

I-7000 Modules Applied in Primary Air and Coal Powder Monitoring

*Zhang Hui, Song Wuqi
Jilin Ruida Company*

When the operators optimize the burning process for boilers, they must control primary air speed and the density of pulverized-coal so as to keep the boiler in the best operating status, which has significantly impact on whether boiler can operate securely, economically and steadily.

At present the method that monitors primary air speed indirectly with static pressure of primary air and decides the quantity of pulverized-coal based on the rotating speed of pulverized-coal feeder is still used in boilers of many generator stations. Because the resistance changes with certain factors (i. e., the coal powder offset quantity in the two-phase flow of each primary air pipe and the different test point distance from the furnace), it is impossible to specify the above two parameters based on the static pressure of primary air. In other words, the static pressure of primary air can't play the role of directing the operation. Sometimes it even misleads the operation so as to make the fire deviate the central, and causes overheating of local heat load. In addition keeping high primary air speed in blocking pipe might affect burning stability; high primary air speed will slow secondary air speed that will reduce boiler economics. Therefore it is necessary to establish on-line monitoring system for primary air and pulverized-coal of boiler.

We developed an online monitoring system for primary air and pulverized-coal of economical boiler and the system has been practiced in power plant and made greatly achievement.

2. System features and usage

The system features include:

2.1. Monitoring

Real-time on-line monitoring of primary air parameters:

- ◆ Flow velocity of air-powder mixture in primary air pipe, primary air speed and quantity at the spouting vent of burner;
- ◆ The density of pulverized-coal in primary air pipe, the quantity of pulverized-coal at the spouting vent of the burner;
- ◆ Hot air temperature, pulverized-coal temperature and air-powder mixture temperature.

2.2 Alarming

Alarm notice will be given when above monitored parameters deviate from their normal values. For example:

- ◆ Excess pulverized-coal in a burner;
- ◆ Insufficient pulverized-coal in a burner;
- ◆ Primary air in a burner is on the low side;
- ◆ Primary air in a burner is on the high side;
- ◆ Overheating pulverized-coal in a layer or corner of each burner;
- ◆ Over-fluctuation of air speed in a burner;

2.3 Diagnosing

With monitoring and analyzing above parameters we can diagnose possible fault status in primary air pipe and give notice to the operators. The diagnosing function include:

- ◆ Blocking pipe diagnosis;
- ◆ Breaking pulverized-coal diagnosis;
- ◆ Pulverized-coal gravity flow diagnosis;
- ◆ Primary air damper failure diagnosis;
- ◆ Pulverized-coal in pipe self-combustion diagnosis;
- ◆ Primary component failure diagnosis.

2.4 History Logging

All the original data can be recorded at the speed of several sets of data per minute. All the data won't be deleted within 24 hours and can be exported for printer, screen or screen curve.

The system can be used for the following applications:

◆ Adjusting burning

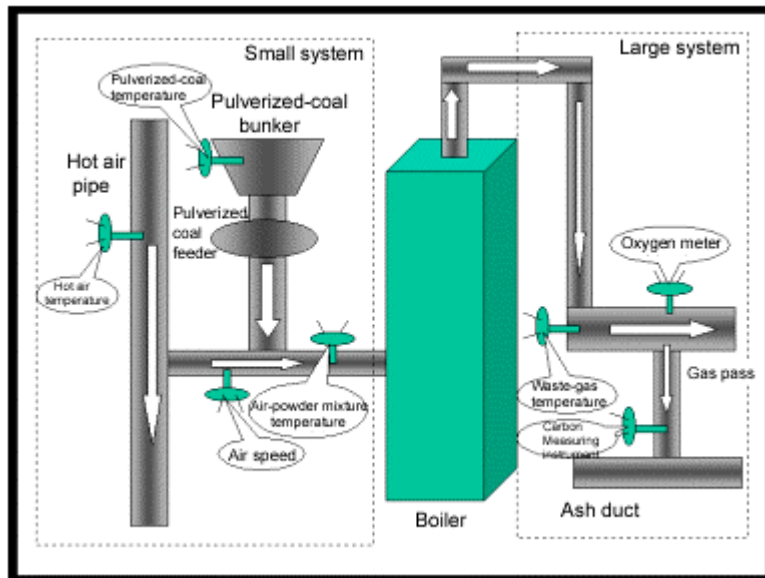
The stoker can adjust load distribution and primary wind speed of each burner based on monitored parameters, which will help to optimize burning and improve operating economics and security of units.

