

Sigma-Aldrich's Waste Management System – A Case Study

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ABSTRACT

A cradle-to-grave waste management system was developed for Sigma-Aldrich Co. to streamline their waste handling procedures. The system starts with the various waste generators notifying environmental of the need to collect waste and then tracks the material through waste collection, containerization, as well as the storage and manifesting process.

The waste management system is both intranet- and Windows-based. The system was developed to allow the environmental department to streamline their operations by maximizing the input of information by the waste generators in intranet modules along with using barcode scanners to easily and quickly track and follow waste throughout the system.

The waste management system tracks hazardous and non-hazardous waste from the waste generators in the form of liquid or solid waste through liquid bulk shipments, lab pack containers, and drums. The system also contains a compliance tickler system that alerts environmental when regulatory clocks require action.

The reporting module prints summaries of waste in storage areas, waste manifested and detailed reports of the cost associated with the waste management process.

The waste management system has allowed the environmental department to increase their capability to handle and process a larger volume of waste with a reduced number of staff as compared to the pre-waste management system operations.

INTRODUCTION

A cradle-to-grave waste management system was developed for Sigma-Aldrich Co. to streamline their waste handling procedures. The system starts with the various waste generators in over 200 laboratories covering multiple facility locations notifying environmental of the need to collect

waste. The system then tracks the material through waste collection, containerization, as well as the storage and manifesting process.

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SYSTEM OVERVIEW

The Sigma-Aldrich Waste Management System was developed to replace the manual system of processing and tracking hazardous and non-hazardous material. In the manual system, each department disposing of material would fill out a paper Waste Transfer Form (WTF) requesting a pick-up of material and then send these forms to Environmental Services through inter-office mail. Delivery of the forms through inter-office mail usually would take a day to arrive. Once Environmental Services received these forms, the material to be collected was classified by an environmental technician. The technician would research each material on the company mainframe to classify its DOT proper shipping name. The technician then would write the physical properties and shipping information on the collected form. This research effort was a very time consuming process and had to be done for every form even if the same material has been handled before, since the material's property information may have been updated since last handled.

After the classification process was complete, the material was collected and brought to Environmental Services for containerization. As material was placed in the containers, the hand written forms were then organized by container with a master coversheet form manually filled out for the container. The containers were then sealed and placed in approved storage locations prior to shipment. A daily inventory of the storage areas was taken and Environmental Services personnel who manually logged the inventory into logbooks.

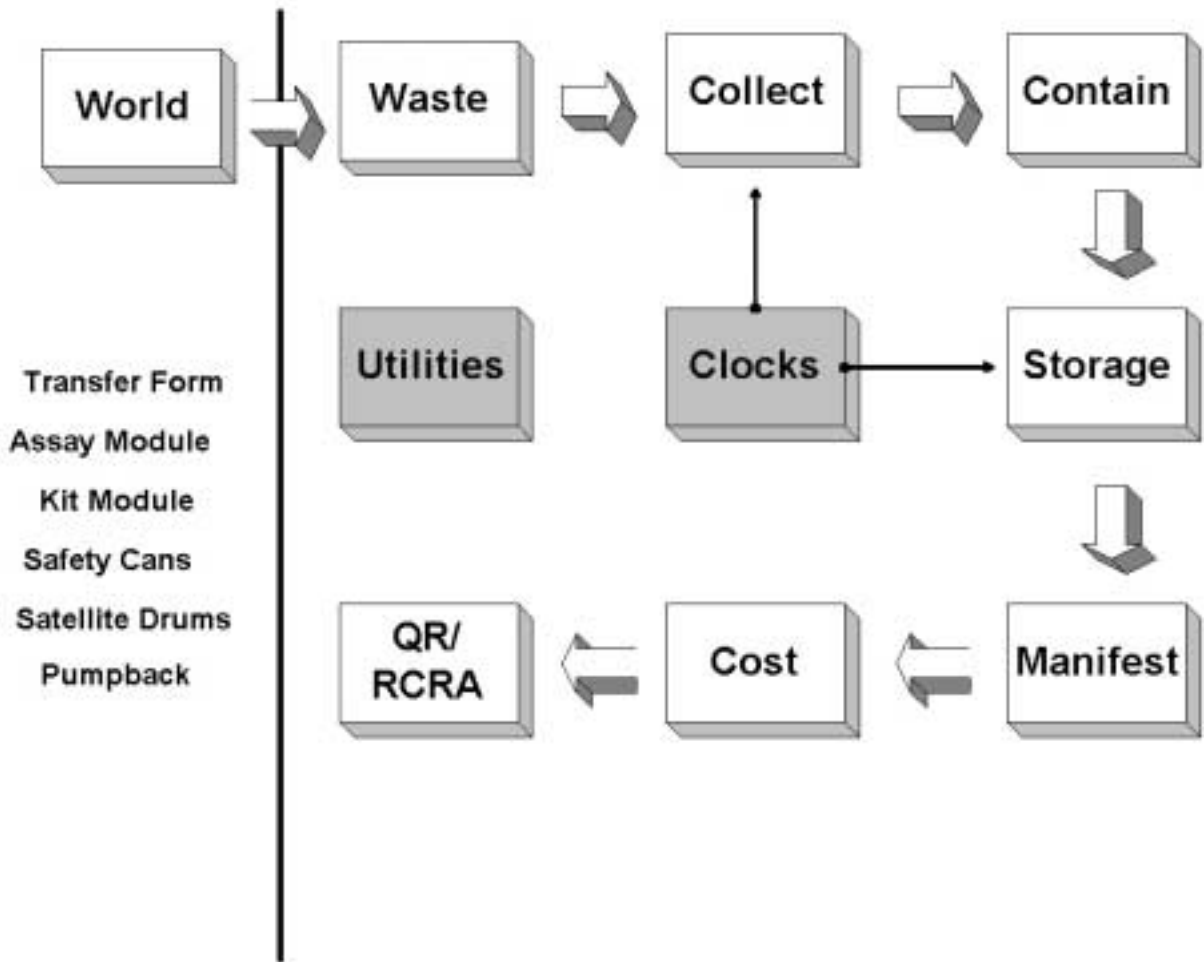
At the time of shipping, manifests were manually prepared and all follow-up costs charged back to each department was also manually prepared using spreadsheets.

