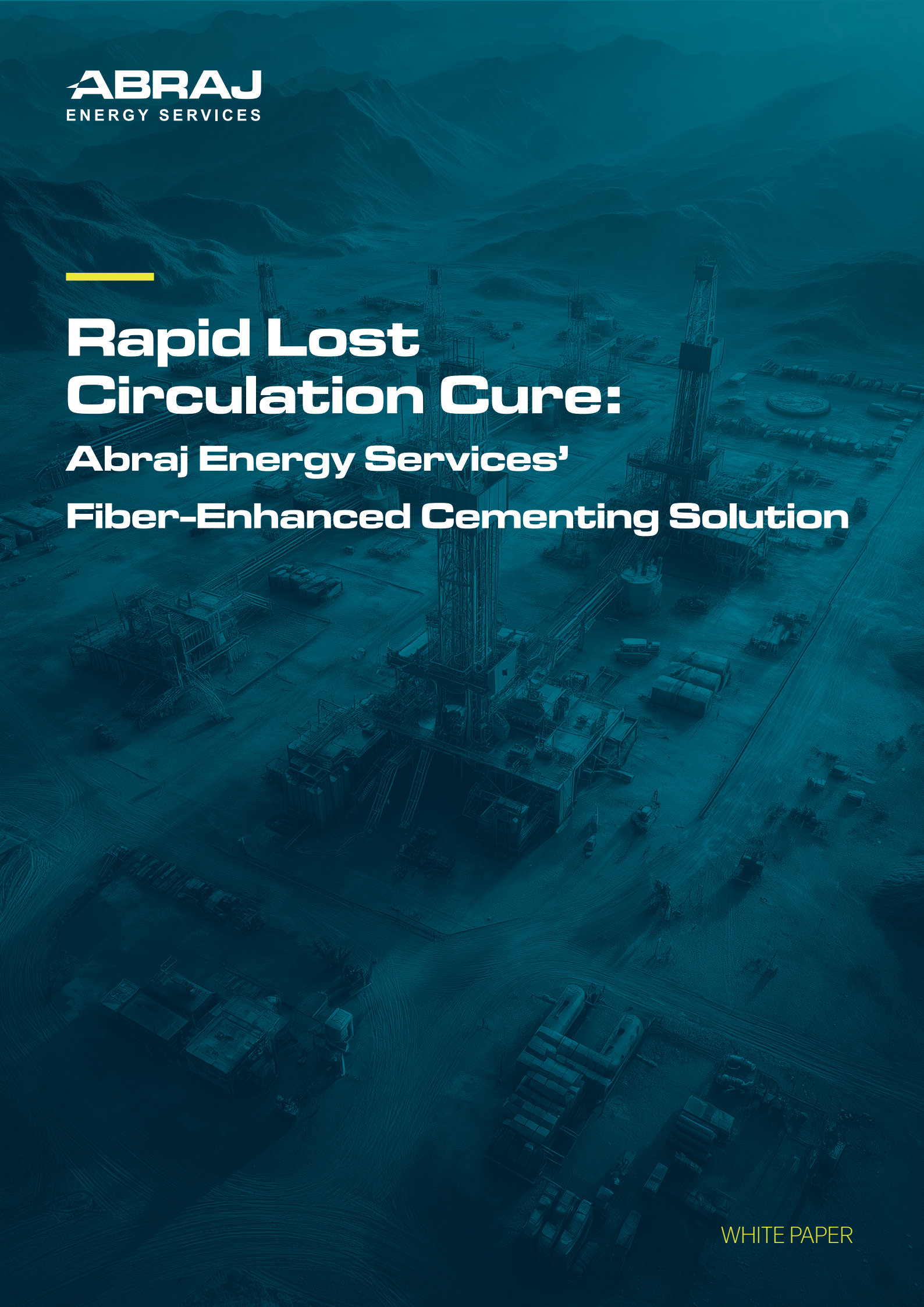
ABRAJ
ENERGY SERVICES

Rapid Lost Circulation Cure:

