A ladle management system and method for steelmaking and refining

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ABSTRACT. *This paper introduces a steel refining ladle management system and method, which includes data acquisition module, data storage module, data analysis module, status setting module, thread management module, process control module and interface display module. The method is to collect data by PLC data acquisition module and set each process equipment to corresponding status The data analysis module judges whether the ladle can access the refining station; the process control module displays through the interface. Automatically collect automatic signal data from field equipment, use network and database resources to support real-time logical analysis and judgment accurate to 1 second, and save production field signal data log. It does not need the operator of the client to operate, timely and accurately reflect the production situation of the field equipment, and real-time display whether the ladle enters and exits the refining station on the steelmaking production scheduling system. Through the real-time display of human-computer interface, the steel-making production scheduling of iron and steel enterprises can be improved to grasp the field situation.*

KEYWORDS: *Ladle, PLC, refining station*

1 Introduction

At present, the process of steel-making plant in iron and steel enterprises has high complexity, strong coordination between processes, fast and timely timing requirements, and high timeliness requirements for information acquisition of production preparation and completion of each process. At present, the dispatching of steel-making molten steel mainly depends on the steel-making dispatcher's on-site command and operation, and the operators in the central control room of the steel-making refining station operate the incoming, refining and outgoing of the ladle. In the process of operation, in addition to the operators of the refining station and the steel-making dispatcher for patrol inspection, the operators of other processes can only understand the steel refining situation of the refining process through a single wireless phone. The main disadvantages of this method are: (1) the

site production environment is bad, and the dispatcher frequently walks around in each process of the site, which is prone to safety accidents. (2) the scene is noisy, the communication quality of each process is low and the cost is high when communicating through the wireless phone, which reduces the process flow speed of the ladle. The time delay will reduce the temperature of molten steel and increase the smelting cost. (3) without the guidance of systematic production scheduling, the traveling crane cannot be informed of the flow direction of the ladle in time, and the detailed automatic process data of refining process cannot be seen, so that the next process cannot be prepared for ladle entry in advance. (4) there is no system consistency, and the business process of the subsequent process can only be manually informed by the steelmaking dispatcher. Therefore, the management system to solve the above problems is very necessary.

2 Overall design

The first purpose of this paper is to provide a steel refining ladle management system; the second purpose is to provide a method for using the steel refining ladle management system.

The steel refining ladle management system includes data acquisition module, data storage module, data analysis module, status setting module, thread management module, process control module and interface display module, among which:[1]

Data acquisition module: used to collect ladle data and transmit it to data storage module for storage;

Data storage module: used to store ladle information;

Data analysis module: it is used for comprehensive analysis of refining station status and equipment status of each process, and the analysis results are sent to the process control module;

Status setting module: used to set the data status of the ladle data in the data storage module for the thread management module to enter

Line read;

Thread management module: used to read the collected ladle data from the data storage module according to the set time and frequency, and transmit

To data analysis module;

Process control module: it is used to receive the analysis results of data analysis module and display them to operators through interface display module for operation;

Interface display module: used to display analysis results for operators to operate.

The method of using the ladle management system for steelmaking and refining includes the following steps:[2]

A. the automation signal data of field equipment is collected by PLC data acquisition module, saved to the refining real-time automation data record table of database server through network transmission, and each process equipment is set as

Corresponding status;

B. the thread management module scans the refining real-time automatic data record table every 1 second, and scans the refining real-time self

When the dynamic data changes, send a message to inform the data analysis module;

C. The data analysis module receives the message notice and runs the logic judgment statement to determine whether the ladle can enter and exit the refining station;

D. after the conclusion of data logic analysis is obtained, the data analysis module transmits the conclusion to the process control module;

E. the flow control module shows the steelmaking production dispatcher whether the current ladle can be accessed through the human-computer interface

The refining station, according to the system configuration, adopts the automatic or manual mode to put the ladle into the continuous casting process according to the preset process route;

F. set the status as molten steel outbound / inbound through the status setting module after the successful entry and exit operation.

