COVION SOLUTIONS

Controlling Crude Oil Deposits Through Applied Magnetic Fields

Abstract

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Covion Solutions
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Crude oil production and transportation face significant challenges from deposits formed by paraffins and asphaltenes, leading to reduced efficiency and increased costs. This white paper explores the application of magnetic fields to fluid flows to control these deposits by altering molecular alignment and preventing aggregation. Drawing analogies from well-studied water systems, we discuss the mechanisms, long-lasting effects, and cost-effective benefits of magnetic field technology. Covion Solutions Charge Control technology is highlighted as an engineered solution for managing deposit-related issues in a diverse range of crude oil and intermediate product systems.

1 Introduction

Crude oil systems are plagued by deposits from paraffins and asphaltenes, which accumulate in production and transportation infrastructure, causing flow restrictions and operational inefficiencies. Traditional methods for managing these deposits include mechanical, thermal, and chemical interventions, but they often come with high costs and significant maintenance requirements. This white paper presents the use of applied electro-magnetic fields as an innovative, non-invasive approach to inhibit deposit formation. By influencing the molecular structure of these compounds, magnetic fields offer a sustainable solution, supported by scientific insights from analogous water systems and real-world applications in oilfields.

2 Challenges with Crude Oils

Crude oil contains problematic components such as paraffins and asphaltenes that precipitate under changing conditions of temperature and pressure, leading to deposits in tubing, valves, wellbores, flow lines, and surface equipment. Paraffins are waxy hydrocarbons with linear structures that crystallize easily, while asphaltenes are high molecular weight aromatic compounds that aggregate into micelles. These deposits reduce oil production efficiency and increase costs of operation for pipelines. The industry has relied on various methods to mitigate these issues over the years, but many are resource-intensive and inefficient.

3 Controlling Deposits with Applied Magnetic Fields

Diamagnetic materials in crude oil, similar to those in water and calcite, respond to magnetic fields by undergoing polarization, which alters molecular alignment and disrupts deposit formation. Magnetic fluid conditioning units have been deployed worldwide, successfully inhibiting both organic (paraffin and asphaltene) and inorganic deposits without changing the oil's chemical composition. Although the precise mechanisms for wax crystallization and deposition are complex and still under study in the industry, the empirical benefits demonstrated in numerous field trials are evident in reduced accumulation and improved flow along with substantial improvements in demulsability and dewatering processes.

4 Scientific Insights and Analogies from Water Systems

Water systems provide a simpler model for understanding magnetic field effects, with extensive research showing inhibition of scale growth through structural modifications. In water, magnetic treatment shifts calcium carbonate from stable calcite to fragile aragonite, reducing scale adhesion. Similarly, in crude oil, magnetic fields are believed to polarize molecules, preventing the organized crystallization of paraffins and micelle formation of asphaltenes. This analogy underscores the potential for magnetic fields to disrupt deposit structures in diverse oil systems, mirroring the disorganization seen in treated water and other materials.

5 Long-Lasting Effects

The effects of magnetic treatment persist beyond the point of application. In water systems, benefits last several days after field removal, while in crude oil pipelines, inhibition of paraffin deposition has been observed up to 174 miles downstream in pipelines. These enduring effects support the hypothesis of shared mechanisms between fluid systems, enabling sustained deposit control with minimal intervention.

Figure 1: 4" Paraffin Control System installed on a 4.7-mile pipeline. Operator eliminated chemical cleaning, disposal, and maintenance, reducing parafin to trace levels.

6 A Cost-Effective Solution

Magnetic field technology offers distinct advantages over traditional methods:

- No consumables or chemicals required
- No moving parts, ensuring low maintenance and high reliability
- No additional operational resources need ed post-installation

Figure 2: 2" tubing on a well using chemical treatment and monthly hot oil flushing. After installation of Paraffin Control System, all interventions eliminated.

Covion Solutions' technology is engineered specifically for crude oil deposit control, providing a cleaner, extremely cost-effective, and maintenance-free alternative to address flow assurance challenges downhole, in pipelines, and refining processes.

7 Conclusion

Applied magnetic fields represent a promising, scientifically grounded approach to controlling molecular charges that inhibit paraffin and asphaltene deposits in crude oil systems. By leveraging principles from water scale inhibition and offering long-lasting, low-maintenance benefits, this technology enhances production efficiency and reduces costs. Electro-magnetic solutions position the industry toward more sustainable and effective deposit management strategies.