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# Design and Implementation of a University Chemical Management Platform Based on B/S Mode

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**Abstract:** ***This paper analyzes the current situation and existing problems of chemical management in the universities under the traditional mode, researches and develops a chemicals management platform based on B/S(Browser/Server), and introduces the structure, demand analysis, functional modules and implementation of the chemicals management system based on B/S mode. The using of this platform makes the whole life cycle of chemicals from purchase to destruction under real-time supervision and tracking, which realizes the high efficiency, accuracy, transparency and safety of chemicals management, and provides accurate data support for the management department to manage the chemicals in laboratory safely.***

**Keywords:** B/S mode, Chemicals, Waste, Safety management**.**

## 1. Introduction

University laboratories are important bases for implementing innovative education and scientific research. In recent years, laboratory construction has undergone rapid development. The diversification of academic programs and the expansion of research fields have led to a yearly increase in the use of chemicals in laboratories, as well as in the waste generated as a result. Consequently, traditional methods of managing chemicals and waste can no longer meet current demands. Any oversight in any part of the process may lead to serious laboratory safety incidents.

The management of chemicals and hazardous waste is a complex task. Due to the wide variety of laboratory chemicals and high transaction volumes, manual record-keeping can no longer meet operational needs. Additionally, factors such as diverse funding sources for chemical purchases, procedures for storage and retrieval, requisition processes, and waste disposal—coupled with university-specific management policies different from those for other equipment or consumables—increase management difficulties. This often results in chaotic chemical management and inefficient workflows in many universities, poor communication between storage and retrieval processes, ineffective internal coordination, and potential safety hazards during chemical use.

To solve these issues and ensure laboratory safety measures are effective, universities need to establish and improve information-based chemical management mechanisms as soon as possible. This will enable closed-loop management of chemicals from “purchase to disposal” and provide reliable information for laboratory management and regulatory departments. Therefore, leveraging modern technologies such as the internet, IoT, and mobile media to establish a management information system covering chemical procurement, storage, use, and waste recovery—enabling online monitoring and closed-loop management of chemical flows—has become imperative.

This paper, based on the context of biochemical laboratories at our university, designs and develops a chemical management system based on the B/S mode, applied to the information-based management of chemical procurement, storage, requisition, and waste disposal in laboratories.

## 2. System Design

### 2.1 B/S Mode Architecture Design

This system adopts a three-tier B/S (Browser/Server) architecture. As shown in Figure 1, in the three-tier B/S structure, the front-end only requires a browser installation with no additional development needed. The middle layer is the application server, which handles Web requests and executes business logic; We uses an IIS server. The back-end is the database for data storage, using the SQL Server database management system.

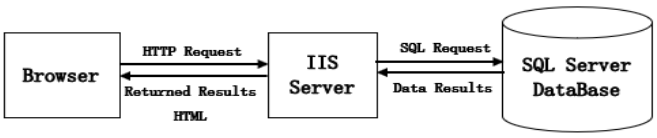


**Figure1:** Technical Architecture of B/S Mode

The B/S mode offers significant advantages over the C/S (Client/Server) mode: (1) Zero client installation and maintenance, low client performance requirements, greatly reducing user costs, with no impact on user systems and high security; (2) Cross-platform deployment and good compatibility—clients can use the system on any platform with internet access, ideal for the widespread use of mobile internet; (3) All business logic runs on the server side—whether for initial deployment or future upgrades and maintenance, only server-side programs need modification. Clients can immediately access the latest updates without any changes, ensuring convenient system expansion, consistent user experience, and reduced maintenance costs and efforts.

### 2.2 Requirements Analysis

This system aims to build an integrated chemical management system covering procurement, storage, requisition, and waste recovery. User roles in the system are divided into four types: System Administrator, Laboratory Supervisor, Chemical

Administrator, and General User.

1) System Administrator has the highest permissions, responsible for user identity management and system maintenance: including user addition, information modification, permission allocation, password resets, system data maintenance, and backups.

2) Laboratory Supervisor is primarily responsible for approving purchase orders and storage/retrieval requests.

3) Chemical Administrator is responsible for chemical and waste inventory registration, maintenance of chemical catalogs, etc.

4) General Users are primarily university faculty and students. They can query current chemical inventory status, apply for chemical use, and upon approval, requisition chemicals. They can also submit waste disposal requests, and upon approval, submit waste for unified, harmless destruction.

### 2.3 Functional Design

The chemical management system includes the following functional modules:

1) System Management: Operations by the System Administrator for user management, permission management, data maintenance, etc.

2) Chemical Procurement Management: Submit purchase requests for out-of-stock or low-stock chemicals, subject to approval by the Laboratory Supervisor. Approved requests generate purchase orders for real-time procurement.