Abraj Energy Services' Fiber-Enhanced Cementing Solution



WHITE PAPER

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EXECUTIVE SUMMARY

Lost circulation is defined as the escape of drilling fluid into subsurface formation voids. This is a costly challenge in oil and gas exploration. Abraj Energy Services has adopted a fiber-enhanced cementing solution that quickly and permanently seals these voids, mitigating severe losses. Key features and benefits of this approach include:

Single-Trip Remedy

A specially formulated fiber-cement slurry is pumped through the bottom-hole assembly (BHA) into the loss zone, immediately bridging fractures and forming a durable plug. Circulation is typically restored within hours rather than days.

Reduced NPT and Costs

Lost circulation commonly accounts for over 10% of drilling downtime and up to 20% of total drilling costs. One study reported more than 100 hours of non-productive time (NPT) and $185,000 in added costs per well. In Oman, Abraj Energy Services' method restored circulation after a single treatment, saving 3 to 5 days (equivalent to $100,000).

Improved Well Integrity and Safety

The fiber-cement plug rapidly stabilizes the wellbore, maintaining control and supporting successful casing cementing, thereby mitigating risk and eliminating the need for costly remediation efforts.

This paper outlines the challenges associated with lost circulation, Abraj Energy Services' innovative solution, and field results demonstrating the method's operational and financial impact in Oman and other regions.

INTRODUCTION AND INDUSTRY CONTEXT

"Abraj Energy Services is evolving beyond traditional service delivery. We're becoming a trusted solutions partner, bringing innovation and performance to the forefront of every operation."

– Eng. Saif Al Hamhami, *Abraj Energy Services, CEO*

Lost circulation has long been recognized as a critical and recurring drilling challenge worldwide. It occurs when drilling fluid or cement enters underground formations instead of returning to surface. When circulation is lost, the rig continues to pump fluid, but little or none is recovered, indicating that the "drilling mud" is escaping into formation voids. This results in serious operational and financial consequences: the drilling process is disrupted, large volumes of expensive fluid may be lost, and the well can be left underbalanced, posing well control hazards.

Industry statistics highlight the severity of the issue – lost circulation is estimated to account for over 10% of drilling downtime in some areas and can contribute to 10–20% of total drilling costs under difficult conditions. In one analysis, wells averaged more than 100 hours of unplanned rig time due to lost circulation, adding at least $185,000 in extra cost per well. The business impact includes higher expenses, schedule delays, and lost production.

LIMITATIONS OF CONVENTIONAL REMEDIES

Traditional mitigation methods for lost circulation frequently fall short in severe scenarios. The first response is typically to deploy lost circulation material (LCM) pills – mixtures of fibrous, flaked, or granular materials pumped into the well to bridge fractures and plug escape points. In cases of extensive fractures, conventional LCMs often fail to completely seal the voids or require repeated applications to be effective.

Another commonly used method is to perform a cement plug job: pulling the "drill string" out of the drill assembly and injecting cement into the loss zone to seal it. This approach demands substantial rig time. Moreover, if the formation is freely taking fluid, much of the cement can disappear into the formation before solidifying, leading to plug failure and the need for additional attempts. Severe losses often require multiple interventions, with no guarantee of success. This iterative process leads to considerable operational delays and increased costs.

The urgency of solving lost circulation has intensified as the industry ventures into more complex wells. In Oman, for instance, many mature fields feature naturally fractured carbonate reservoirs and depleted formations where fluid losses are prevalent. These local challenges mirror global trends; whether in Oman's interior or the deepwater Gulf of Mexico, managing mud losses is critical to avoid NPT and maintain well control.

