Research on Dry Mixed Control System of Milk Powder Based on MES

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ABSTRACT

In order to avoid the risk of quality in the various production processes of milk powder mixed, to achieve control and traceability of the whole process in milk powder production, we set up a small MES system based on dry mixed powder and pneumatic conveying technology. This system consists of distributed touch screen computer, bar code scanning equipment and PLC, which using SQL database structure based on client/server to achieve sterilization, ingredients, dry mixing, varieties of pneumatic conveying and the variety and quantity of ingredients (weight) in the packaging link and the verification and control of personnel information, as well as the process flow control in the front and back of the process. The practical application shows that this system has a friendly man-machine interface, fast response speed, and provides a practical basis on the further research and application of MES system in food industry such as milk powder.

KEYWORD

Dry mixed milk powder; Pneumatic conveying; MES; Bar code tracing; PLC.

INTRODUCTION

Dry process for producing milk powder is with special mechanical mixing of dry mixing pre production of high fat untreated milk power and other raw materials (including sugar, malt dextrin, minerals, vitamins, etc.) in the scientific and reasonable formulation, while adding nutrition fortifier, making by mixing, packaging and other processes, which is more suitable for a small amount of production and a wide variety of requirements such as infant formula milk powder. Compared with the wet process, dry process can make the physical and chemical indexes of the products get reasonable control, save energy consumption, reduce the cost, shorten the production cycle, reduce the loss of trace elements[1].

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However, the addition of trace elements can cause the problem of the quality if it is not controlled properly in the small batch mixing, and it is not easy to trace back. Therefore it is needed to establish a set of perfect quality control system to monitor the process and quality of the process. This article is equipped with a bar code scanner, touch screen computer and other equipment based on PLC control system which is used on dry process. It uses a relatively mature MES system theory in the manufacturing industry, with the formula (BOM) control and management as the core, a small MES system is realized from the process of sterilization, dry mixing, transportation, storage and packaging. The system has the whole plant MES system interface, and it has a large dairy enterprises in the country and has achieved good results.

**TECHNICAL PROCESS OF DRY MIXED POWDER PRODUCTION LINE AND INTRODUCTION OF HARDWARE CONFIGURATION OF MES SYSTEM**

**Technical Process of Dry Mixed Powder Production Line**

The process of dry mixing includes three parts: small material (trace elements added ingredients) storage and packaging, small material pre mixing and products for dry mix. The subsequent packaging process is the same as the conventional process. Process chart as shown in figure 1.

Small material pre mixing is to carry out a pre amplification in order to improve the efficiency of dry mixing. 25Kg great packaging original powder from stereo library, after sterilization by the sterilization machine, is placed into the vibration sieve in the small material dry mixed feeding station together with small material after pre packing (small material storage and dispensing station in figure 1). Then these are lifted to the dry mixer machine for small material by the negative pressure pneumatic powder feeding system. Subsequently these are packaged into bar code premix after the dry mix and are sent to each powder silo after mixing with the original powder from another way in sterilization machine. Finally, the packaging process is completed by the packaging machine.

![Figure 1. Process of dry mixed powder production line and configuration of MES system.](image)

It can be seen that the transport process of dry mix is basic on a series of closed pipes or tanks, the main node that may the problem is in the feed and sterilization and...
packaging phase. Therefore, these nodes are equipped with a touch screen computer and bar code scanner as shown in figure 1;

For bar code printing requirements of the link, such as pre mixed, material storage and dispensing link, they are equipped with bar code printer, also with electronic scales for weighing.

**Introduction of Hardware Configuration of MES System**

The key to the realization of the Manufacturing execution system (MES) is to determine the architecture of the system, and then through technical decomposition to determine the function of each sub module and the convergence between the essentials and so on[2]. According to analysis of production requirements, the characteristics of the information and the method of the realization of the technology, so this MES system consists of several functional modules, as shown in figure 2:

![Functional architecture of MES system](image)

**Figure 2. Functional architecture of MES system.**

Basic information: Including systems such as PC sub stations, operators, testing, products and batches and so on, these information is the key to system management, it plays an important role in quality control

**REALIZATION OF PRODUCTION PROCESS CONTROL**

The quality control of the production process mainly includes the internal quality control of the process and the quality control of the process.