The Sigma-Aldrich Waste Management System was developed to speed-up and streamline, what was once a manual system of material processing and tracking.

The Sigma-Aldrich Waste Management System was developed using Microsoft's Visual Basic 6. The underlying databases used throughout the system are Oracle and Microsoft Access. The reports that are produced in the system use Crystal Decision's Crystal Reports.

The system is comprised of two sections: intranet web-based applications available facility-wide, and a Window-based application only available to users in Environmental Services. Figure 1 shows the overall layout of the waste management system.

Figure 1. Overview of the Waste Management System.



The section labeled “World” represents the intranet applications by which individuals throughout the 200 plus laboratories at various locations alert Environmental Services of material ready for pick-up. The volume of waste now processed via the intranet modules numbers in the thousands of individual pieces per month whereas with the previous manual process only hundreds per month were processed.

These intranet modules include:

- Waste Transfer Forms
- Assay Module
- Kit Module
- Safety Cans
- Satellite Drums
- Pumpback

The Windows-based modules are used by Environmental Services personnel to manage, process, ship and report the materials collected from various laboratories on-site.

The new system also contains many administrative utilities that are maintained by Environmental Services and the data in these utilities are used to fill drop lists in the other programs to minimize the typing required by a user.

The key support databases in the system are as follows:

- Chemicals
- EPA / State Codes
- Destination Facilities
- Transporters
- Research History
- Facility Information
- Storage/Site Locations
- Container Types
- Material States/Types
- Units of Measurement

The Waste Transfer Form intranet application (Figure 2) allows users to alert Environmental Services personnel of material to be picked-up by filling out online an electronic Waste Transfer Form (WTF). The reason for this module being an intranet application is due to the volume of users and the ease of updating the program when required. With personnel from over 200 laboratories entering waste information, having a visual basic program for this function would require an inordinate amount of maintenance every time an update was released. As an intranet HTML application, every time users run the application in the browser they are running the most recent version.

The WTF requires the user to enter their name, department, telephone extension, building location and the Sigma-Aldrich specific catalogue, stock or unique material profile ID number of the material. The system then looks up the research information on the material in an on-line history file and adds all physical properties and DOT handling and shipping information to the electronic WTF.

Figure 2. Waste Transfer Form.