◆ Reducing accidents

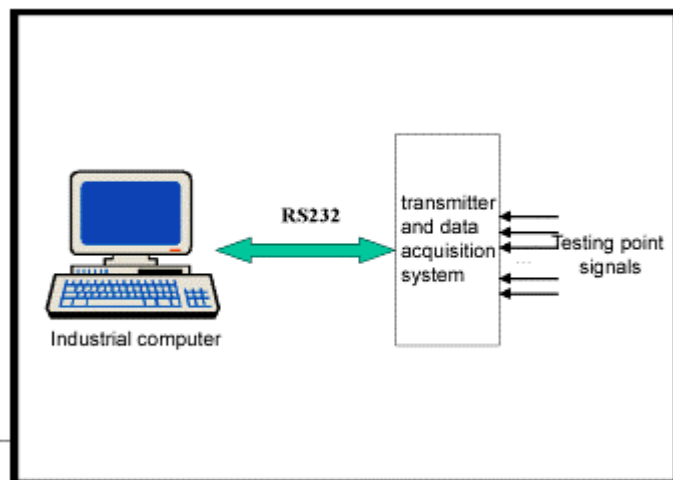
Warning and diagnosing functions can help to find operating abnormality roundly and in time so that operators take measures to prevent accidents from arising and spreading.

◆ Analyzing accidents

After the boiler arose accidents and abnormality the operators can call out operating parameters at the moment of accident using accident review function to help to analyze the reason of accident.



Measure components mount sketch



3 Measuring Principle

3.1 Measuring principle of primary air speed

The method is called dynamic pressure that means to work out air speed with relation to measure dynamic pressure of primary air.

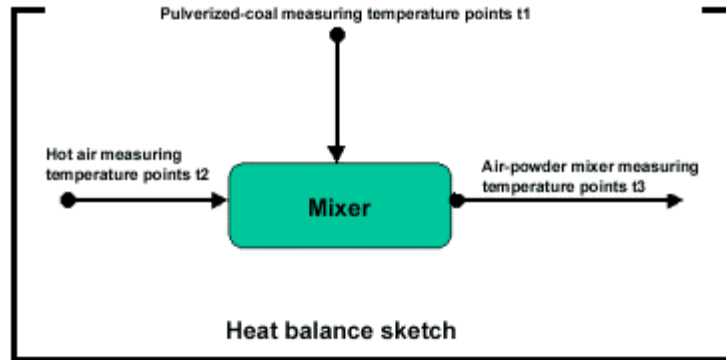
3.2 Measuring principle of pulverized-coal density

According to conversation of energy, pulverized-coal density is worked out by temperature. That is, the summary of heat quantity of hot air and pulverized-coal entering pulverized-coal mixer equals to total heat quantity of air-powder mixture pouring out pulverized-coal mixer. Using this method has to ignore some unimportant elements and assume the following conditions:

- ◆ Neglecting heat dissipation, exchanging heat process in pipe is adiabatic process.
- ◆ Pulverized-coal and hot air have blent completely and keep heat balance at the

exit of pulverized-coal mixer.

- ◆ The moisture in pulverized-coal doesn't evaporate after the pulverized-coal is



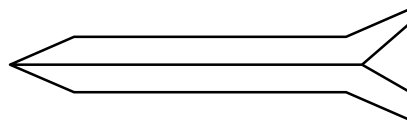
heated.

The pulverized-coal density and quantity can be worked out based on heat equilibrium equation.

4 Primary measuring components

4.1 Dynamic pressure measuring components

- ◆ Dynamic pressure measuring components can be used for measuring dynamic pressure of primary air, outputting **热平衡示意图** differential pressure signal.
- ◆ Speed measurement pipe can be disassembled for easy examination and replace.
- ◆ Since pre-heater is used for measuring hot air it is designed pipe-type. Because it contains little dust no regular anti-abrasion and sootblowing system are designed. But after period of time maintenance man should check the abrasion of the pre-heater and_sootblow_manually if necessary.
- ◆ Speed measurement pipe is installed on hot air pipe located in the entry of the pulverized-coal mixer.
- ◆ Speed measurement pipe installed in field must be calibrated before it can be used.



Wedge-type dynamic pressure measurement pipe sketch

4.2 Temperature measurement component

- ◆ Temperature measurement component uses E-graduation standard thermocouple.
- ◆ Hot air temperature measuring points are distributed on primary air box or primary pipe of hot air.
- ◆ Pulverized-coal temperature measuring points are distributed on central storage

bin in front of pulverized-coal supplier.

- ◆ Air-powder mixture temperature measuring points are distributed on feed-powder pipe of primary air in front of the burner. Since air containing pulverized-coal there abrades the temperature measuring points the thermocouple must be covered by wear-resistance shelf which is designed wearproof steamline to reduce heat transferring inertance. The wear-resistance shelf can be replaced.

