ChemTracker Consortium – The higher education collaboration for chemical inventory management and regulatory reporting

Tracking chemical inventory is necessary for safety management as well as regulatory compliance. However, this task is especially challenging for diverse and decentralized research and laboratory organizations. Safety and compliance, waste minimization, emergency preparedness, and facility planning design all benefit from knowing what chemicals exist at a facility, who has responsibility for them, and where they are located. Stanford University developed a web-based application for chemical inventory information management and compliance reporting throughout its research and service support operations. After successful implementation and use at Stanford, and significant interest, approval and use by other organizations, Stanford's chemical management solution is now accessible to other not-for-profit institutions through a consortium member arrangement. The chemical information management system is currently used by twelve colleges and universities and one hospital clinical laboratory. This system provides powerful tools for users to control their chemical inventory, access safety information, maintain inventories, review compliance and generate complex regulatory reports. Since all users operate from a hosted, centrally located application server site via their own desktop web browsers, minimal local IT support is required. This collaborative system support approach encourages rapid user acceptance, facilitates single click compliance reporting and supports best in class lab safety management in a cost-effective and efficient manner for higher education.

By L.M. Gibbs

INTRODUCTION: THE CHEMICAL INVENTORY MANAGEMENT CHALLENGE

Managing chemical inventories at colleges and universities has often been identified by environmental health and safety (EH&S) directors as one of the major safety and compliance management challenges for higher education institutions. The complex organizational structure at colleges and universities combined with the extent and diversity of chemical use activities has made resolving this issue most difficult. Environmental Protection Agency (EPA) Region I officials have taken enforcement actions against many higher education institutions in New England. EPA has cited the lack of an operational chemical inventory system as a root cause of the compliance problems encountered and has required institutions to create or implement a chemical inventory management system as part of settlement agreements or as required good practice.[1] To date, several individual institutions have embarked on developing a system or acquiring a commercial system and implementing it on the campus, at significant initial and on-going expense to the campus EH&S programs.

More recently, heightened homeland security requirements have begun to focus on the need to identify and securely monitor and track the more hazardous chemicals at a facility, such as Select Agents and Toxins. There are many chemical materials, even in basic science teaching laboratories, which can be considered dangerous when used with malicious intent. Many institutions are also now facing a major chemical monitoring compliance challenge with the implementation of the International Building Code (IBC) and International Fire Code (IFC) in most jurisdictions across the country. These codes include limitations on the amount of chemical by hazard category that can be stored within a building occupancy, including laboratories.[2] The end result is that many institutions and organizations are rethinking the need to ensure that the hazards on campuses are easily identified, and that an effective system to demonstrate code compliance is in place. The best means to ensure compliance and safety information exists is via an operational and active chemical information management system. To minimize the replication of effort and expense, the need

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exists for a comprehensive and collaborative solution for higher education and other not-for-profit sector organizations such as hospitals and government facilities.

A workable chemical inventory system is becoming an essential tool for institutions today. Multiple laws and regulations for chemicals are varied and, at times, have conflicting requirements for chemical data and information. There are over 20 regulatory reports that require the use of chemical inventory data. The most difficult reports to generate are those for fire and life safety code compliance with hazardous materials limits. These reports require detailed information on the hazardous properties of each material (as defined by the fire/building code), the amount of each material in defined fire separation areas within a building, and aggregation of the amount of each substance by hazard category in a defined space (the fire control area) of the building. There are many methods available for collecting inventory data. These range from use of index cards and spreadsheets to sophisticated computer systems. The real challenge, however, is to link the chemical container information to both hazard reference data and to building space data to meet regulatory reporting requirements. Data management challenges also include the need to aggregate chemicals by respective hazard category, rather than solely by chemical name. Existing commercial applications, in addition to be relatively expensive, were unable to accomplish these required functional tasks.