Industry bodies such as the International Association of Drilling Contractors (IADC) and the International Association of Oil & Gas Producers (IOGP) have issued guidelines stressing early detection and prompt response to loss events as best practice. For example, API Bulletin 92L (2015) advises that lost returns are common across regions and can be managed safely with proper planning and execution. In line with such guidelines, modern drilling programs are increasingly proactive about loss prevention, employing strategies such as pretreating mud with optimized LCM blends when entering loss-prone intervals. Other measures include reducing mud weight, adding bridging materials in advance, and continuously monitoring fluid returns. However, even with meticulous planning, some loss zones are unavoidable.

Operators require reliable contingency solutions capable of quickly sealing the formation to keep the drilling operations on schedule. This sets the stage for innovation beyond conventional approaches, which is where Abraj Energy Services' fiber-enhanced cementing solution delivers measurable values.

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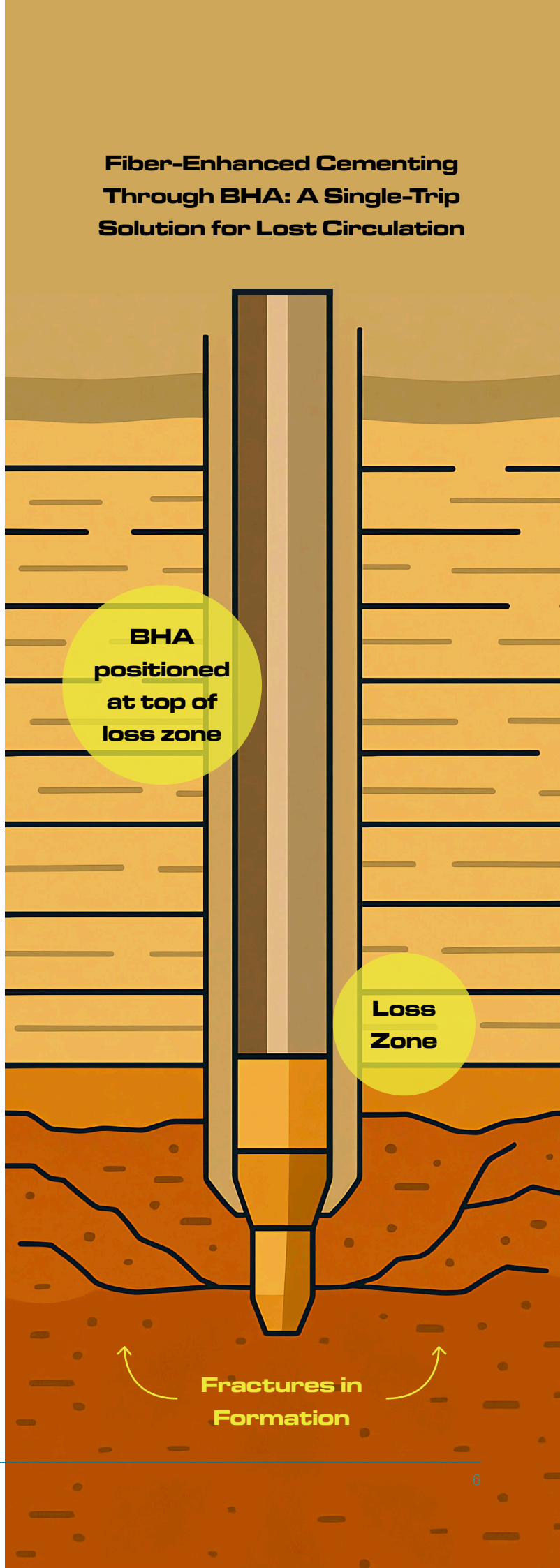
ABRAJ ENERGY SERVICES' APPROACH: FIBER-ENHANCED CEMENTING SOLUTION

Solution Overview

Abraj Energy Services has implemented a fiber-enhanced cementing system specifically engineered to address lost circulation more effectively than conventional methods. Specialized fibers are incorporated into a cement slurry and pumped into the loss zone via the drill string. By deploying the treatment through the BHA, eliminating the need for the crew to "pull out of hole" (POOH) to run a separate cement string – a significant time-saving measure, supported by prior industry research. Once placed into the formation, the fiber-laden cement slurry bridges formation openings and sets into a solid plug, permanently sealing the fractures or voids.