This paper overcomes the problems of the lack of timeliness, accuracy, traceability and coherence in the entry and exit of the steel refining ladle, automatically collects automatic signal data from the field equipment, uses the network and database resources to support the real-time logical analysis and judgment accurate to 1 second, and saves the production field signal data log. It does not need the operator of the client to operate, timely and accurately reflect the production situation of the field equipment, and real-time display whether the ladle enters and exits the refining station on the steelmaking production scheduling system. Through the real-time display of human-computer interface, the steel-making production scheduling of iron and steel enterprises can be improved to grasp the field situation.

Description of drawings

Fig. 1 is a schematic diagram of the module structure of the invention;

Fig. 2 is a flow diagram of the management system of the invention.

3 Concrete realization

In the data acquisition module, the ladle data includes the signal of argon blowing out of the station, the signal of refining ladle moving away, the signal of ladle car arriving at the seat and ladle position, the signal of ladle car entering the heating station, the signal of ladle cover rising, ladle cover falling and ladle car retreating to the hoisting ladle position.

The ladle information in the data storage module includes ladle weight, ladle temperature, ladle number, outbound time of argon blowing ladle and ladle schedule.

In the data analysis module, the status of refining station is ladle in station, ladle heating, ladle in station and ladle leaving.

In the data analysis module, the equipment status of each process is converter blowing, converter furnace end, argon blowing start, argon blowing end, subcontracting signal of continuous casting rotary table, signal of No. 1 arm in pouring position and signal of No. 2 arm in pouring position.

In the data analysis module, the analysis results are as follows: the ladle arrives, the ladle enters the hoisting position, the ladle enters the heating position, the ladle is refining and the ladle leaves.

In the state setting module, the states are ladle in refining, ladle in refining and ladle out refining.

The thread management module refreshes the signal data at the frequency of 1 second, and calls the data analysis module to analyze whether the ladle can be refined according to the obtained argon blowing out signal and refining ladle transfer signal. If so, the call status setting module sets the refining status as the refining ladle entry status; according to the obtained ladle car arriving at the ladle seat or ladle car entering the heating station The signal calling status setting module sets the refining status as being refined; the data analysis module is called to analyze whether the ladle has been refined according to the obtained ladle leaving the hoisting position signal; if so, the calling status setting module sets the refining status as the refining ladle outbound status.

The process control module scans the ladle status of the refining station set by the status setting module. When the status is set to the inbound status of the refining ladle, the process control module sends a message to inform the interface display module, which displays the current ladle inbound refining station on the interface display module. When the status is set to the outbound status of the refining ladle, the process control module sends a message The message notification interface display module shows that there is currently a ladle refining station on the interface display module interface.

The method of using the ladle management system for steelmaking and refining includes the following steps:[6]

A. the automation signal data of field equipment is collected by PLC data acquisition module, saved to the refining real-time automation data record table of database server through network transmission, and set each process equipment to corresponding status through status setting module;

B. the thread management module scans the refining real-time automation data record table every 1 second, and sends a message to inform the data analysis module when the change value of refining real-time automation data is scanned;

C. The data analysis module receives the message notice and runs the logic judgment statement to determine whether the ladle can enter and exit the refining station;

D. after the conclusion of data logic analysis is obtained, the data analysis module transmits the conclusion to the process control module;

E. the flow control module shows the steelmaking production dispatcher whether the current ladle can enter and leave the fine station through the human-computer interface, and according to the system configuration, the ladle can be put into the continuous casting process in the automatic or manual way according to the preset process route;

F. set the status as molten steel outbound / inbound through the status setting module after the successful entry and exit operation.