The screenshot shows a web browser window with the following elements:

- Browser Title:** WTF Form - Microsoft Internet Explorer
- Address Bar:** C:\PROJECTS\Sigma - Waste (Demo)\World Side\WTFFRM.htm
- Form Title:** Waste Transfer Form
- Form Fields:**
 - Filed By: [Text Input]
 - Department: [Text Input]
 - Extension: [Text Input]
 - Waste Name: [Text Input]
 - Waste Type: [Dropdown Menu]
 - Waste ID: [Text Input]
 - State: [Dropdown Menu]
 - Waste Description: [Text Input]
 - Location: [Dropdown Menu]
- Containers Section:**

# of Cont.	Amount/Cont.	Units	Type
[Text Input]	[Text Input]	[Dropdown Menu]	[Dropdown Menu]
[Text Input]	[Text Input]	[Dropdown Menu]	[Dropdown Menu]
[Text Input]	[Text Input]	[Dropdown Menu]	[Dropdown Menu]

When a material is not found in the on-line research history database, a new record is added with any physical property data provided by the user. This new material information is then added to the history database and will now be available for future requests.

The intranet users also enter the number of containers to be collected along with the container type and weight. Each WTF request is then given a unique tracking number and the local requestors can printout a hard copy of the request.

Environmental Services is then electronically notified and a hard copy form is printed at Environmental Services indicating what materials need to be picked-up and where they are located. Both the local printout in the laboratory and the Environmental Services copy contain a barcode corresponding to the WTF's tracking number (Figure 3).

Figure 3. Waste Transfer Form Printout Example with Barcode.



990300001

MATERIAL TRANSFER FORM

Date of Generation: 03/05/99

Catalog Number : W1000
Material Name : WHEAT GERM OIL
Log Number : 990300001
Description of Material : WHEAT GERM OIL
Material Type : MISC. LAB, LIQUID/SOLID
Material State : LIQUID
Department Number : 89
Location : Site 1
Filed By : JOHN DOE
Extension : 1234

Container Number	Container Quantity	Units	Container Type
2	100.00	MILLILITERS	GLASS
1	500.00	MILLILITERS	GLASS

Material to be collected by Wednesday, March 10

If not, Please call Ext. 9876 - Tech 1
5432 - Tech 2
1987 - Supervisor

From the printouts that arrive in Environmental Services, a collection is made of the waste indicated on the received WTFs. Using portable barcode scanners, Environmental Services personnel scan the printed pickup request sheet in the laboratory during the pick-up run to verify collection and then they attach the sheet with the material. The collected material is then taken to one of five Environmental Services sites for sorting and containerization.

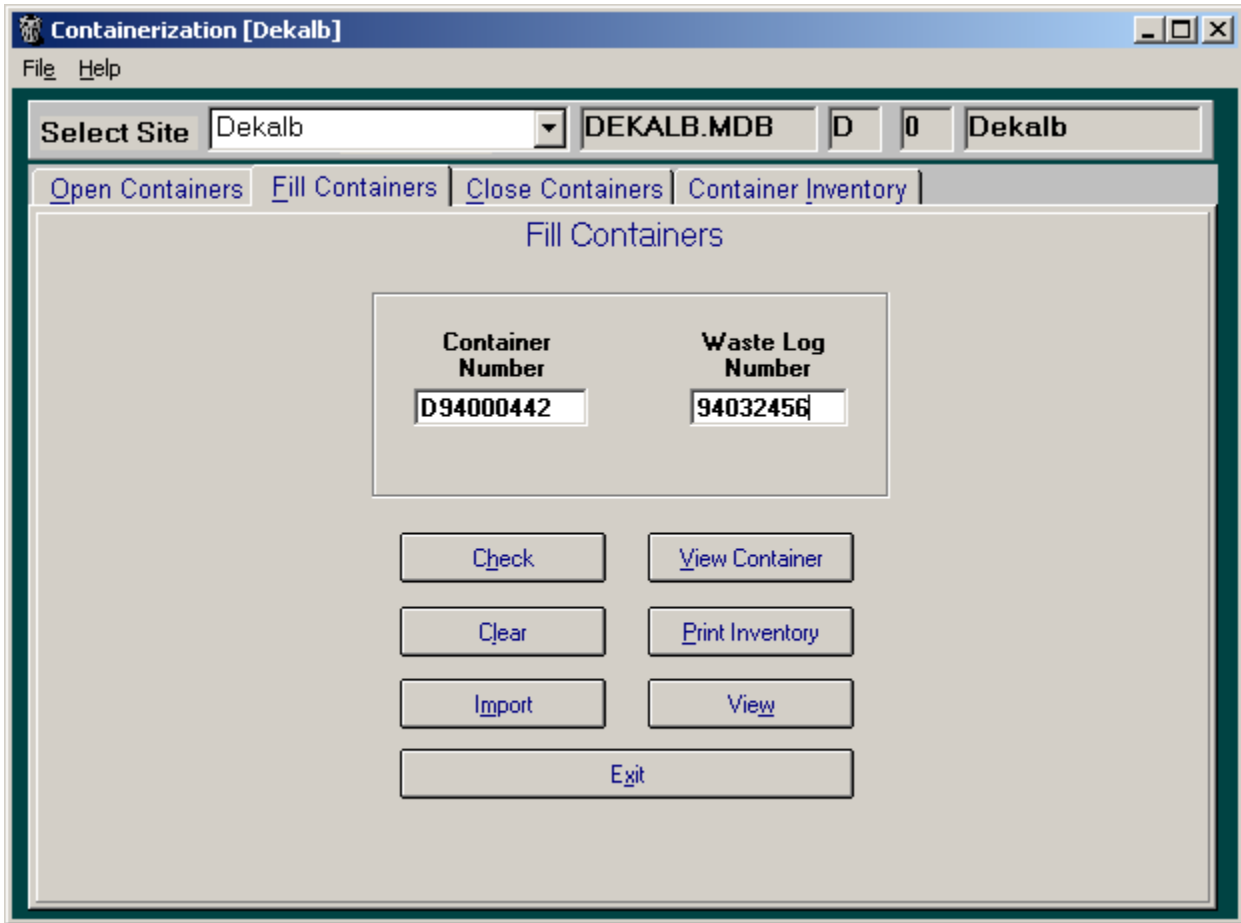
The data from the hand-held scanner is downloaded and the WTFs are automatically marked in the system as collected along with the date. The system tracks that the requested material is picked up from the requestor by Environmental Services within the regulatory prescribed 3-day period.