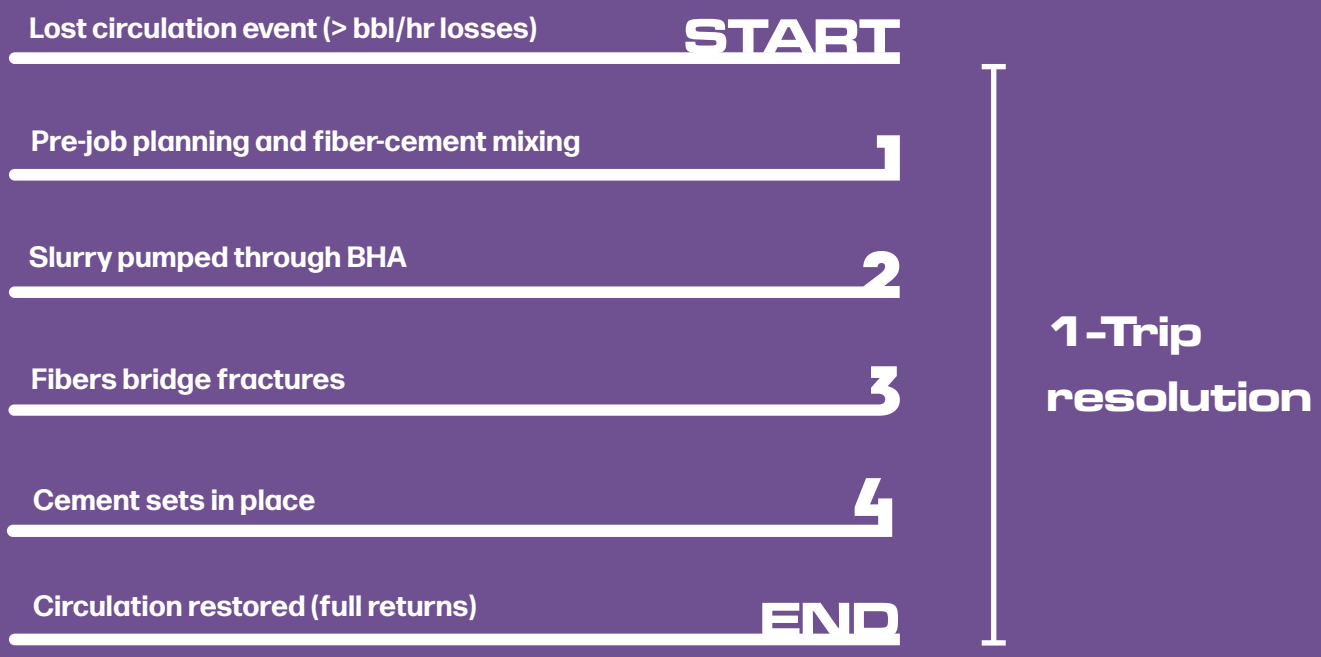
How It Works

The engineering behind the fiber-enhanced slurry is the foundation of its innovation. The fibers – typically engineered blends of synthetic polymer strands or natural fibers – are selected based on optimal size, length, and flexibility to ensure smooth passage through drill bit nozzles and BHA restrictions without clogging, while forming a reinforced mesh within the slurry once pumped into a loss zone.