The purpose of this paper is to overcome the problems of timeliness, accuracy, traceability and coherence of the above-mentioned steel refining ladle in and out of the station, and to provide a method of automatically judging the steel refining ladle in and out of the station. The basic data for judging whether the ladle can be refined or not is obtained through the automatic signal of the collection equipment. The collected signal is transmitted on the PLC network in the form of data packet. After the data arrives at the database, the logic analysis and processing are carried out by the judgment process after the data sorting, state setting and other processing actions. The conclusion can be drawn in time and accurately, and the data can be traced According to the consistency, trigger the execution of the next process flow to improve the utilization efficiency of the equipment.

The technical solution adopted to solve the technical problem is: the system is composed of PLC data acquisition module, data storage module, data analysis module, status setting module, thread management module, process control module and human-computer interface; PLC data acquisition module collects field equipment automation signals and arranges them into data packages, and submits the data to data storage module through acquisition workstation At the same time, the status is set by the status setting module (ladle in refining, in refining, ladle out refining). The thread management module reads and collects data according to the set time and frequency. Through the data analysis module, the current refining station status and other process equipment status are comprehensively analyzed, and the analysis results are sent to the process control module, which sends messages to the steel The information of whether the package can enter or leave the

station can be displayed to the steelmaking production dispatcher through the human-computer interface for automatic or manual operation.

Automatic judgment method of steel refining ladle entry and exit:[3]

1) the automation signal data of field equipment is collected by PLC data acquisition module, saved to the refining real-time automation data record table of database server through network transmission, and each process equipment is set to corresponding status by status setting module;

2) the thread management module scans the refining real-time automation data record table every 1 second, and sends a message to inform the data analysis module when the change value of refining real-time automation data is scanned;

3) the data analysis module receives the message notice and runs the logic judgment statement to determine whether the ladle can enter and exit the refining station;

4) after the conclusion of data logic analysis is obtained, the data analysis module transmits the conclusion to the process control module;

5) the flow control module shows the steelmaking production dispatcher whether the ladle can enter and exit the refining station through the human-computer interface, and according to the system configuration, the ladle can be put into the continuous casting process automatically or manually according to the preset process route;

6) set the status as molten steel outbound / inbound through the status setting module after successfully executing the inbound and outbound operation.

It is used in the production scheduling system of the steel plant of the iron and steel enterprise to automatically judge whether the refining ladle can enter or leave the station in the system at present. Through obtaining the operation condition and automatic signal of the refining equipment, the system can make real-time judgment and draw a conclusion. The system collects the automatic signal of the field equipment every 1 second, automatically judges the signal every 1 second, and displays the judgment result to the human-machine interface The interface can provide the production situation to the steelmaking dispatcher in time. The steelmaking dispatcher can choose manual operation or automatic operation by default to complete the entry and exit of refining ladle in the scheduling system.[7]

The beneficial effect is to automatically collect automatic signal data from field devices, use network and database resources to support real-time logical analysis and judgment accurate to 1 second, and save the production field signal data log. It does not need the operator of the client to operate, timely and accurately reflect the production situation of the field equipment, and real-time display whether the ladle enters and exits the refining station on the steelmaking production scheduling system. Through the real-time display of human-computer interface, the steel-making production scheduling of iron and steel enterprises can be improved to grasp the field situation.