The collected material is then sorted by Environmental Services and packed in larger containers. Since the system has already classified the material from the on-line research database, the sorting of material by its DOT proper shipping name and hazard class is much easier. Environmental Services personnel use the system to track via barcode scanning what material is placed in the various containers. Technicians first use the system to record the opening of a new container (Figure 4), then scan the container number, and then scan each of the items as they are placed in the container (Figure 5).

Figure 4. Containerization Screen to Open a New Container in the System.

The screenshot shows the 'Containerization [Dekalb]' software interface. At the top, the window title is 'Containerization [Dekalb]'. Below the title bar is a menu bar with 'File' and 'Help'. The main interface area has a 'Select Site' dropdown menu set to 'Dekalb', followed by 'DEKALB.MDB', 'D', '0', and 'Dekalb'. Below this are four tabs: 'Open Containers', 'Fill Containers', 'Close Containers', and 'Container Inventory'. The 'Open Containers' tab is active, displaying a form with the following fields: 'Container Number' (D03000091), 'Date Opened' (01/23/2003), 'Container Type' (DRUM, 55 GAL.), and 'Waste Type' (USED OIL-95/NC). At the bottom of the form is a 'Record 1 Of 76' indicator. To the right of the form is a 'Controls' panel with buttons for 'Top', 'Previous', 'Next', 'Bottom', 'Save', 'Add', 'Delete', 'Print Label', 'View Contents', 'Find', and 'Exit'.

Figure 5. Containerization Screen for Recording the Placement of Material into Containers.



When a container is filled and sealed, the system is used to print a container inventory of all packed material (Figure 6). The sealed containers are then moved to storage locations to await shipping to an approved facility (Figure 7).

Figure 6. The Containerization Screen to Close and Classify a Container.

The screenshot shows a software window titled "Containerization [Dekalb]". At the top, there is a menu bar with "File" and "Help". Below the menu bar, a "Select Site" section contains a dropdown menu set to "Dekalb", a text box with "DEKALB.MDB", a dropdown with "D", a text box with "0", and another dropdown with "Dekalb".

Below this is a navigation bar with four tabs: "Open Containers", "Fill Containers", "Close Containers" (which is highlighted with a dashed border), and "Container Inventory".

The main area is divided into two sections: "Container Information" and "Constituents".