"You need to find the optimum fiber concentration... If you have too much fiber, you may plug the entire well – even your surface equipment." – Abraj Energy Services' Operations Manager for Cementing Services

When the slurry flows into formation fractures, the fibers tangle and accumulate at the fracture throat, forming a fibrous network that traps cement particles. As the cement hydrates, this fiber network is encapsulated within the hardening matrix, resulting in a stronger plug. Abraj Energy Services' team refined both fiber concentration and cement formulation through laboratory testing and initial field deployment to ensure the slurry remains pumpable under downhole conditions avoiding BHA blockage while still achieving the necessary viscosity to seal fractures effectively.

Notably, the fiber-cement system is designed with an adjustable setting time: fast enough to secure its position within the formation, yet with sufficient working time for controlled placement. This balance is achieved by calibrating the cement additives based on bottom-hole temperature and by choosing fiber material that won't overly thicken the mix during preparation. The outcome is a single-trip lost circulation remedy that can be deployed directly during drilling operations, without requiring a separate cementing run.



This fiber-cement solution directly addresses the gaps in existing methods. Traditional LCM pills often fall short in large fractures as they may slow fluid losses but not completely stop them. Conventional cement plugs offer mechanical strength but require pulling the drill string which can fail if placed in active flowing formations without effective bridging. Abraj Energy Services' fiber-enhanced cement combines bridging with strength in a single treatment. Industry researchers have found that adding lost circulation materials to cement slurries can significantly improve their sealing performance, particularly in large fractures.

Field results from other regions likewise validate the concept: a fiber-based spacer and cement system was used offshore near Mexico to cure total losses, saving 15–24 hours of rig time per operation by eliminating the need for additional remedial jobs. In another recent study, laboratory investigations on lost circulation materials found that additives like rubber and synthetic fibers substantially improve loss control in fractured formations.

Building on these principles, Abraj Energy Services tailored its solution to the specific geological contexts of Oman and the Middle East. The fiber-cement recipe has been fine-tuned through internal R&D, ensuring compatibility with the drilling fluid systems commonly used in the region (e.g. water-based muds) and effectiveness against the types of fractures seen in Omani fields.

Value Proposition

In an initial field trial, Abraj Energy Services deployed fiber-enhanced cement on a well that experienced total losses, successfully restoring full circulation after just a single treatment. This achievement underscores the efficacy of the proposed approach. By using standard oilfield cement enhanced with engineered fibers, the solution fits into familiar drilling practices and complies with established well construction standards. This operational familiarity fosters greater acceptance among drilling teams, viewing it as a practical improvement on existing methods rather than as an unproven experiment. By integrating industry best practices with an innovative and proven approach, Abraj Energy Services demonstrates its commitment to solving real-world drilling problems through practical, results-driven innovative solutions.

IMPLEMENTATION BEST PRACTICES

Abraj Energy Services' fiber-enhanced cementing approach incorporates industry best practices to ensure successful deployment:

Pre-Job Planning

The team tailors slurry design to the loss zone's characteristics, selecting the appropriate fiber type and concentration and adjusting the cement blend (e.g. density and additives for setting time) to match the conditions. When the BHA includes narrow flow paths (small bit nozzles), fiber length and diameter are chosen to ensure unobstructed passage. Abraj engineers collaborate with the operator's drilling team to integrate this contingency into the drilling program, ensuring that specialized additives are available on-site. Pre-job meetings define the placement strategy, determine pump volumes, and outline success criteria.

Mixing and Preparation

On the rig, fiber-enhanced slurry is prepared using conventional cement mixing equipment. The key distinction is the controlled addition of fibers to the slurry. Rig personnel are trained to introduce fibers gradually into the mix to prevent clumping. Abraj provides detailed guidelines on the proper mixing order and energy input to achieve a uniform slurry with consistent fiber distribution. The mixture's flowability is verified through a BHA nozzle simulator, and standard API quality control protocols are followed to ensure pumpability and performance.

"Before you execute the job, briefing your operation team, including the client, is very important... why each step is important, what happens if steps are not followed."

