Electronic Data Analysis and Laboratory Fraud

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EPA/OECA/OCEFT/NEIC

EPA Science Forum 2004

Healthy Communities and Ecosystems

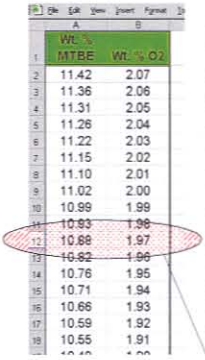
Abstract

Environmental data integrity is a growing concern for the Environmental Protection Agency's Office of Enforcement and Compliance Assurance (OECA). The accuracy and truthfulness of environmental data is a cornerstone for environmental enforcement and compliance, and is essential to the protection of public health and the environment. The National Enforcement Investigations Center (NEIC) provides technical expertise and support to data integrity investigations. Recently the NEIC has been using an innovative approach in these investigations by merging electronic data analysis (EDA) techniques (a.k.a computer forensics) with analytical chemistry and environmental science and engineering. NEIC's capabilities in data integrity investigations are enhanced by its unique combination of EDA seizure and recovery, a modern state-of-the art chemistry laboratory, and multi-media field inspections.

The EDA team works closely with experienced chemists, environmental scientists, and engineers to trace the origins of data fraud. This multidisciplinary approach has recently been applied across the country on criminal and civil data integrity investigations at:

- Fuels testing laboratories
- Environmental analytical laboratories
- Automated wastewater treatment plants

This poster illustrates the unique niche being filled by NEIC and its impact on data integrity investigations.



	A	B
1	Wt % MTBE	Wt % O2
2	11.42	2.07
3	11.36	2.06
4	11.31	2.05
5	11.26	2.04
6	11.22	2.03
7	11.15	2.02
8	11.10	2.01
9	11.02	2.00
10	10.99	1.99
11	10.93	1.98
12	10.88	1.97
13	10.82	1.96
14	10.76	1.95
15	10.71	1.94
16	10.66	1.93
17	10.59	1.92
18	10.55	1.91

Figure 1.

Fuels Testing Laboratories

NEIC has supported Laboratory fraud investigations at fuels testing laboratories under the Clean Air Act Reformulated Gasoline Program (RFG). Fraudulent practices can be as simple as picking the analytical concentrations you want from an Excel spreadsheet [Figure 1].

The complexity of regulatory standards for reformulated fuels has made the detection of RFG fraud difficult. For example, gasoline blends often are regulated for multiple chemical components and physical parameters, such as the oxygenate compound, methyl tertiary butyl amine (MTBE), benzene, octane, and vapor pressure. Figure 2 lists the typical chemical components found during a typical oxygenate analysis conducted on an Agilent gas chromatograph. The calculation of the percent oxygenate contributed by MTBE is magnified below.

$$(10.88*16*1)/88.2 = 1.97$$

Compound	MW	O	(A*16*1)/B
Methanol	32	1	(A*16*1)/32
Ethanol	46.1	1	(A*16*1)/46.1
Isopropanol	60.1	1	(A*16*1)/ 60.1
tert-Butanol	74.1	1	(A*16*1)/ 74.1
n-Propanol	60.10	1	(A*16*1)/ 60.10
MTBE	88.2	1	(A*16*1)/ 88.2
sec-Butanol	74.12	1	(A*16*1)/ 74.12
DIPE	102.2	2	(A*16*2)/ 102.2
Isobutanol	74.1	1	(A*16*1)/ 74.1
ETBE	102.2	1	(A*16*1)/ 102.2
tert-Pentanol	88.1	1	(A*16*1)/ 88.1
DME_Int Std	90.1	1	(A*16*0)/ 90.1
n-Butanol	74.12	1	(A*16*1)/ 74.12
Benzene	78	0	(A*16*0)/ 78
TAME	102.2	1	(A*16*1)/ 102.2
			Mass % Oxygen = sum of =

Figure 2.

HP Chemstation / Gas Chromatograph

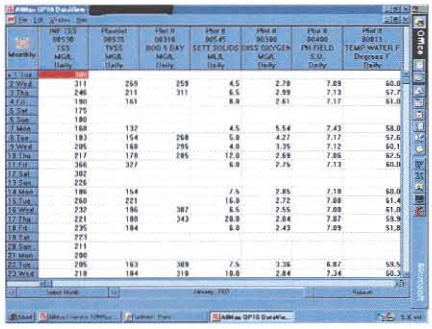


Figure 3.

Environmental Analytical Laboratories

NEIC scientists and engineers have investigated laboratory fraud and false reporting at laboratories that use Laboratory Information Management Systems (LIMS) such as OP10® [Figure 3].

