CASE STUDY

LNAPL REMOVAL FROM FRACTURED ROCK

Background

CLIENT: Oil & Gas Company

DURATION: Ongoing, 3 Years

LOCATION: Northern Saudi Arabia

PROJECT VALUE: $350,000 CDN

At an active bulk storage facility located on the outskirts of a town in Northern Saudi Arabia, wells installed within fractured sandstone had accumulated up to 13 m of LNAPL in the form of gasoline, kerosene, and diesel. The depth of the LNAPL, approximately 40 m below ground surface, combined with the saline groundwater, required special equipment that could withstand salt corrosion as well as overcome the pumping issues associated with small diameter wells. Furthermore, the location of the treatment system required a secure, explosion-proof, low-impact solution that could function without interfering with the facility's daily operations.

Approach

IRSL and their partner earned the project via a competitive bid process against two other firms. Together, they designed, implemented, maintained, and continuously optimized a total fluids recovery system. They incorporated numerical modeling to maximize the LNAPL capture zone while minimizing smearing effects and volumes of water requiring treatment.

TOTAL FLUID PUMPING

The free-phase gasoline, kerosene, and diesel, was captured and recovered using specialized submersible pumps, which were installed to target specific water levels. Once above-ground, the LNAPL was separated from the water using a proprietary system designed specifically for the site.

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GEOLOGY: Fractured Sandstone

PLUME SIZE: Approx. 4,000 m²

APPLIED TECHNOLOGIES

To capture and recover the LNAPL, in the form of free-phase gasoline, kerosene, and diesel, IRSL and their partner used specialized submersible pumps installed within 0.1 m diameter wells. The pumps were powerful enough to accommodate the 40 mbgs depths and all components were constructed of stainless steel and carbon steel to withstand corrosion. The proprietary design aimed to enhance the density differences between the LNAPL and saline groundwater while maximizing natural attenuation processes to address the dissolved phase impacts. The above-ground systems covered a footprint of less 24 m2 and consisted entirely of explosion-proof components.

MEASUREMENT & OPTIMIZATION

The pumps were programmed to extract LNAPL and groundwater until was obtained a specific level in fluid elevation. The team determined that measurement based on historical analysis of the water/LNAPL levels, transmissivity testing, and optimization tests. The process required ongoing adjustment to compensate for regional de-watering of the aquifer by nearby farms, which caused levels to fluctuate with an overall downward trend. However, through continuous optimization, the team maintained a recovery rate of greater than 87% LNAPL within the fluid over the recovery period.

Challenges

- Considered a high-risk site from a security perspective, the facility's rigorous health and safety regulations required working with site managers and their loss prevention department to ensure the NAPL removal system was safe, sound-and-explosion-proof, and highly secured.
- The saline groundwater required specialized water treatment materials resistant to corrosion.
- Water table variation required constant monitoring and adjustment to optimize LNAPL recovery.
- The unusually deep water (approximately 40 mbgs) created monitoring and pumping challenges.

Results

- The LNAPL plume was contained and shrinking.
- LNAPL thickness in the monitoring wells decreased by over 95% within three months.
- System operation and maintenance costs have decreased relative to inflation over time.

INSITU | INNOVATIVE TECHNOLOGIES GROUNDED IN EXPERIENCE

InSitu Remediation Services Ltd. (IRSL) is one of Canada's most experienced remediation companies. Our team has designed, implemented, and optimized, soil and groundwater remediation programs in diverse geological environments in North, Central, and South America, Asia, Europe, and the Middle East.

We confidently implement innovative solutions, based on sound knowledge, using seasoned field staff. Our pragmatic, flexible approach reduces effort, cost to our clients, and environmental risk.

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