– Abraj Energy Services' Operations Manager for Cementing Services

Pumping Operation

The fiber-laden cement slurry is pumped down the drill pipe at a controlled, moderate pump rate - fast enough to place the slurry before it begins to set, yet gentle enough to avoid inducing new fractures. As the slurry exits the bottom of the drill string, it enters the loss zone and fills the voids. The fibers cause rapid bridging of the formation openings. Operators monitor pump pressure and mud returns; a telltale pressure increase or improvement in returns often indicates the losses are being mitigated. Abraj Energy Service's procedure usually includes injecting a spacer of clear water or base mud ahead of the slurry to clear the path, followed by a post-slurry spacer to displace any remaining cement into the formation and prevent residual buildup within the drill string.

Setting and Verification

Once the fiber-cement slurry has been placed, pumping is halted with the drill bit positioned at the loss zone. The slurry is then allowed to sit for a short period to harden into the formation. The drill string remains stationary during the process to avoid disturbing the developing plug. After sufficient curing time, the crew carefully re-establishes circulation with regular drilling fluid. In successful jobs, full circulation returns will be observed, indicating the formation fractures have been effectively sealed. Additional verification can include a gentle pressure test and later running a cement bond log after the casing is set to confirm the loss zone is properly isolated. If the plug holds pressure, the operation is deemed a success and normal drilling resumes. Abraj Energy Services also emphasizes documentation of outcomes and any lessons as part of continuous improvement.

Case Study:
Onshore Oman – Severe Losses Cured in One Operation

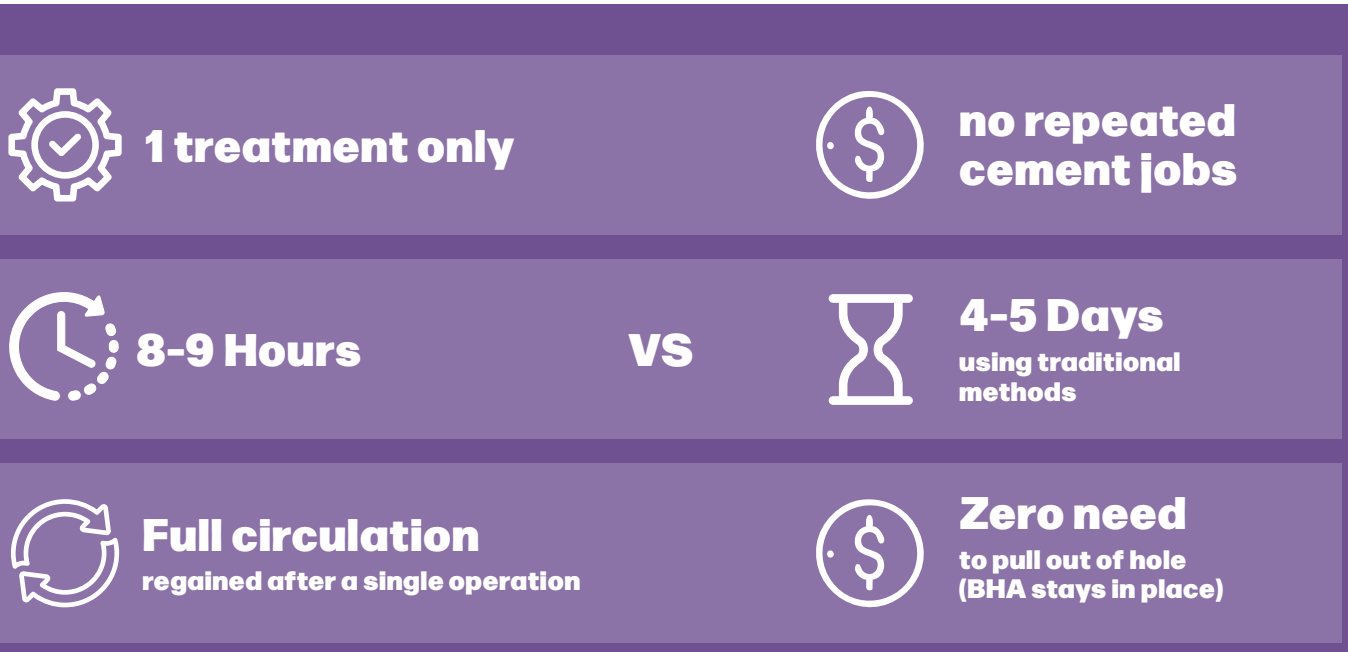
In a recent trial, an operator in Oman's interior was drilling an exploratory well through a known fractured limestone formation. At approximately 3,200 meters depth, the well experienced total losses, with drilling mud disappearing into the formation and virtually no returns observed. The team first tried conventional lost-circulation material (LCM) pills, but the loss rate remained extremely high (exceeding hundreds of barrels per hour).