5 Transmitter

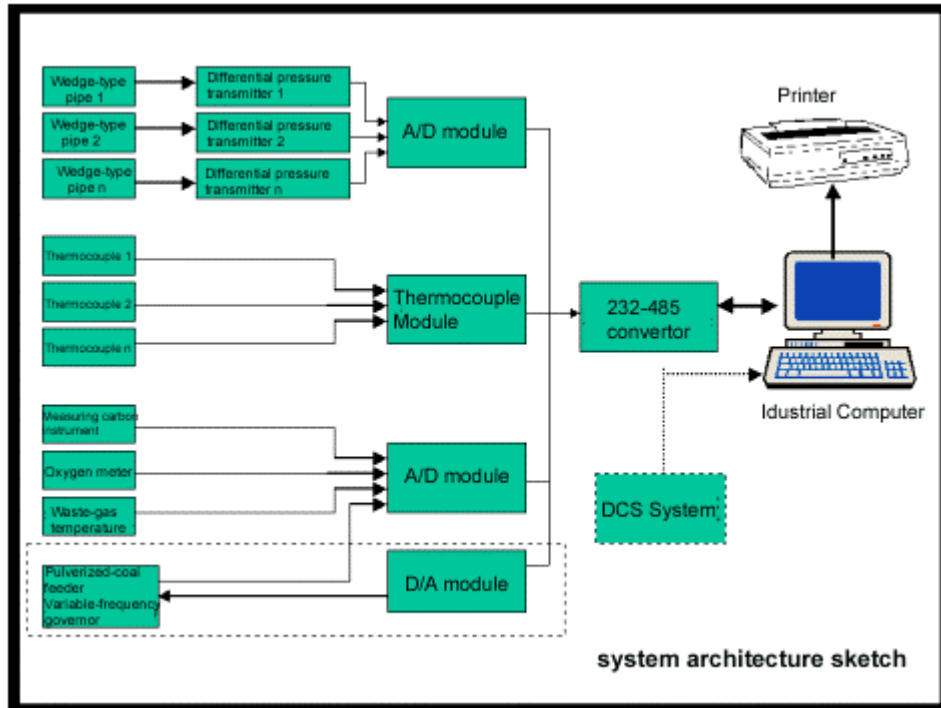
Differential pressure transmitter

Differential pressure transmitter is used to convert differential pressure signal of the dynamic pressure of primary air into electrical signal. The transmitter is new diffusing silicon two wire system with compact construction and reliable performance. The precision and sensitivity of the transmitter suit fully the demands after wind tunnel test and calibration in laboratory. The following are main technical parameters:

- ◆ Measuring range: 0—1.7KPa
- ◆ Power supply: 24V
- ◆ Output signal: 4-20mA
- ◆ Load resistance: $\leq 500\Omega$
- ◆ Operating temperature: 0-65°C
- ◆ Precision: 0.2%

6 System architecture

Online supervising system of boiler air-powder is used to monitor the air speed at the exit of the burner and pulverized-coal density so as to calculate operating status and efficiency of boiler. It consists of measuring air speed component, differential pressure transmitter, temperature sensor, ash measuring carbon instrument, oxygen meter, waste-gas temperature signal and ash content instrument. It adopts imported I-7000 series network data acquisition modules and industrial computers to build data acquiring and monitoring workstation.



The architecture is shown in the following diagram.

6.1 System hardware architecture:

- ◆ Computer system includes 586 industrial computer, color CRT monitor and printer, etc.
- ◆ RS-485 network distributed data acquisition system includes I-7000 series modules;
- ◆ Air speed inspecting component group includes 16 measuring speed components and 16 differential pressure transmitters;
- ◆ 36 thermocouples compose hot air, pulverized-coal and air-powder temperature inspecting component group;
- ◆ 1 ash measuring carbon instrument and 4 oxygen quantity meter compose burning inspecting unit group. (optional)

6.2 System software:

- ◆ Windows 95 platform;
- ◆ Chinese star 2.97;

6.3 Application software package include:

- ◆ Data acquisition and graduation conversion modules;
- ◆ Data calculation modules;
- ◆ Primary air speed simulation bar modules;
- ◆ Primary air powder density bar modules;
- ◆ Real-time curve trending;

- ◆ History curve review trending;
- ◆ Inputting pulverized-coal quantity in each corner display modules;
- ◆ Real-time displaying operating status modules;
- ◆ Auxiliary fault analysis modules;
- ◆ Sensor assistant calibration modules;
- ◆ Alarming modules;
- ◆ Printing modules;
- ◆ Channel self-checking modules;
- ◆ Pulverized-coal feeder rotate speed display and adjust modules;(optional)

Software features:

The system features include using Windows 95 as software platform, graphic interface and graphic buttons switching. Human-computer interface is friendly and easy to extend.

7 670t/h boiler facility configuration

- ◆ 586 computer 586/133/20M/1G: 1
- ◆ 21" right angle flat color monitor: 1
- ◆ Printer: 1
- ◆ Air speed inspecting component :16
- ◆ Thermocouple: 50
- ◆ Thermocouple antichafe cover: 20
- ◆ Differential pressure transmitter box 4 units per box : 4 boxes
- ◆ Data acquisition module box: 16 channels per box;4 boxes
- ◆ Smart 232 to 485 converter : 1
- ◆ Signal cable (special for imported 485 bus)
- ◆ Application software package (support communication with DCS system)