3) Chemical Inventory Management: Register newly purchased chemicals into inventory, including details such as chemical name, packaging specifications, quantity, purchase date, invoice number, storage time, and storage location. Register chemical disbursement, including requisitioner, retrieval time, chemical name, packaging specifications, quantity, purpose, and estimated waste liquid/volume generated.

4) Waste Management: Submit waste disposal requests for administrator approval; approved requests are processed uniformly.

The functional modules are shown in Figure 2.

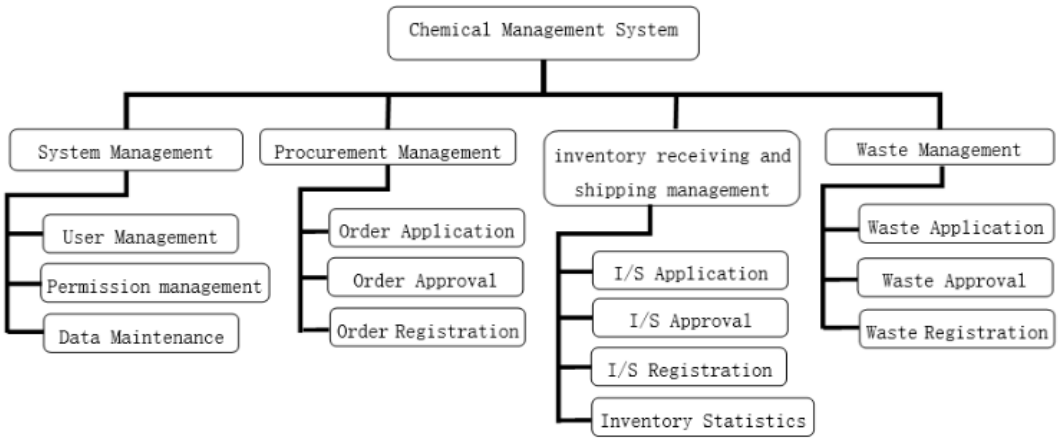


**Figure2:** Functional Modules Design for the Chemical Management System

## 3. System Implementation

Technologies available for developing a B/S-based chemical management system include ASP, JSP, and PHP. Considering system performance, security, development cost, and operational cost, this system adopts ASP.NET technology. Using the Visual Studio.NET integrated development environment and Microsoft SQL Server as the database system, coupled with ADO.NET data access technology, ensures optimal integration and seamless connectivity.

Furthermore, the design based on the B/S mode facilitates application expansion and upgrade maintenance. During development, the system was designed with detailed consideration for portability, scalability, and security.

1) Portability: Environment and structure configurations are written into configuration files rather than program code. Future migration only requires modifying configuration files, not the code. Files and images are stored using relative paths, not absolute paths, allowing easy migration by moving the entire system folder.

2) Scalability: The database design is flexible and comprehensive. All potentially modifiable content (e.g., department information, major information, project category information) is stored in the database, not hardcoded, facilitating future additions, updates, and expansions. It also allows easy integration with other university websites or external sites.

3) Security: The system designs four levels of user permissions (expandable), with each level restricted to corresponding operations to prevent unauthorized access. Database operation codes include character checks to prevent SQL injection attacks. Most deletion operations are logical rather than physical deletions; even if data is illegally deleted, it can be restored by database administrators. Regular database backups prevent accidental data loss.

## 4. System Operation Results

After repeated debugging and practice, the platform has been put into operation at our university. Practical application shows that the platform enables “immediate purchase and use”

of chemicals university-wide, reducing inventory levels and chemical storage risks. It also achieves full-lifecycle supervision of chemicals from purchase and use to waste disposal.

Compared to traditional management methods, the platform offers the following features:

1) Precision and Transparency: Traditional manual record-keeping often led to omissions or duplicates, resulting in chaotic inventory data. The system automatically records and summarizes each operation, ensuring clear records, accurate data, and convenient queries, significantly improving chemical management efficiency.

2) Full-Lifecycle Management: Each batch of chemicals is tracked from application, procurement, and use to final waste disposal, enabling full-lifecycle supervision.

3) Accountability: The platform establishes four user roles, each with specific responsibilities. Each record is automatically linked to the operating user, strengthening regulatory accountability.

4) Convenient Maintenance: Hosted on the university's intranet, initial operational issues were resolved efficiently due to the B/S design, allowing server-side debugging and upgrades, making system and database maintenance very convenient.

## 5. Conclusion

Based on the existing campus network platform, this paper researches and develops a chemical management information platform using the B/S mode. The platform comprehensively manages university laboratory chemicals across application, procurement, storage, retrieval, use, waste generation, and disposal. It achieves electronic, networked, informational, and automated chemical management, enhancing safety, reliability, and accuracy. The entire lifecycle of chemicals — from purchase to destruction—is under real-time supervision and tracking, providing precise data support for management departments to ensure laboratory chemical safety.

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