ADVANCED TECHNOLOGY: INFORMING & EMPOWERING FUEL AUTHENTICATION PROGRAMS

The financial impact of fuels stolen or adulterated every year is estimated to be over $133 billion, creating fuel manipulation and fraud concerns for commercial fuel companies and government agencies. Fuel manipulation has a significant impact on branded fuel companies, decreasing revenue and threatening brand reputation and competitive advantage. Similarly, fuel fraud affects governments through lost tax revenue and the exploitation of subsidies. These concerns can be mitigated through advanced technologies for fuel markers, devices and the resulting data and analytics.

Methods of Fuel Manipulation

While fuel manipulation can occur accidentally through equipment failures or human error, it is most often an intentional act of adulteration, substitution, diversion or smuggling.

ADULTERATION — adding a lower quality product to the fuel in an attempt to increase profits. Adulterants may include:

- Lower taxed or subsidized fuels
- Inferior products (e.g., waste oil, solvents)
- Lower grade products
- Stolen petroleum products

SUBSTITUTION — substituting one product for another and misrepresenting its quality or classification to sell for a higher price, typically non-branded or differentiated fuel sold as premium.

DIVERSION/SMUGGLING — diverting product from the intended supply chain and recipient as it crosses various points in the supply chain, including national and state boundaries or between control points. Transport is one of the biggest risks in fuel supply chain management:

- Subsidized products are diverted during transport and sold as premium
- Fuels are smuggled to higher priced markets

> **"The financial impact of fuels stolen or adulterated every year is $133 billion."**
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> *— Ernst & Young Fraud Report on Oil & Gas, 2017*

Authentix®
The Authority in Authentication

Fuel Markers, Devices & Analytics: The Technology Behind Fuel Authentication

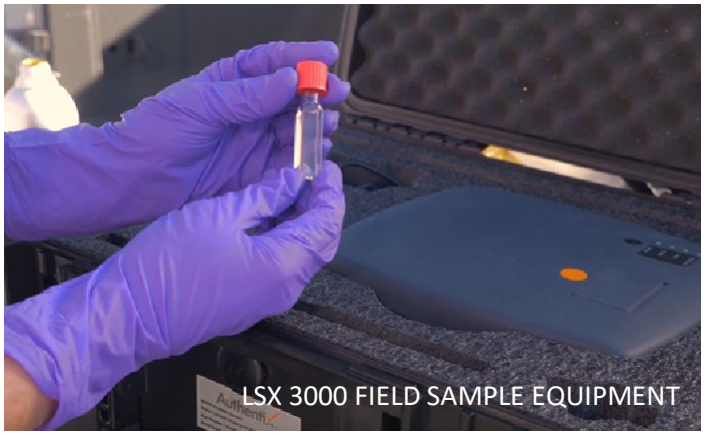
An effective fuel authentication program uses advanced technologies to help governments and commercial fuel companies improve operations, increase revenue, diminish toxic emissions and protect the integrity of fuel in the supply chain. The concept is simple – by adding a unique marker, the fuel obtains a unique fingerprint. Using the appropriate analyzer, the fuel is then identified as legal or adulterated.

Fuel markers are used to distinguish different types or brands of fuel and can take different forms, each serving a specific purpose. For example, markers injected into the fuel can allow for end-to-end supply chain tracking. When the fuel reaches its destination, quality control processes test for markers to ensure the supply chain hasn't been disrupted and the fuel isn't compromised. Quality control testing can take place in the field (station or terminal) with handheld or mobile devices or in a laboratory setting, depending on the needs of the organization.

OVERT VS COVERT — Overt markers are typically colored dyes that are visible to the eye and may be imitated or replicated. Covert markers, on the other hand, can only be identified by a highly sensitive detection device. At Authentix, we develop and employ only proprietary and unique covert markers to ensure the highest security and effectiveness.

RECOGNITION, OPTICAL AND MOLECULAR — Authentix offers three different categories of covert markers which vary in complexity and use.

- Recognition markers are captured by custom-matched antibodies and are then detected by a reader or test kit. Detection can be in the field (qualitative) or laboratory (quantitative). Industry accepted and commercially proven, these markers provide a substantial barrier to entry and use low marking levels.
- Optical markers use covert organic chemicals that emit a detectable fluorescent light when excited and are visible only with a highly sensitive field detection device that provides near-instantaneous results.
- Molecular markers exploit the unique mass spectrum of chemical entities, enabling lab-based qualitative and quantitative analysis. The forensic lab device used by Authentix is a customized gas chromatography mass spectrometer (GC-MS), the globally recognized gold standard for court-defensible forensic analyses.