A system and method for automatically judging the entry and exit of steel refining ladle applied in iron and steel enterprises, including PLC data acquisition module 1, data storage module 2, status setting module 3, thread management module 4, data analysis module 5, process control module 6, interface display module (Human-Computer Interaction Interface) 7, as shown in Figure 1, automatic signal data acquisition industrial computer is installed on site Standby electrical room, through the connection of PLC bus network to obtain and transmit data. PLC data acquisition module 1 obtains automatic instrument signal data from PLC network, and the acquired data is submitted to data storage module 2 for storage. The storage medium is database. At the same time, it refreshes the signal data at the frequency of 1 second through thread management module 4, and calls data analysis module 5 to analyze whether the ladle can be refined according to the acquired argon blowing out signal and refining ladle transfer out signal Refining, if yes, the call status setting module 3 sets the refining status as the refining ladle inbound status; the call status setting module 3 sets the refining status as the refining status according to the obtained ladle car arriving at the seat ladle position or ladle car entering the heating station signal call status; the call data analysis module 5 analyzes whether the ladle has been refined according to the obtained ladle leaving the ladle position signal call status , if yes, call the status setting module 3 to set the refining status as the refining ladle outbound status. The process control module 6 scans the ladle status of the refining station set by the status setting module 3. When the status is set to the inbound status of the refining ladle, the process control module 6 sends a message to inform the human-computer interaction interface 7, which displays the current ladle into the refining station; when the status is set to the outbound status of the refining ladle, the process control module 6 sends a cancellation Notice the human-computer interface 7, which shows that there is currently a ladle out of the refining station.[8][10]

Characteristic:

A. automatic acquisition of equipment automation instrument signal.

B. the signal data of the automatic instrument is transmitted to the local area network of the enterprise through the on-site PLC network.

C. through thread scanning, state setting, data analysis and process control, the ladle in and out management of refining station is realized.

D. dynamic analysis and judgment according to automatic instrument signal, real-time and reliable.

E. the whole process does not need manual intervention.

As shown in Figure 2, the figure shows the system workflow and implementation processing method, and the specific implementation method is as follows:

I. steel making and argon blowing ladle entering station:

A. equipment automation instrument signal, as follows:[4]

Table1 Equipment automation instrument signal

Signal name	value
Argon blowing exit signal	1
Ladle transfer signal	1

B. PLC data acquisition module collects the above signal data;

C. refining real-time automatic data record form transmitted through enterprise LAN and saved to database;

D. the thread management module scans the argon blowing real-time automatic data record table according to the frequency of 1 second, and sends the acquired records to the data analysis module for analysis;

E. the analysis results infer that the refining station can currently allow ladle in for refining operation, then send the results to the status setting module, and set the current refining station as the refining ladle in status;

F. the process management module reads the status of the refining station and displays it on the human-computer interface.

II. Ladle exit from steel refining station:[5][9]

A. equipment automation instrument signal, as follows:

Table2 Equipment automation instrument signal

Signal name	value
Ladle leaving hoisting position signal	1

B. PLC data acquisition module collects the above signal data;

C. refining real-time automatic data record form transmitted through enterprise LAN and saved to database;

D. the thread management module scans and refines the real-time automatic data record table according to the frequency of 1 second, and sends the acquired records to the data analysis module for analysis;

E. the data analysis module infers that the current refining ladle has carried out outbound operation;

F. send the result message to the status setting module, and set the current status as the outbound status of refining ladle;

G. the process management module reads the exit status of the refining ladle, transmits the heat information to the next station according to the preset process route, and displays it on the human-computer interface.

