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Electro-Magnetic Field Application for Diesel Fuel Combustion Optimization

Abstract

Diesel fuel combustion efficiency and emissions remain critical challenges in meeting stringent EPA Tier 2, 3, and 4 standards. Varnish accumulation on injector tips and suboptimal fuel droplet size contribute to reduced fuel economy and increased emissions. This white paper explores the application of magnetic fields, specifically using Covion Solutions' Charge Control technology, to mitigate varnish deposits and enhance combustion efficiency. By altering the interfacial tension and promoting varnish agglomeration, the technology's electro-magnetic field effects improve fuel economy and system cleanliness. Field tests demonstrate measurable improvements, positioning this technology as a cost-effective solution for diesel engine optimization.

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Diesel fuel combustion efficiency and emissions remain critical challenges in meeting stringent EPA Tier 2, 3, and 4 standards. Varnish accumulation on injector tips and suboptimal fuel droplet size contribute to reduced fuel economy and increased emissions. This white paper explores the application of magnetic fields, specifically using Covion Solutions' Charge Control technology, to mitigate varnish deposits and enhance combustion efficiency. By altering the interfacial tension and promoting varnish agglomeration, the technology's electro-magnetic field effects improve fuel economy and system cleanliness. Field tests demonstrate measurable improvements, positioning this technology as a cost-effective solution for diesel engine optimization.

1 Introduction

Improving diesel fuel combustion efficiency and reducing emissions are key objectives for meeting EPA Tier 2, 3, and 4 standards. Varnish deposits on fuel injector tips and suboptimal fuel droplet size hinder these goals, leading to inefficiencies and increased maintenance. Traditional approaches, including mechanical and chemical interventions, have limitations in cost and effectiveness. This white paper examines the use of electro-magnetic fields, specifically Covion Solutions' Charge Control technology, to address varnish accumulation and enhance fuel atomization, offering a non-invasive, cost-effective solution for diesel fuel and other petroleum combustion systems.

2 Challenges in Diesel Fuel Systems

Diesel engines face challenges from varnish deposits, which are chemically similar to those in lubricants, and accumulate on injector tips, altering flow dynamics and reducing combustion efficiency. Additionally, fuel droplet size directly impacts combustion completeness, with smaller droplets and wider dispersion in the combustion chamber correlating to better fuel economy and lower emissions. Mechanical advancements, such as higher injection pressures and redesigned combustion chambers, aim to reduce droplet size, but these increase sensitivity to varnish. Chemical additives, like detergents and cetane improvers, address these issues but are not universally present in fuels necessitating alternative solutions.

3 Magnetic Field Application

The use of an electro-magnetic device such as the Charge Control technology applies a magnetic flux to diesel fuel as it recycles from the engine to the fuel tank. This process induces charge agglomeration of varnish particles, in-creasing their size to allow capture by fuel filters, thus preventing accumulation on injector tips. Additionally, passing through the system's induction coil with its inherent electrical and magnetic fields alters the interfacial tension of the fuel, reducing droplet size and enhancing atomization during combustion. These effects mirror observations in lubricant systems, where magnetic treatment mitigates varnish formation, and in water systems, where it disrupts calcium crystal and scale formation.

4 Scientific Insights

The application of magnetic fields leverages the diamagnetic properties of diesel fuel components, polarizing molecules to disrupt varnish formation and improve fuel properties. By increasing varnish particle size, magnetic treatment ensures effective filtration, maintaining injector cleanliness. Furthermore, reducing interfacial tension leads to smaller fuel droplets, promoting more complete combustion. These mechanisms are analogous to those observed in water systems, where magnetic fields shift calcium carbonate to less adhesive forms, supporting the applicability of this technology to diesel fuel systems.

5 Field Test Evidence

The company conducted a six-month field test with the Pittsburgh Port Authority, equipping five buses with Charge Control devices and comparing them to five untreated buses. Over an average of 60,000 miles, treated buses achieved 4.69 mpg, compared to 4.42 mpg for untreated buses. This 6.1% improvement in fuel economy was statistically significant and repeatable, highlighting the efficacy of magnetic treatment, even in fuels lacking detergent additives, underscoring its potential for broader application.

6 A Cost-Effective Solution

Charge Control technology offers several advantages for diesel fuel systems:

- No consumables or chemical additives required
- No moving parts, ensuring low maintenance and high reliability
- Minimal operational resources needed post-installation

Covion Solutions' technology provides a cleaner, maintenance-free alternative to traditional methods, enhancing fuel economy and reducing emissions while addressing varnish-related challenges.

7 Conclusion

Magnetic field application, exemplified by Covion Solutions' technology, offers a scientifically supported, cost effective solution for optimizing diesel fuel systems. By mitigating varnish deposits and improving fuel atomization, this technology enhances combustion efficiency and supports compliance with stringent emission standards. Field tests demonstrate tangible benefits, making magnetic field application a compelling choice for diesel engine operators seeking improved performance and sustainability.