Container Information:

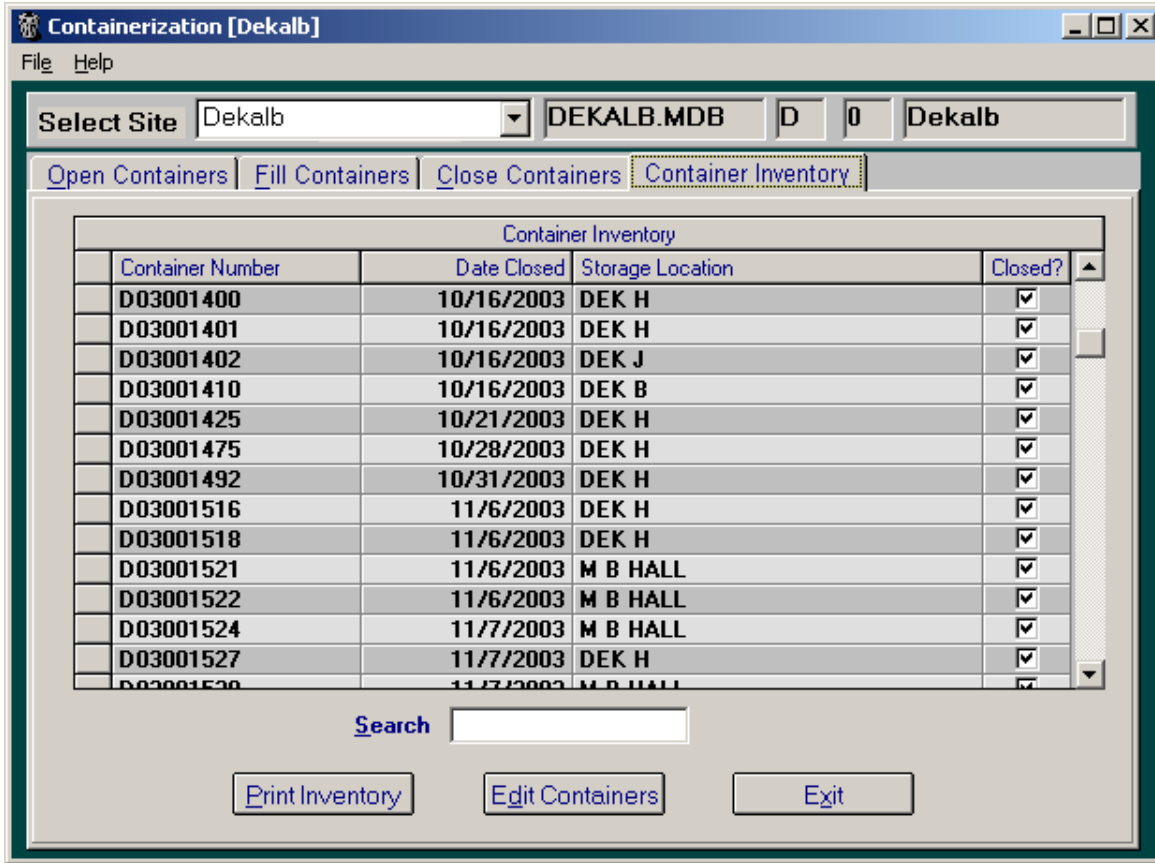
- Container Number:** A text input field.
- Weight:** A text input field.
- Storage Location:** A dropdown menu.
- Closure Date:** Radio buttons for "Today" and "Yesterday".
- Packing Group:** Radio buttons for "I", "II", and "III".
- Log Weight:** A text input field.
- DOT Proper Shipping Name:** A dropdown menu.
- Guide Number (UN/NA):** A text input field.
- Emergency Response #:** A text input field.
- Hazard Class:** A text input field.
- RQ:** A checkbox.
- Print Inventory?:** A checkbox.
- Vendor:** A dropdown menu.
- Profile:** A dropdown menu.

Constituents:

- Two text input fields, each with a dropdown arrow on its right side.

On the right side of the window, there is a vertical toolbar with the following buttons: "Start", "Add", "View", "Close", "Clear", "Cancel", "View Containers", "Print Container", and "Exit". To the right of this toolbar are two vertical labels: "Container Information" and "State Codes".

Figure 7. Containerization Screen - Storage Location of Closed Containers



The Storage Module in the system tracks the location of each container and how long it has been stored on-site (Figures 8 & 9). The system also automatically checks regulatory compliance clocks to make sure containers stored at the storage locations are not approaching any daily time limits on material storage. Printed reports are available to aid Environmental Services personnel in grouping material for shipment off-site.