A solution that will benefit higher education and others is to take advantage of the utility of the Web to provide a comprehensive chemical inventory management and reporting system that is accessible to all higher education organizations in the country. A web-based system requires only a Web browser on a local desktop computer connected to the Internet to access a comprehensive management system and reference database, thereby reducing costs to the higher education and not-for-profit sectors. There are literally thousands of institutions, including community colleges and hospitals with laboratories that have need for such a system for identification, tracking and reporting of the chemicals used in their facilities.

CHEMTRACKER BACKGROUND

Stanford University is a large, dynamic educational and research organization. The physical campus consists of over 8,100 adjacent acres located in six different governmental jurisdictions. There are 678 major buildings with over 12.5 million square feet of floor space. There are approximately 2,000 labs on campus with about 180 buildings and facilities where chemicals are permitted for use and storage and for which reporting is required. The inventory history at Stanford began in the mid-1980s with the collection of information on paper. In 1987, a desktop computer was used for transposing the data to a simple database for ease of manipulation of large quantities of chemical inventory information. In the early 1990s, the Uniform Fire Code and Uniform Building Code, model consensus codes adopted by most jurisdictions west of the Mississippi river, incorporated quantity limitations on the amount of hazardous materials that could be stored or used within building fire control areas. As a result, the need arose to ensure users of chemicals were in compliance with these new requirements. Based upon this significant regulatory driver, Stanford began a review of the chemical inventory system needs by including all stakeholders in an extensive process improvement study.

STUDY PROJECT FINDINGS

A project to clearly identify system needs was undertaken. This involved extensive benchmarking with approximately 50 institutions ranging from other academic facilities and government laboratories to private companies. A key finding from the benchmarking was that none of the institutions were completely satisfied with the solution they were currently using. From internal stakeholder meetings, it was determined that for any system to be effective it must generate compliance as a by-product of conducting the core business, allow flexible implementation and maintenance of data, and provide value to the core user. It must also be adaptable to new regulatory requirements, be sustainable and scalable for the long-term use, and integrate with purchasing and space management systems. This study led to the development of an improved process for chemical inventory on campus. It also resulted in an extensive list of functional requirements necessary for any system to meet both the institutional need for a compliance management tool, as well as a system for maintaining chemical inventories by laboratories and other chemical-use sites on campus. The initial goal was to identify an existing commercial system to meet Stanford's needs. However, after extensive review of existing systems, and several RFP processes, no available solution existed that would meet the functional and program needs for the University environment.

It was at this point that Stanford EH&S decided to develop a web-based chemical inventory and reporting system. Utilizing contracted programming support working very closely with EH&S subject matter experts a web-based system was developed over a 10-month period and subsequently implemented to the campus. This system has evolved into the ChemTracker chemical inventory system.

ChemTracker implements a system of users, chemical owners and groups (Figure 1). All chemicals and materials are linked to a "chemical owner." This distinction allows users of different categories to access the information necessary to perform their responsibilities. For example, Environmental Health & Safety personnel may have access to all inventory, all reporting capabilities, and user administration. A researcher in the lab may require read only access only to a specific principal investigator's inventory. A lab manager may need the ability to see inventory flagged for purchasing, add inventory, delete inventory, view and move inventory from room to room, etc. Different categories of users can be provided varying levels of access to the data and information, based upon their need and use of the

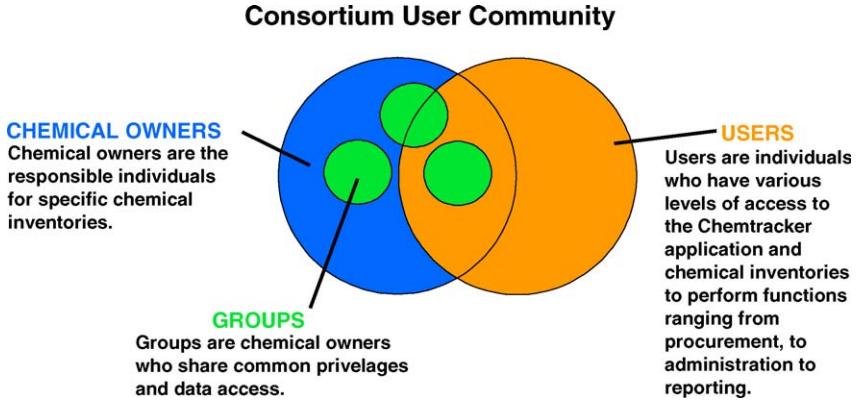

Figure 1. Inventory user community relationships.