Abraj Energy Services was consulted and recommended using the fiber-enhanced cement solution while keeping the drill string in place. The specially formulated fiber-cement slurry was mixed on the rig and pumped through a 12¼" drilling BHA directly into the loss zone. Shortly after placement, the crew observed a drop in the loss rate. After allowing the slurry to cure for a few hours, a circulation test confirmed that full returns had been regained. The previously gaping fractures had been successfully sealed in a single operation, allowing the rig to resume drilling in the next section with no further loss challenges.

In this case, the time savings were significant: the entire intervention (including preparation and waiting) was completed within one shift, whereas a conventional approach might have required multiple days and additional cement plug attempts.

"We did it in eight to nine hours... They had attempted a similar process before and they spent four or five days curing losses." – Operations Manager

Rapid loss mitigation also reduced the waste of drilling fluid and cement, and it spared the crew from the logistics and environmental hassle of having to dispose of large volumes of mud lost to the formation. The downstream impact was equally important. With the loss zone stabilized, the ensuing casing installation was cemented with full returns, ensuring effective zonal isolation. This trial proved the effectiveness of the fiber-cement system under high-loss conditions.



BUSINESS & ECONOMIC IMPACT

Abraj Energy Services' approach offers key advantages for operators and contractors:

Minimized NPT and Direct Cost Savings

Every hour, a rig not drilling can cost tens of thousands of dollars. By resolving severe losses in a single attempt, Abraj's fiber-cement method transforms what would typically be days of non-productive time into a delay of just a few hours. In the case above, regaining circulation saved on the order of 72 hours of rig time, translating to roughly $500,000 in savings for an onshore rig based on estimated day rates:

"The day rate is about $25,000 to $30,000. Additionally, you have associated costs such as drilling fluid, fuel, consumables..."

Abraj Operating Manager for Cementing Services

Industry studies further quantified the cost of lost circulation problems. One analysis found an average additional expenditure of at least $185,000 per well, due to lost circulation challenges. By eliminating repeated loss events and the associated corrective trips, the fiber-cement solution can greatly reduce or eliminate these unplanned costs..

72 hours of rig time saved =

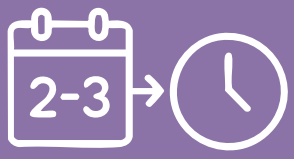
~$100,000

Conventional method

2-3 days

Fiber-Cement

1 Trip



One-trip solution

Reduces fluid loss

Protects well integrity

Improved Well Integrity and Safety

Effective lost circulation control directly contributes to higher well quality and operational safety, both of which can generate long-term cost savings and risk mitigation. If a loss zone is properly sealed with the fiber-cement, the primary cementing is far more likely to be successful, eliminating the need for expensive remediation procedures.

Maintaining well integrity by curing losses also prevents the cascade of risks (like kicks, blowouts, or stuck pipe) that can arise when a well is left underbalanced. By ensuring sufficient hydrostatic pressure and full returns, the fiber-cement plug helps maintain well control in vulnerable zones, aligning with the highest safety standards.