Figure 8 Storage Location Module - Specific Information About a Container.

The screenshot shows a software window titled "Storage [Dekalb]". The main area displays information for "Container 142 Of 142". The data is organized into several sections:

- Container Information:** Container Number (D97001554), Storage Location (SHIP), Container Type (PALLET).
- Material and Date:** Material Type (EC), Date Closed (06/18/1997), Weight (300).
- Shipping Details:** DOT Proper Shipping Name (NON-REGULATED MATERIAL), Packing Group (PG II).
- Hazardous Material Info:** Guide Number (UN/NA) (NONE), Emergency Response # (NONE), Hazard Class (NONE), and a checkbox for RQ.
- Vendor and Profile:** Vendor (Vendor 1), Profile (1234-55).

On the right side, there is a "Controls" panel with buttons: Top, Previous, Next, Bottom, Save, Print, Find, and Exit. Below this is a vertical navigation bar with "By Container" and "By Location" options.

At the bottom, there is a "Constituents" section with two empty dropdown menus. Next to it is a list of "EPA Codes" (D001, D002, D003, D004, D005, D006) with navigation arrows. To the right of the EPA codes is a "Selected EPA" field.

The bottom of the window features a navigation bar with buttons for "Dekalb", "South 2nd Street", "Ewing", "Broadway", and "RadioChem".

Figure 9. Storage Module Screen of Container Inventory at a Location.



The Manifesting module allows Environmental Services personnel to create shipments using the material in storage to approved disposal sites (Figures 10 - 12). The Manifesting module allows the user to easily build shipments, view completed manifests (Figures 13-15) and print manifests on individual state forms. Since each container has been already classified, the system is used to prevent incompatible materials from being placed on the same shipment. When material is shipped off-site, all of the tracking data for each shipment is archived to prevent the system database from growing too large, but still allowing access to satisfy environmental requirements.

Figure 10. Manifesting Screen Used to Build a Shipment of Containers.

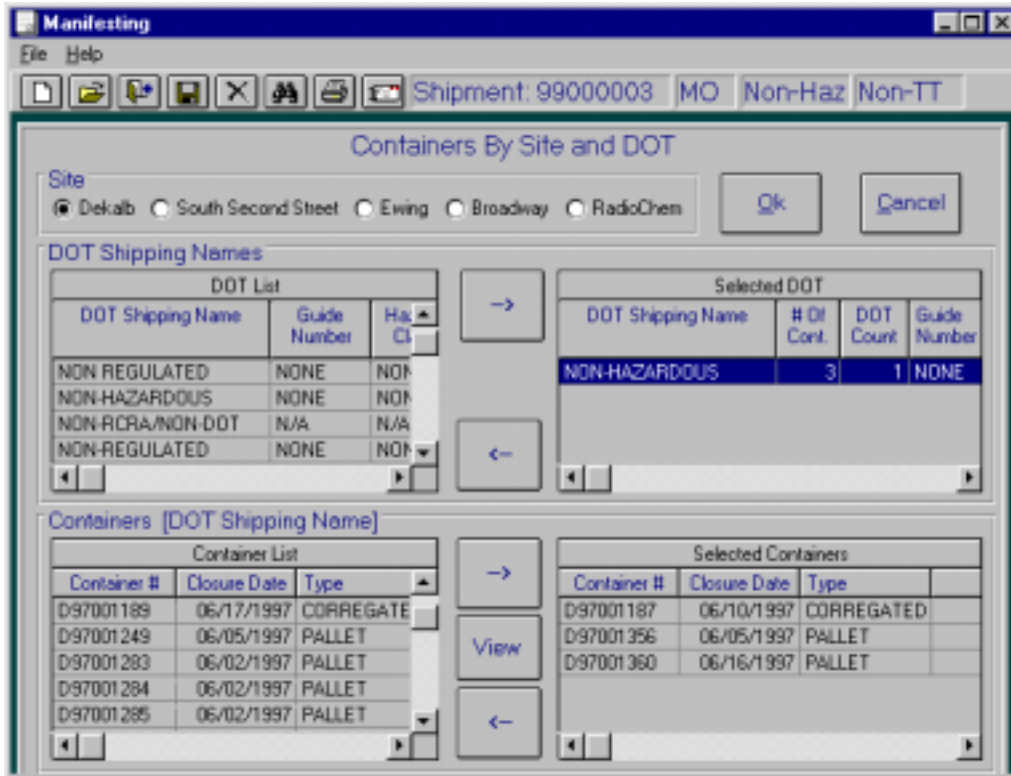


Figure 11. Manifesting Screen for Bill of Lading Showing Facilities Used.

