

CASE STUDY

GASOLINE REMEDIATION IN NORTHWESTERN SAUDI ARABIA



Background

CLIENT: Oil & Gas Company

DURATION: Ongoing, 5 Years

LOCATION: Northwestern Saudi Arabia

PROJECT VALUE: \$650,000 CDN

At an active bulk fuel storage facility outside a city located in Northwestern Saudi Arabia, on the coast of the Red Sea, historical spills and leaks had resulted in the accumulation of up to 1.5 m of gasoline in an unconfined, highly saline aquifer. Tidally influenced, the water table levels fluctuated up to 0.5 m per day. The location of the impacts required a secure, explosion-proof, low-impact solution that could accommodate tidal water table fluctuations, withstand salt corrosion, and function without interfering with the facility's daily operations.

Approach

The oil & gas company tendered the remediation project for competitive bid to four firms. IRSL partnered with a Middle Eastern Environmental Consulting Firm and, together, they were awarded the project based on their price and innovative approach. IRSL's partner firm characterized the site whereas IRSL designed and optimized the remedial system using numerical modeling to maximize the capture zones while minimizing smearing effects and volumes of water requiring treatment.

VACUUM-ENHANCED PNEUMATIC SKIMMING

To contain and remove the LNAPL in the form of gasoline, IRSL, with their partner, implemented and continue to maintain and optimize a vacuum-enhanced pneumatic skimming system.

GEOLOGY: Unconfined Silty Sand Aquifer

PLUME SIZE: Approx. 100 m²

APPLIED TECHNOLOGIES

To capture and recover the gasoline from the surface of the water table, IRSL and their partner installed specialized pneumatic skimmers within 10 wells, in an area extending approximately 60 m². The chosen system was based on a series of tests, including NAPL transmissivity tests, in select wells. They enhanced the recovery of LNAPL from each 10 cm diameter well using a low-vacuum system, which increased both the rate of recovery and area of influence.

LOW-VACUUM ENHANCEMENT

Intensive testing comparing the effect of the vacuum versus no vacuum indicated that the radii of influence increased from approximately 1 m to greater than 8 m under the vacuum conditions and increased the rate of recovery by 4-fold.

The above-ground vacuum system was housed in a sound-and-explosion-proof, secured container, which required less than 10 m³. A full-time engineer remains on-site throughout the year to continuously monitor, adjust, and optimize the system.



Challenges

- Considered a high-risk site from a security perspective, the active bulk fuel facility's rigorous health and safety regulations required working with the facility and loss prevention department to ensure the NAPL removal system was safe, sound-and-explosion-proof, and highly secured.
- Potential for corrosion due to the highly saline groundwater required specialized materials to be used for the skimmers.
- The tidally influenced water table created a challenging optimization environment, which required constant monitoring for optimal gasoline recovery.

Results

- As a result of continuous optimization, the percentage of gasoline within the fluid recovered has been greater than 99.999% over the recovery period.
- The NAPL plume has been contained and over 60,000 L of gasoline have been recovered from a 100 m² area in less than four years.
- Free product thickness in monitoring wells has decreased by over 75%.
- System operation and maintenance costs have decreased relative to inflation over time.



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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