From a health, safety, and environment (HSE) perspective, avoiding uncontrolled fluid losses also reduces environmental exposure, as drilling mud is retained within the formation rather than migrating to unintended zones. In summary, the solution not only saves time and money, but also protects the well and crew from hazards, reinforcing a "Safety by Design" approach.

High Return on Prevention

Economically, the fiber-enhanced cement method can be viewed as a high-yield investment in contingency planning. The upfront cost of preparedness is relatively modest – fibers are low-cost on a per-well basis, and execution relies on standard rig equipment already in use. Pumping a fiber-cement pill incurs minimal expense, typically involving only a few barrels of cement and fiber.

However, if that intervention prevents even a single day of rig downtime, the financial return is substantial. In contrast, deferring action (or continuing with conventional LCM attempts) could lead to spiraling costs as multiple attempts fail and rig time accumulates.

Thus, from a cost-benefit standpoint, Abraj's solution offers a strong value proposition. With minimal expenditure and small operational adjustment, it averts the much larger costs associated with uncontrolled lost circulation.

Regulatory Compliance and Competitive Edge

Implementing this innovative solution also brings strategic benefits. It aligns with industry best practices and standards for well control and cementing. For example, API Standard 65-2 provides guidelines for isolating flow-prone zones during well construction; it recommends using tailored cementing techniques and materials in weak zones rather than one-size-fits-all methods. Abraj's fiber-cement system is the exact fit-for-purpose solution that these standards encourage. Proactively managing well control risks improves safety outcomes and protects companies from regulatory penalties, project delays and operational shutdowns, indirectly safeguarding financial performance.

Beyond compliance, a contractor capable of rapidly and reliably curing losses provides added value to clients, reducing operational risks and time constraints. This capability improves the likelihood of on-schedule, incident-free drilling, which operators highly value. Companies that proactively adopt advanced loss-control technology demonstrate technical leadership and operational excellence, bolstering their reputation with partners, regulators, and stakeholders.

In Oman, for instance, improving drilling efficiency aligns with national objectives to make resource development more cost-effective. Thus, beyond the immediate savings, Abraj's fiber-cement solution offers the benefits of credibility, compliance, and competitive advantage in the industry.

CONCLUSION

Lost circulation remains a persistent and costly challenge in drilling operations. However, with Abraj Energy Services' fiber-enhanced cementing solution, the industry now has a field-proven method to address even the most severe loss scenarios. The evidence is clear: integrating engineered fibers into cement slurry and deploying them through the BHA is highly effective in sealing fractures and restoring circulation. This approach also aligns with industry best practices with substantial reductions in NPT. The next step is for operators and industry leaders to put this knowledge into action.

Abraj Energy Services encourages drilling engineers, operators, and project managers to consider deploying the fiber-enhanced cement solution in their upcoming wells – particularly in formations known for loss-prone zones or time-sensitive drilling windows. By embracing this technology, companies can de-risk their operations and gain a tangible edge in performance over those still relying on trial-and-error methods. The solution is field-ready today. It leverages standard rig equipment The solution is field-ready today. It leverages standard rig equipment and materials, requires minimal procedural adjustments, and offers significant returns. In an industry where every dollar and day matters, failing to adopt available innovations comes at a significant opportunity cost.

By moving beyond conventional approaches that have limited success in severe losses and adopting this proven fiber-enhanced cementing technology, operators can ensure safer and more efficient drilling operations. They can also demonstrate their commitment to innovation and operational excellence in the eyes of regulators and stakeholders. Abraj Energy Services stands ready to assist in implementing this cutting-edge lost circulation solution. Reach out to Abraj, learn more about the fiber-enhanced cementing solution, and pilot it in your operations. Together, we will set a new benchmark for drilling performance across Oman's oilfields and elevate lost circulation control throughout the industry.

For more information, please visit **our website**

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