



Golden Specialty Laboratory, Ltd.

## Taking Peaks to New Heights - Improving Safety and Response to Emergent Environmental and Civilian Threats with Air Analysis

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Accurate and defensible air analysis is more critical than ever, for more than the usual reasons and causes, to companies and communities concerned with VOCs, metals and other toxins in our air. This is so for both quality of products and environment health as a common and public resource. A threshold was crossed in environmental protection with the amendments to the Clean Air Act in 1990 and the momentum has continued in these two decades but there are emerging problems and threats due to massive industrialized growth and consumption in formerly under-developed parts of the world, as well as accumulation and new environmental triggers, and also threats from deliberate sabotage and terrorism. The growing awareness of fundamental global climate unrest and change, especially given the impact of rising use of fossil fuels without significant emission controls by emerging economics, China in particular, has added impetus to the need for increased accuracy, timeliness and defensibility in air analyses of all types. Coal-fired plants are being increasingly regulated or transformed in the USA; they are going up by the hundreds in China, with relatively scant emissions control or countermeasures.

The changing landscape of environmental dynamics and air chemistry fluctuation, consequences from increased high-concentration population, massive industrialization, and also factors linked with storm impact or protracted conflict and war, dictates new requirements upon the analytical and monitoring community. Fuels, raw products, catalysts and even water change in response to the open global market and also the unfolding effects of global climate change are among the major triggers for unexpected air quality changes. Occasional (e.g., annual) test of air supplies going in and coming out of a plant need to be repeated often when there are changes in the chemistry of those raw ingredients whether or not they are combustible compounds. Some of today's demands include the needs for faster turnaround in sampling and results so that known and proven optimization of plant processes can be performed. More expansive sample ranges covering both urban and less populated areas (e.g., those not generally associated with high or even moderate chemical emissions) are needed – wind currents and rainfall patterns are not only a global networked process but something where change is more the norm than in past generations. There is also need for an ability to coordinate test results with rapid dissemination and communication to both authorities and civilian populations in affected areas, not only for emergencies but for long-term planning such as siting a plant or waste facility. All of these changes mean that air analysts need to be equipped with the technical resources and means for providing more results in less time from larger sampling regions. Furthermore, there is a need to combine informatic tools such as situation awareness and notification networks with traditional sample analysis. The lab is increasingly being made into a real-time distributed operation and not something that has just one location to which samples are sent and from where reports are generated.

### The ACORD Model

The ACORD acronym means, "Accurate, Consistent, On-Time, Reliable, Defensible."

First of all, there are the obvious ways that involve the actual instrumentation and methods. At Golden Specialty Laboratory, Ltd. and in concert with Golden Specialty Consulting, Ltd., we have been taking an approach for years that is now becoming more of the necessary course of action rather than a luxury when it comes to sampling, monitoring and high-resolution, quick-turnaround analysis of air contents. We perform all the standard methods and this involves using a mix of gas chromatography, mass spectroscopy and Fourier Transform InfraRed spectroscopy (FTIR) as well. However, we have learned over the course of more than a

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decade that seeing with four eyes is better than just glancing with two. Redundancy is an important ingredient of our methodology and this applies to all facets of the analytical work, from data (sample) acquisition to the information reporting. Having two FTIRs in a trailer, for instance, as a regular *modus operandi*, means having zero down time if one instrument needs recalibration, means being able to “jump on” a request for a parallel testing site, and means getting the confirmation and consistency in a history of measurements with a sub-ppm, sub-1% variance level over a 5-hour observational window.

Sensor fusion, aka data fusion, was developed initially in the defense and aerospace sectors, but it is important for safe and reliable results today in medicine and many fields. Also called multimodal sensing, this translates often into using different types of instrumentation and analytical methods for the same sample or test situation. Nowadays we begin to consider what can be seen at 100m with THz or mm-wave while planning exactly where to take samples for GC/MS or where and when to place vapor-based sensors such as piezoresistive microcantilever MEMS chips.

ACORD is not only about instrumentation. It is about keeping things “in accord” and consistent with both nature and manmade protocols and rules.

- Strict adherence to regularly reviewed and updated – and “read” – SOPs.
- Critical review of our methods, and the standard methods from EPA, NIOSH, ASTM and other sources, with the latest in research and development reports from peer-reviewed as well as industry literature.
- Having an operational LIMS that is not just an add-on for purposes of compliance and regulation but a centerpiece for productivity, so that each sample received can be given the optimal attention by the analyst and the instrumentation.
- Making use of the most advanced DCS (document control system) technology for ensuring that the human mind is both aided in matters concerning chain of custody and document accuracy and also lightened and assisted; having the automated vigilance of a system that serves quality control, internal online collaboration, and external communications with customers (such as through online web conferencing).

Staying ahead of both compliance legislation and product (instrumentation) acceptance in the marketplace is another part of our ACORD system. We consider it to be essential “best practice” to be working on technologies that can enhance or replace some of today’s conventional measures where increased sensitivity and accuracy may be gained. The emerging issues and problems that are arising today and in coming years due to “global” factors go far beyond the singular emission of compounds from production or distribution facilities. Global climate change, global unrest and terrorism, larger population centers and more volatile traffic patterns and sensitivities all contribute to new requirements affecting both immediate and long-term safety, public health, and energy availability. The pace and closeness of our world dictates that we develop approaches to problems before they become critical rather than afterwards. Linking analytical results (both conventional air testing types as well as new sensor network and mobile testing types) with emergency response, security, and population management organizations in our society, is where our ACORD approach provides a solid and reliable foundation for building tools for environmental analysis informatics just as there are now within the medical sciences.

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