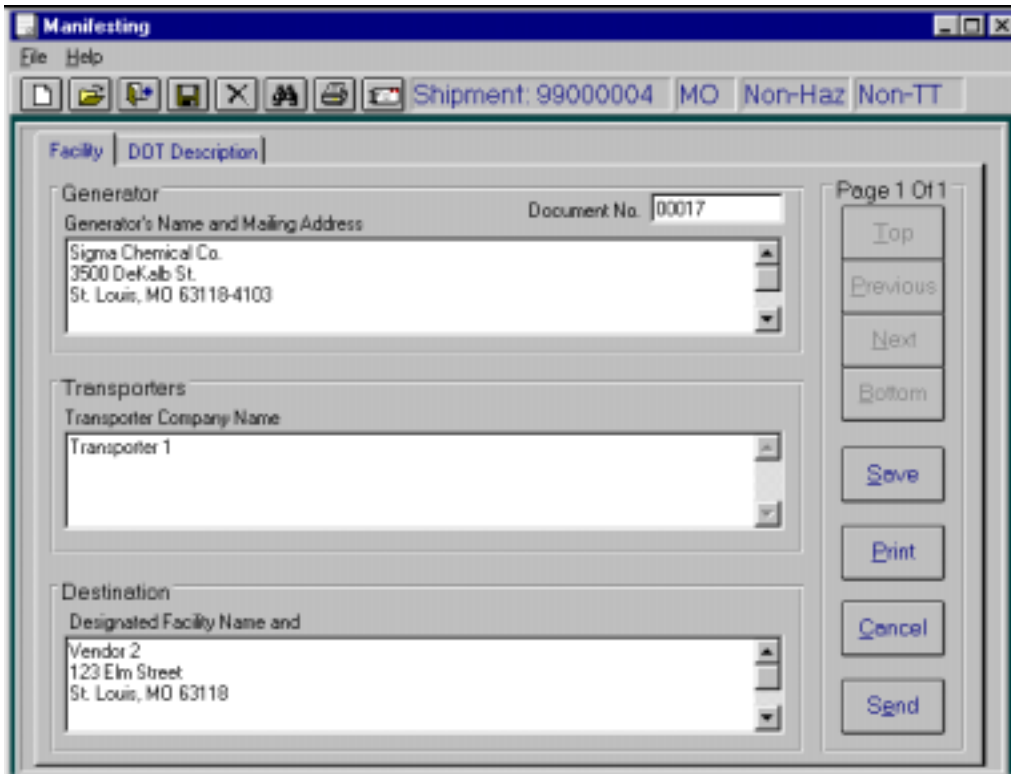


Figure 12. Bill of Lading Showing Material Shipped.

The screenshot shows a software window titled "Manifesting" with a menu bar (File, Help) and a toolbar. The main area displays a table with columns: Facility, DOT Description, No. Packages, HM, Description, ERG #, Weight, and Class or Rate. The first row is populated with the following data:

Facility	DOT Description	No. Packages	HM	Description	ERG #	Weight	Class or Rate
		3 (CF)	<input type="checkbox"/>	NON-HAZARDOUS EC-HM	N/A	1075	
			<input type="checkbox"/>				
			<input type="checkbox"/>				
			<input type="checkbox"/>				
			<input type="checkbox"/>				

At the top of the window, there is a status bar showing "Shipment: 99000003 MO Non-Haz Non-TT".

Figure 13. Manifest Viewer Facility Information.