In Laboratory fraud investigations, NEIC's EDA specialists electronically image LIMS systems using EDA seizure and recovery techniques. The LIMS systems and laboratory instruments are recreated in the NEIC Electronic Data Analysis Laboratory (EDAL).

NEIC scientists and engineers examine and analyze the LIMS data recovered by the EDA. Data analysis uncovers discrepancies and data feud in Discharge Monitoring Reports submitted to EPA and the states.

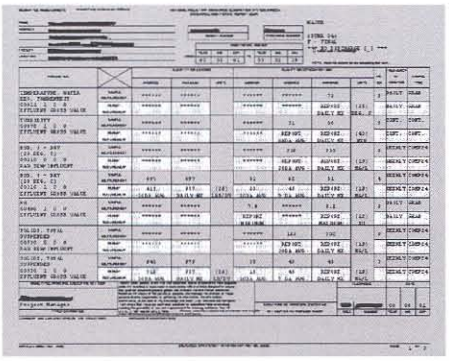


Figure 4.

Automated Wastewater Treatment Plants

Many of today's modern Wasterwater Treatment Plants (WWTPs) [Figure 4] are automated with Supervisory Control and Data Acquisition (SCADA) software and hardware. These systems use automated valves and switches controlled through programmable logic controllers (PLC). With SCADA and PLCs WWTPs can operate more efficiently.

NEIC takes WWTP investigations one step further through EDA forensic seizure, recovery, and analysis. Operational data from the WWTP's automated processes are stored automatically. This data records the plant processes, plant controls utilities, and continuous monitoring sensors.

SCADA has built in security and audit processes that provide functions critical to maintaining a WWTP. Built in software tools automatically record changes made to system files. NEIC's computer staff, chemists, and multi-media field personnel analyze this data to trace the origins of data fraud. All three skills are essential in an investigation of automated industrial processes.

Waste Water Treatment Plant

NEIC's Electronic Data Analysis Team working closely with chemists, environmental scientist and engineers are able to trace sources of data fraud at a WWTP. Figures 5, 6, and 7 demonstrate how NEIC personnel are able to prove that continuous chlorine residual monitoring was not being performed as required by the facilities' NPDES permit.

Figure 5 is a recording of the WWTP's flow (red), influent chlorine residual (yellow), and effluent chlorine residual (green). The permittee is required to report any chlorine excursions of greater than 10 ppm. The restored data demonstrates that the effluent chlorine residual monitor was probably not operating correctly because the green line on the chart is flat and less than zero.

Figure 6 shows attempts by the WWTP operators to correct the problem the day after an unannounced inspection by state inspectors. The green line on the chart is no longer less than zero.

Figure 7 shows the plant operating after maintenance. Note the effluent residual monitor reading is a continuous flat line. Continuous monitors operating normally have some signal noise.

The skills of computer specialist, chemists, and field personnel are essential in an investigation of laboratory instruments and automated industrial processes.

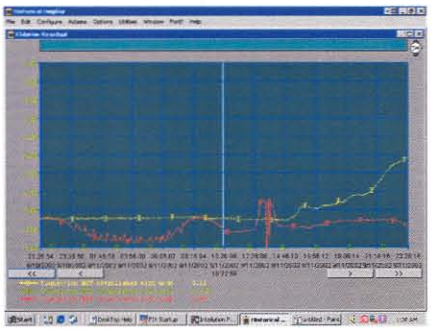


Figure 5.

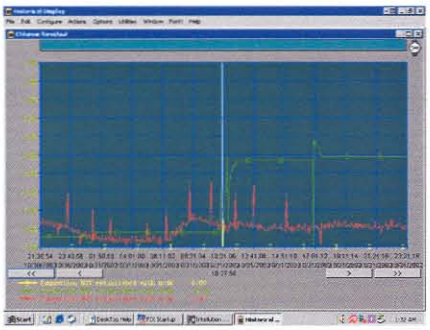


Figure 6.

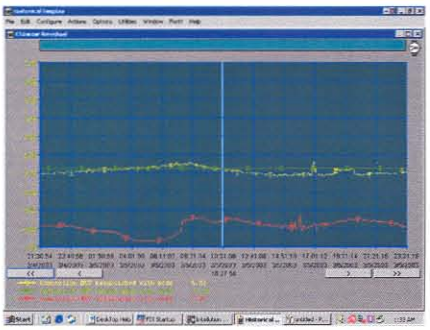


Figure 7.

Science and Innovation to Protect Health and the Environment