**The Internal Quality Control Of The Process**

The control of the Internal product quality is easy to achieve, mainly rely on bar code scanners, electronic scale and PLC control of the various processes to ensure. Each bar code information contains weight information, in addition to product type and other information. The station computer scans the bar code information, and then compares it with the BOM in the database. When the weight is within the specified
range, which bar code is qualified. In order to meet the requirement of system quality and traceability, the related information and the operator information for each station are stored in the database.

For small material packaging and premix packaging, electronic measuring scale of communications data is directly printed to a bar code to avoid detection error caused by manual input.

The Quality Control of the Process

The quality control of the process mainly depends on the bar code. The bar code system scans the bar code to add the powder material in the process each time. And at least we guarantee that there is one bag of bar code in each process to scan, in order to form a sequence of steps. The bar code is called the process mark bar code[3]. After the operation is completed, the system will automatically generate and print the total bar code according to the bar code rule of the product, and the operator of the last process will stick the bar code and pack products.

The flow chart of process quality control is shown in figure 3:

![Figure 3. Flow chart of process quality control.](image1)

![Figure 4. Data exchange between programs using shared memory.](image2)

Communication Between PC and PLC and Electronic Scales

Using MSComm control in VB achieves communication between the station PC with PLC and electronic scales. Communication program and control interface program are designed separately. We use the memory common data area as shown in figure 4 to exchange data. The communication program is called by the main program, running in the background. The advantages of this method are that communication program and the man-machine interface with other control program - the main program are completely separate. Even if the communication program has a temporary
deadlock, it does not affect the normal operation of the main program, so as to improve the reliability of the application software.

DESIGN OF DATABASE

The Environment of System

The environment of system development use XP Windows operating system; background database software is selected to Microsoft SQL2000 with a strong capabilities; the foreground development tool select Basic Visual 6.0. System uses advanced client/server architecture. The client/server model has the characteristics of good interactivity, expansibility, fast transmission speed and so on. It can improve the security and processing ability of the system. In this mode of operation, client request and server complete data processing. In terms of software, we optimize the database structure and composition, make sure that the temporary database and master data can coexist, and effectively solve the contradiction between the real-time production data access and tracing.

Realization of Database Function

Server SQL database implementation is generally divided into the following three steps:

1. Configuration database

We put the database which is already existed into SQL server through enterprise manager with Microsoft SQL Server 2000 server computer, or directly to set up the database and create a form, thus completing the program design database.

2. Configuration ODBC

The way is to register a data source through the ODBC manager, the manager then provides the ODBC driver and database attribute information based on the data source to establish a connection.

3. Access to the Server SQL database in VB 6.0

Methods of access to the Server SQL database in VB 6.0 are: the use of DATA controls, the use of ADOData controls, and so on[6]. We are using ADO data objects to access the Server SQL database approach.

ADO has many advantages, easy to use, has a familiar user interface, high speed and low memory usage, etc. ADO data object is the most commonly used method in the system development of the current Client/Server architecture.

CONCLUSION

Milk powder as an important source of nutrition for infants and young children, the quality of its production and processing monitoring is very important. In this case, a pipeline composed of a computer, a scanner of bar code, a PLC and an electronic scale is proposed. Through the practical application in the production line, the system has a good man-machine interface, fast response and so on. From the rational choice, configuration and implementation flexibility of each station through the system can be seen, it can fit a variety of product types. And then it greatly improves the milk powder enterprise's service level, the level of product quality traceability and even the
whole enterprise's information management level, so it can bring huge management and economic benefits for the dairy production enterprises. This control system is not only stable and reliable. In addition, it is designed to enable the production process more automatic, intelligent. Therefore, the study of modern powder food production process stability and safety significance are very important.

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