information. This access is controlled by the "owner" of the chemicals for that group or area. For laboratories, principal investigators are normally the designated "chemical owner" while for non-laboratory areas such as shops and studios, supervisors are often designated as the chemical owner.

ChemTracker's Reference Database is the product of significant investment and years of research at Stanford University. ChemTracker protects the quality and integrity of its reference data with a strictly enforced data policy and domain experts with chemical, regulatory and database administration expertise. With ongoing research ChemTracker continues to build its compendium of reference data. Research is collected from approved and ranked data sources and noted in a material's bibliography. Regulatory analysis is conducted and classifications are made by approved authorities and or presented to the regulatory body for approval. Materials are then reviewed and validated by domain experts and graded by quality of the classification and data. Approved data is promoted to the production database.

Baseline inventory and facility information is uploaded or input into the ChemTracker application and linked to the ChemTracker Reference Database. The ChemTracker Reference Database contains extensive chemical and regulatory information on over 11,000 unique chemicals with over 49,000 synonyms. Inventory, hazard communication and a variety of regulatory compliance reports can be generated at the click of a mouse.

The ChemTracker system has many features that can only be truly evaluated by viewing and working with the system. The system starts with adding records, editing and deleting records, searching inventory and, most importantly, regulatory reporting. To maintain the data in a state of readiness for reporting, the system only permits the entry of data that is validated against established reference tables. Every inventory record in the database has a system validated owner, department, building, room and chemical name, as well as validated units of measure. Accurate compliance reports cannot be provided unless a system has such a validation process in place.

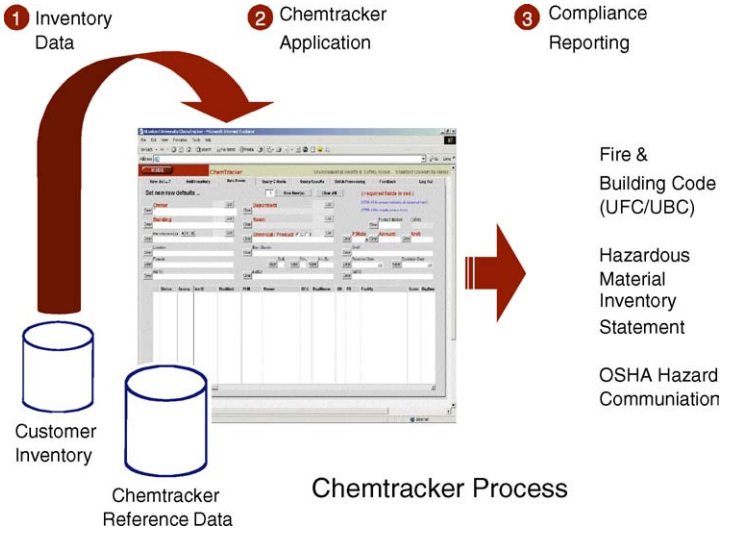

Figure 2. The ChemTracker process.

APPLICATION SECURITY

ChemTracker's servers are housed in a secured data center within Stanford University. Each user is issued a password to gain access to the system. The database containing reference data and client inventory records are behind multiple layers of security and mirrored for disaster recovery (Figure 2).

The ChemTracker user interface utilizes an approach of providing screens that mimic a spreadsheet, an interface that is familiar to most users and a feature that has been developed based upon feedback from laboratory users of the system. This interface is within the Web browser environment, but is significantly more flexible and user friendly than html pages which are used by most systems.

