrained sand.

The post-treatment response indicates that SCON provided both sand-control and operational benefits. In addition to suppressing observable sand production, the treatment contributed to a more stable oil production rate of 200–360 BOPD and reduced the operational limitations previously imposed by the restricted choke opening. These findings are consistent with Hadi et al. (2019), who demonstrated that resin-based sand consolidation could stabilize unconsolidated formations while preserving sufficient flow capacity, and Abidiy et al. (2022), who reported improved formation stability and the elimination of observable sand production following chemical consolidation treatment. The consistency between the present field response and previous studies supports the technical applicability of furan-resin SCON in high-porosity and high-permeability unconsolidated sandstone reservoirs.

Nevertheless, the observed production improvement should not be attributed exclusively to the SCON treatment without considering other operational variables, particularly the gas-lift injection rate,

wellhead pressure, water production, choke setting, and surface-facility conditions. Furthermore, the field-production response does not directly demonstrate the magnitude of the increase in mechanical strength or confirm that formation permeability remained unchanged. Direct evidence would require supporting measurements, such as compressive-strength testing, core-flow experiments, pressure-transient analysis, or productivity-index comparisons before and after treatment. Therefore, the present findings should be interpreted as evidence that furan-resin SCON improved sand-control performance and production stability during the evaluated observation period rather than as direct proof of changes in the formation's mechanical and petrophysical properties.

CONCLUSION

Based on the analysis results, the Chemical Sand Consolidation (SCON) method using furan resin is suitable for application in the "DNA" Well, which is characterized by an unconsolidated sandstone reservoir with a porosity of 30%, a permeability of 1050 mD, and a Permanent Coiled Tubing Gas Lift (PCTGL) production system. The furan resin successfully formed grain-to-grain bonding, thereby improving the mechanical strength of the formation without significantly reducing its permeability. The implementation of SCON effectively controlled sand production, as evidenced by the absence of sand production after treatment, while improving production stability with an oil production rate of 200–360 BOPD, a gas production rate of 10–100 MMSCFD, and continuous well operation for 24 hours per day. Furthermore, the choke opening could be increased, resulting in improved fluid flow continuity and enhanced well production performance.

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