Design and implementation of quality management system for cement enterprises

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Abstract—The process of intellectualization, information and refinement of cement quality management in China develops slowly. This paper aims at this problem, Taking Zhonglian* Company as an example, on the basis of careful investigation and analysis of system functional requirements, based on the thought of modern quality management, it conducts an in-depth study of it, from the entry of cement raw materials to the finished cement products. The detailed design of the comprehensive quality management system laid the foundation for China's transition from a large cement country to a strong cement country.

1. overall structure design of the system
The software architecture of the whole client system adopts B/S three-tier architecture, realize "high cohesion and low coupling" in the system, improve code commonality and maintainability. The frame structure is shown in Fig.1.

![Diagram](image)

Fig. 1. Overall structure of the system
2. **System Function Architecture Design**

Due to the variety of cement quality data and the large amount of data, the system adopts the modular design idea, the functions are divided into five modules, they are quality monitoring, original data processing, account management, report statistics and quality analysis. The functional architecture is shown in Fig. 2:

![System Function Architecture](image)

3. **Quality Data Integration Subsystem**

A large number of quality data are generated in the cement production process. Because of the variety, large quantity and scattered distribution of these data, it is difficult to analyze, classify and find them by traditional manual processing methods, and it is difficult to find the hidden quality control rules in the historical data. Therefore, it is difficult to fully develop and utilize enterprise quality information resources, making it difficult to improve cement quality, which seriously affects the scientific nature of decision-making.

3.1 **Source of Quality Data**

Cement quality data comes from two parts: one is the data directly stored in the database through the data acquisition subsystem, which is called DCS Data; The other part is the data obtained by the cement enterprise laboratory, national standards and enterprise-defined standards design of quality database, which is called Original voucher. The original voucher need to be manually entered into the database manually.

3.2 **Database Design**

The main function of the database is to store data for the system. The key to the design is to select a database storage system that is consistent with the actual demand. Considering the characteristics and cost of cement production quality data, the system selects the relational database sqlserver2012 as the data storage environment. According to the system requirements and data classification, the following data tables in fig 3.

4. **Quality Management Client Subsystem**

The client subsystem is mainly divided into five modules, specifically: the original data processing module, DCS quality monitoring module, account management module, report statistics module and quality analysis module. The specific function structure is shown in Fig.4:
4.1 Original data processing module

Design 9 pages according to the actual needs, specifically: raw material chemical analysis, coal chemical analysis, control group data, chemical analysis, physical performance, 3-day strength, 28-day strength, Kiln coal powder and bag weight spot check etc. original data processing pages. Each page processes different data. Limited space, take raw material chemical analysis raw data processing page as an example, the data information processed on this page includes the date of raw material entering the factory, input time, name of raw material, source of raw material, input person, specific surface area and chemical composition of raw material, etc. This module adopts the method of full screen editing, users can add, delete, modify and query data.

![Quality Data Sheet](image)

Fig. 3. Quality Data Sheet

![Functional structure diagram of client subsystem](image)

Fig. 4. Functional structure diagram of client subsystem
4.2 Quality monitoring module
Through the storage and display of the information affecting the cement quality in the production process of raw meal grinding production line, clinker calcination production line and cement grinding station, the manager can grasp the quality information in the cement production process in real time, and make timely adjustments in case of problems.

4.3 Account management module
Five pages are designed for the account query module, including raw material account management, coal analysis account management, control group account management, chemical analysis account management and physical performance account management.
User can select any time period to query the account. In addition to the existing data in the database, user can add the average value, qualified rate, standard deviation, etc. In addition, this module also adds report export function.

4.4 Report statistics module
The report forms statistics module mainly includes cement quality daily report forms and monthly report forms. Daily report forms are the summary of quality parameters in the whole day. Each part of Excel format is displayed with a datagrid. Excel is fixed in length and width. If too much data cannot be displayed, a scroll bar will be added. According to the excel format template provided by the manufacturer, it is realized by the way of re splicing in blocks. Each block is set with a fixed length and width. Because there are too many data to be displayed, it is realized by adding a scroll bar.

4.5 Quality analysis module
This module is divided into two parts: quality analysis of raw materials and quality analysis of cement production process.

4.5.1 Quality analysis of raw and combustion materials
Quality analysis of raw materials includes quality analysis of various raw materials and chemical analysis of coal. This part of quality analysis only studies the influence of its own factors on the quality, such as the quality analysis of chemical analysis of raw materials. The factors affecting the quality include water, loss, SiO2, SO2 and MgO. It is realized in the form of check box and line chart. Users can configure their own parameters for comparative analysis.

4.5.2 Quality analysis of production process
It mainly analyzes the quality of each link of cement production, the factors affecting the quality of production process are 2:
1) All DCS parameters related to this production link.
2) The physical properties and chemical indexes of current production objects.

5. Conclusions
The research and development of cement quality management system, at present, lies in improving the information level of cement industry. The system is based on C# programing language, and uses SQL Server 2012 database for store all kinds of cement quality information reasonably and safely. The system developed of enterprises, and improve the competitiveness and viability of enterprises.

References
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