INVENTORY: ADD SCREEN

On the Add screen within the application, users can add chemicals directly into their stock by entering one of over 70,000 Manufacturer product numbers or by completing the following required information: Chemical Owner, Department, Building, Room, Chemical Name, Physical State, Amount per Container, Units of Measure. Default values can be saved for each of these fields. If the chemical name is selected from the pick list, the chemical is automatically

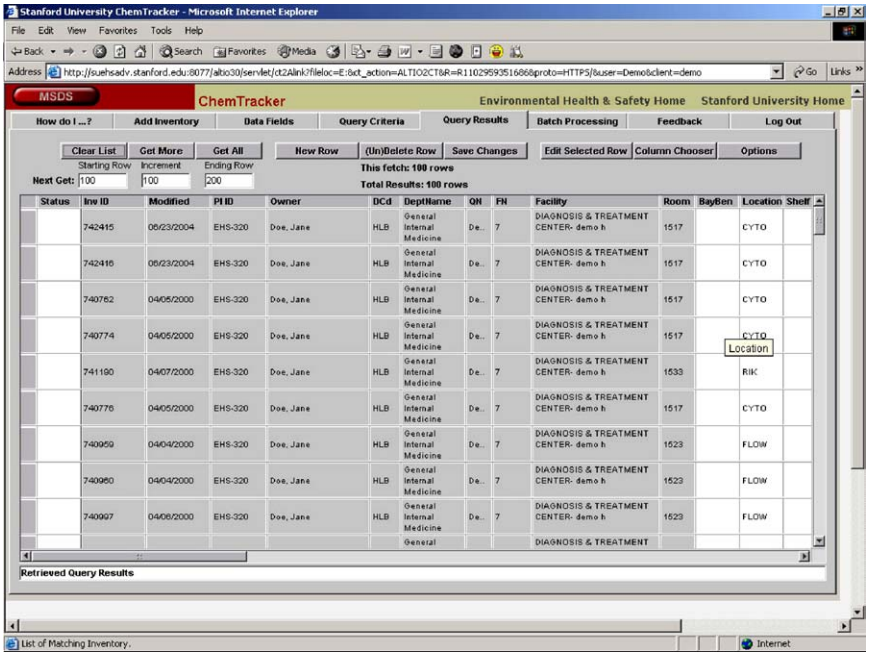

Figure 3. Inventory query (search) and results screen.

linked to ChemTracker reference data. A multiple save feature can also be used to save multiple records of the same inventory container type.

INVENTORY: QUERY (SEARCH) AND RESULTS SCREEN

Query reports allow chemical owners and users to view their chemical and hazardous material inventories as well as create ad hoc reports of interest to the laboratory user (Figure 3). These reports are typically used to assist in physical inventory counts, edit inventory, determine storage comparability, identify presence of specific hazard type materials, and to present an inventory snapshot.

The search screen within the chemical inventory management application allows users to add, view, edit or delete items in their inventory on a centralized database. Depending on user privilege level, this can be made available in a full version or a read-only version. Inventory items can be queried on one or any combination of the following field values: Inventory ID, Chemical owner, Department, Building, Room, Manufacturer, Product Number, Chemical Name, Physical State, Amount, Unit, Formula, Storage Group, GDN, Bay/Bench, Location, Shelf, Modify Date, Modify By, Inventory By, Expiration Date, Privacy, Surplus, and any of the three User Defined Fields.

From the Query screen, a user can choose to generate any number of ad hoc inventory reports including hazard communication, storage group update reports, chemical name update reports, or to move inventory to card files or an Excel spreadsheet. Relevant safety information on a chemical can be obtained by clicking the safety information icon. This safety information includes building code and fire code classifications, NFPA classifications, DOT information, hazard types, physical properties and other identifiers for the selected material. Additionally, the user can process inventory for the selected records that allows moving, copying or deleting the queried inventory. EH&S staff can easily produce reports and also scan a campus for specific chemicals of interest from a health and safety or regulatory compliance perspective.