The screenshot shows a "Facilities" tab in a manifest viewer. The form is divided into three main sections: Generator, Transporters, and Destination. The data entered is as follows:

Generator

- 1. Generator's US EPA ID No.: MOD00000000
- 2. Manifest Document No.: 00003
- A. Missouri Manifest Doc. No.: 01234
- 0003
- 3. Generator's Name and Mailing Address: Sigma Chemical Co., 3500 DeKalb St.
- B. G.S.I. (Gen. Site Address): Same
- 4. Generator's Phone: (314) 771-0000

Transporters

- 5. Transporter 1 Company: Transporter 2
- 6. US EPA ID Number: ILD000000001
- C. MO Trans. ID: MD123
- D. Trans Phone: (618) 123-4567
- 7. Transporter 2 Company: (empty)
- 8. US EPA ID Number: (empty)
- E. MO Trans. ID: (empty)
- F. Trans Phone: (empty)

Destination

- 9. Designated Facility Name: VENDOR 2, ELM STREET, ST. LOUIS, MO 63118
- 10. US EPA ID Number: MOD010101010
- G. State Facility's ID: XX-123
- H. Facility's Phone: (314) 987-6543

On the right side of the form, there are navigation buttons: Top, Previous, Next, Bottom, Save, Print, Cancel, and Send. The page indicator shows "Page 1 Of 1".

Figure 14. Manifest Viewer Showing Material in Shipment.

Facilities		DOT Description		Additional Description		Special Handling	
11A. US DOT Description	12. Containers Number	12. Containers Type	13. Total Quantity	14. EPA Waste Code	14. EPA Waste Code	State Code	A.C.D.F.G.I.
CORROSIVE SOLID, N.D.S. 8 UN1759 PG II	001	DF	00005	P	NONE		
11B. US DOT Description	12. Containers Number	12. Containers Type	13. Total Quantity	14. EPA Waste Code	14. EPA Waste Code	State Code	
11C. US DOT Description	12. Containers Number	12. Containers Type	13. Total Quantity	14. EPA Waste Code	14. EPA Waste Code	State Code	
11D. US DOT Description	12. Containers Number	12. Containers Type	13. Total Quantity	14. EPA Waste Code	14. EPA Waste Code	State Code	

Figure 15. Manifest Viewer Showing Special Handling Instructions.

Facilities		DOT Description		Additional Description		Special Handling	
Special Handling Instructions							
<input checked="" type="checkbox"/> Avoid all ignition sources.							
<input checked="" type="checkbox"/> Return to generator if undeliverable as addressed.							
<input checked="" type="checkbox"/> Emergency phone #: (314) 771-0000							
<input checked="" type="checkbox"/> Attention: John Doe							
<input checked="" type="checkbox"/> Missouri Generator ID: 01234							
<input checked="" type="checkbox"/> Missouri Transporter ID: M0123							
<input checked="" type="checkbox"/> ERG's: A) 154							
Avoid all ignition sources. Return to generator if undeliverable as addressed. Emergency phone #: (314) 771-0000 Attention: John Doe Missouri Generator ID: 01234 Missouri Transporter ID: M0123 ERG's: A) 154							
Certifying Person: John Doe							

After material is shipped off-site, it is tracked in the systems costing module (Figure 16). The costing module also contains information on the return of manifest copies and the certificate of destruction. The final cost of the transportation and disposal is entered into this module for each shipment and a charge is issued back to each department from which the material was disposed.

Figure 16. Costing Module - Charge Breakdown Screen by Material Shipment.

Dept.		Costs						Quantity	
Dept	%	Disposal	Transp.	Demurrage	HW	Supply	Total Cost	Quantity	Units
▶ 20	0.9209	\$2,302.25	\$598.59	\$138.14	\$0.00	\$322.32	\$3,361.29	1,548.26	Pounds
30	0.019	\$47.50	\$12.35	\$2.85	\$0.00	\$6.65	\$69.35	32.0	Pounds
41	0.003	\$7.50	\$1.95	\$0.45	\$0.00	\$1.05	\$10.95	5.0	Pounds
55	0.0066	\$16.50	\$4.29	\$0.99	\$0.00	\$2.31	\$24.09	11.03	Pounds
58	0.0297	\$74.25	\$19.31	\$4.46	\$0.00	\$10.40	\$108.41	50.0	Pounds
95	0.0208	\$52.00	\$13.52	\$3.12	\$0.00	\$7.28	\$75.92	35.0	Pounds

CONCLUSION

The Sigma-Aldrich Waste Management System was designed to improve upon the manual process of collecting, processing, shipping and reporting of waste disposal. The fluid integration of this system into the Environmental Services business practices has allowed the department to streamline their operation and to process and manifest more material than thought was possible.

With this system the Environmental Services group has been able to increase throughput almost an order of magnitude with less personnel on staff. The system is also very dynamic and easily modified to incorporate new modules and reports to help increase efficiency.

KEY WORDS

EIMS, EMIS, Software, Management Systems, Waste Management System, Environmental Data Management