4 System features

In this paper, a ladle management system for steelmaking and refining and the use method of the ladle management system for steelmaking and refining are provided. To overcome the problems of insufficient timeliness, accuracy, traceability and coherence of the entry and exit of steelmaking and refining ladle, automatic signal data is automatically collected from the field equipment, and the network and database resources are used to support the real-time logical analysis and judgment accurate to 1 second, and the production field signal data log is saved. It does not need the operator of the client to operate, timely and accurately reflect the production situation of the field equipment, and real-time display whether the ladle enters and exits the refining station on the steelmaking production scheduling system. Through the real-time display of human-computer interface, the steel-making production scheduling of iron and steel enterprises can be improved to grasp the field situation. In order to improve the ladle process flow speed, effectively prevent the occurrence of safety accidents, improve the quality and reduce the cost.
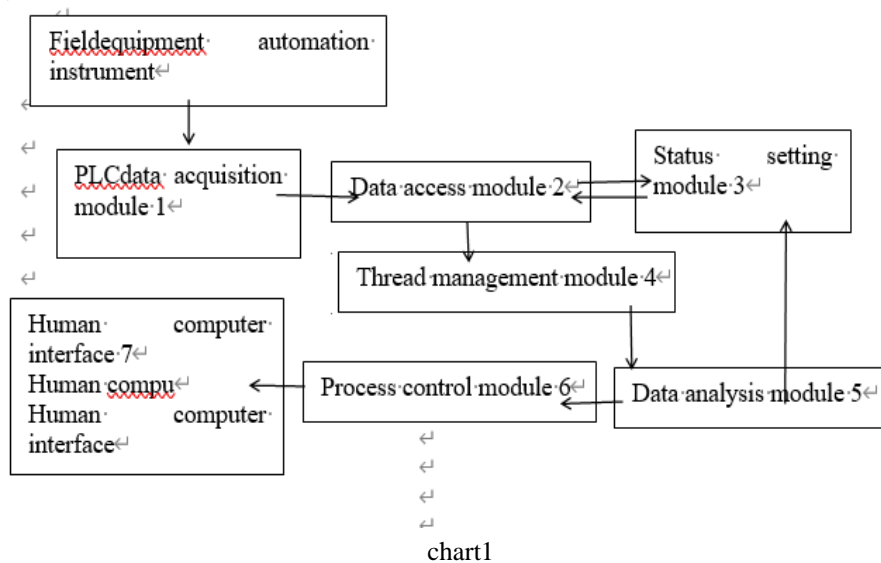

chart1

Fig. 1 is a schematic diagram of the module structure of the invention
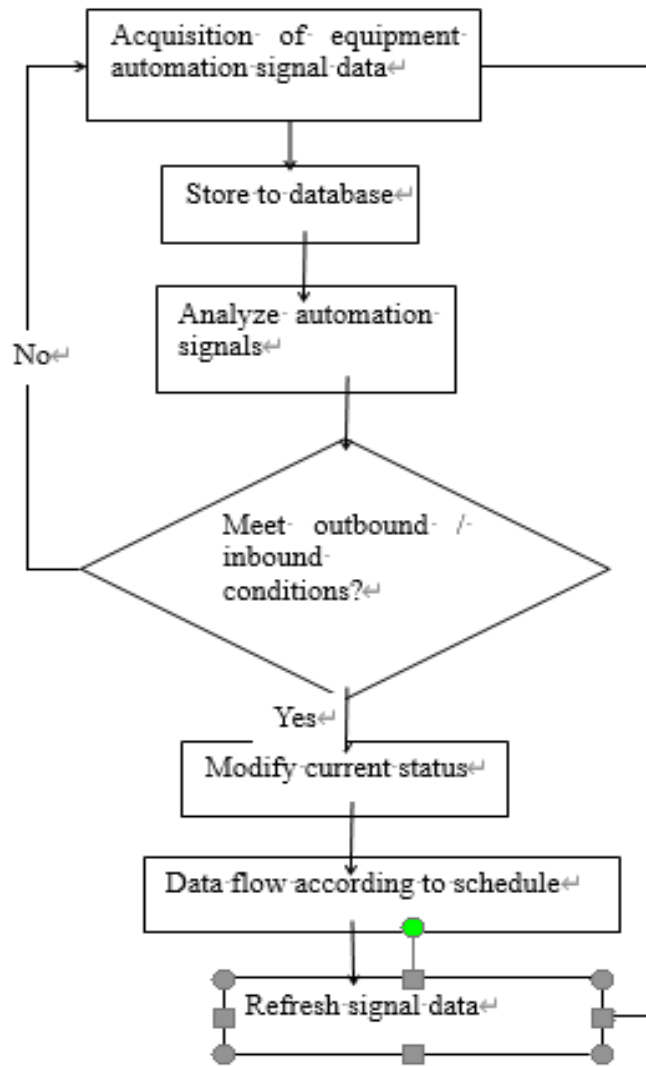
chart2

Fig. 2 is a flow diagram of the management system of the invention

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