HAZARD COMMUNICATION AND SAFETY INFORMATION

Additional reporting within the inventory management application allows users to obtain hazard information on specific chemicals and materials or generate reports of their inventory by hazard type. The system provides flexibility for organizations to determine how to manage and control the core data for the program while the central application addresses the relationship of a user's chemical materials to relative hazards for subsequent regulatory reporting. Administrators can assign user, chemical owner, and departmental designations as needed to suit the organization's needs. The system can be implemented centrally or it can be decentralized and used as a chemical receiving system, a stock room management system, or as a standing inventory system at the floor or laboratory level. Users can pick chemicals off a valid pick list or can enter a chemical not found on the list. Additional uses of the system include reviewing inventories, tracking date-sensitive chemicals, and identifying and encouraging the redistribution of surplus chemicals.

ChemTracker can also provide direct links to an institution's electronic MSDS systems as well as numerous third party MSDS solutions, which can be made available to the entire organization, and allows MSDS searches for specific inventory items integrated into the ChemTracker solution.

COMPLIANCE REPORTING

The Regulatory Reporting application allows users to select standardized compliance reports for facilities, control areas or facility groups. These reports can be generated with a click of the mouse by the local user or EH&S administrator at any time or for formal submission to a regulatory agency.

REPORT FORMATS

Reports are generated in the most widely accepted formats by regulatory sovereignty. Reports are presented on the screen in either HTML format or PDF file format. They can easily be printed or posted to a web site for review from these formats. Regulatory reporting routines are available for

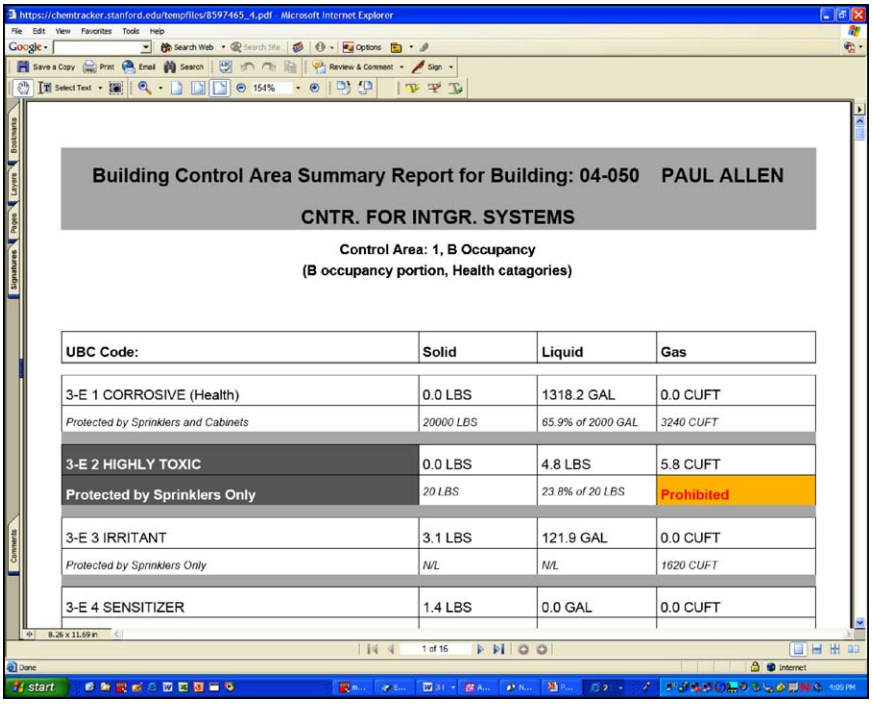

Figure 4. Building/fire code hazardous materials compliance report.

standard Hazardous Materials Inventory Statements reporting, such as SARA 313 or reports for the LEPC, as well as analyzing and reporting of building occupancy classifications based on fire and building code requirements (Figure 4). The system also simplifies projections of the chemicals to be used in a planned facility by moving or copying groups of data into new 'virtual buildings' allowing them to be analyzed for hazardous materials compliance and building design requirements by architects and engineers. Many jurisdictions now require the submission of fire and building code hazardous materials compliance reports prior to issuance of a permit to build a new facility or renovate an existing building. Prior to development of this system, Stanford project management would expend $75,000 to $100,000 on consultants to develop a single building code report for a proposed new building. With the use of the ChemTracker system, such reports are quickly and efficiently provided with just a few mouse clicks, and all via the web browser.