LSX 3000 FIELD SAMPLE EQUIPMENT

FIELD VS LABORATORY — Devices and analyzers can vary in the types of results produced, as well as the location the analyses occurs. In the field, for example, Authentix uses handheld devices and mobile applications that are easy to use and can collect large amounts of data quickly that is then uploaded to an information system. The Authentix Information System (AXIS®) rapidly produces actionable insights that flag suspicious results, increasing the chances of preventing future manipulation. Lab-based testing is often used if a fuel sample collected in the field produces a 'failed' or 'suspect' result. Conducted under strict guidelines, this testing can provide excellent forensic analysis or confirmation.

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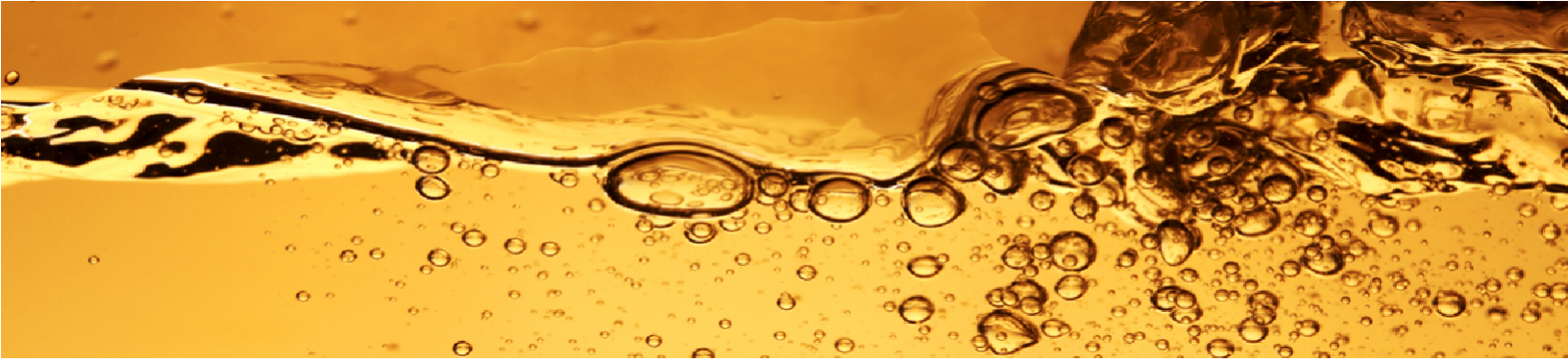

Key Considerations of Fuel Protection Programs

QUALITATIVE VS QUANTITATIVE
A qualitative analysis is used to quickly verify the presence of a marker by producing yes/no results. A quantitative analysis provides additional insight into an amount (percent) of dilution or adulteration that may have occurred. Authentix works with its customers to determine the need for instantaneous results or more detailed results, or in some instances, both.

PORTABILITY
Manipulation and fraud decrease dramatically when overseers are in place, enabling real-time enforcement. Authentix can deploy teams equipped with user-friendly devices into wide geographic areas to serve as an effective deterrent.

ENVIRONMENTAL COMPLIANCE
Fuel authentication programs can also help decrease the impact fuel manipulation can have on the environment and public health. As a rule, all Authentix markers comply with the United States Clean Air Act, comprising carbon, hydrogen, oxygen and nitrogen (CHON) which allows marked fuels to retain their performance specifications, emissions characteristics and environmental compliance.

PROPRIETARY VS PATENTED MARKERS
When choosing a program, it's important to know if the solution uses patented or proprietary markers. When applying for a patent, for example, the composition of the markers is accessible to anyone who wishes to detect or replicate them. To further increase marker security, Authentix only uses proprietary markers that are confidential and virtually impossible to reverse engineer.

DATA & ANALYTICS
A monitored and digitized fuel integrity program provides useful data to mitigate the risks of fuel moving through the supply chain. Using AXIS®, Authentix collects and analyzes data from different applications and disparate data sources. Insights gained help anticipate future challenges, identify new threats and accelerate detection, providing a significant competitive advantage through predictive analytics.

Authentix. The Authority in Authentication.

Working with governments, central banks and commercial companies, Authentix provides custom authentication solutions tailored to meet specific business challenges. Our core capabilities in developing and manufacturing proprietary chemical markers, designing analytical instruments and devices, and applying interdisciplinary chemometric models are enhanced by data integration, analytics and program management.

With over 25 years of experience in government and commercial fuel authentication, Authentix helps ensure local economies grow, banknote security remains intact and commercial products have robust market opportunities. Visit www.authentix.com.

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