At Stanford, each laboratory has listings of aggregate hazard amounts and complete inventory of the materials stored within posted at its entrance for easy access by emergency personnel. This is part of the Life Safety Box (LSB) system used to provide laboratory specific emergency information (Figure 5). Researchers and EH&S share the responsibility for making sure the contents of the LSB are current. A properly filled LSB includes:

- LSB Cover sheet (EH&S);
- Guide to Hazard Quantities (EH&S);
- Hazardous Materials Inventory (EH&S);
- Emergency Contact Notification Sheet (Department or lab);
- Chemical Storage Map (Department or lab).

The front of each LSB has DOT hazard stickers to indicate the presence of a significant amount of chemical, radiological, biological and other hazards such as Prop 65 warnings, etc. The interior of the LSB contains information regarding the specific chemicals in the room, emergency contact information and a diagram of the room.

EH&S updates the LSB cover sheet based on the hazardous materials inventory reported by the laboratory.

ADMINISTRATION OF THE SYSTEM

The user administration application within ChemTracker allows a local program administrator to set privileges for specific users, add users to groups, add users to departments, monitor user activity and link users to chemical owners. Additionally, the local program administrator can establish the tables for chemical owners, users, buildings and other data necessary for validation of specific data elements. The Administrator toolkit within the ChemTracker system simplifies the setup process and eliminates the need for localized IT support.

CHEMTRACKER ADVANTAGES

The advantages of the system include centralized, safe and secure off-site data storage with easy, distributed access via web browser. The laboratory personnel or chemical owners are responsible for data entry eliminating transcription errors and work redundancy. The system also provides immediate feedback and is adaptable to individual in-lab chemical management processes and business rules.

Real-time monitoring of chemical hazard information by users, departments or EH&S enables more effective compliance and access to information. The system supports fire and building code compliance as well as other EH&S operational needs such as identifying locations of select agents, carcinogens, toxic gases, cylinder tracking, etc., and allows EH&S to add value to the business. In the words of a Professor of Organic Chemistry, "You guys finally did something right!"

CHEMTRACKER CONSORTIUM – THE HIGHER EDUCATION COLLABORATIVE

After successful implementation and use at Stanford and significant interest and use by other organizations, Stanford's chemical management solution is accessible to other not-for-profit institutions through consortium user group collaboration. The system is currently used by twelve colleges and

Figure 5. Life safety box system.

universities and one hospital clinical laboratory. This application service provides powerful tools for consortium members to control their chemical inventory, access safety information, maintain inventories, review compliance and generate regulatory reports directly from their own web browser. With need for minimal local IT support, this system encourages rapid user acceptance, facilitates single click compliance reporting and supports best in class lab safety management.

The ChemTracker Consortium is a collaborative undertaking that serves as a forum for the interchange of information and creative resolution of inventory related management and systems issues for participating institutions. Member institutions provide enhancements to the system that are shared by all participants, thereby promoting the consortium approach in higher education. The consortium also provides for continued development of the EH&S programs serving smaller colleges and universities. Ultimately, the vision for the higher education community is to provide a support service to small colleges and community colleges that need such tools for compliance and safety management.

For further information about the ChemTracker Consortium for Higher Education, contact Sheldon Heitz, Consortium Manager or Larry Gibbs, Associate Vice Provost for EH&S at Tel.: 650 723 0448 or send an e-mail to Sheitz@stanford.edu.

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