

Instrumentation and Control System for CWM Plants

Yasuo Itoh

1. Introduction

CWM (Coal Water Mixture) is a liquefied coal that can be handled like heavy oil. CWM is widely recognized in the field of coal utilization.

CWM is a fluid coal of slurry, consisting of about 70% coal particles with a specific diameter distribution and about 30% water. This is mixed and pugged with a small amount of dispersant and stabilizer, then conditioned to a uniform and stable state. CWM is expected to be utilized as a fuel in addition to conventional pulverized coal. Moreover, it is expected that CWM will be used as a raw material for coal gasification.

This paper introduces a control system developed for Yanri CWM Company Ltd., a joint company of JGC Corporation, Nissho Iwai Corporation and Yanzhou Coal Mine Bureau under China National Coal Corporation. **Figure 1** shows the outline of the CWM manufacturing process.

2. Outline of CWM Manufacturing Process

The CWM manufacturing process consists of the following:

(1) Coal crushing process

Coal of various sizes is crushed by a cage crusher into particles with a diameter of several mm.

(2) Fine and ultra-fine crushing process

The coal particles are further crushed by ball mills into even finer particles with a diameter from several μm to several hundred μm . These ball mills have two stages for fine and ultra-fine pulverizing. Particles which have exited the ball mill for fine pulverizing are put on a classifier, and particles not up to standard are returned to the ball mill. Ideal particle distribution is attained by

Fig. 2 Raw coal silo, conditioning tank and manufacturing building

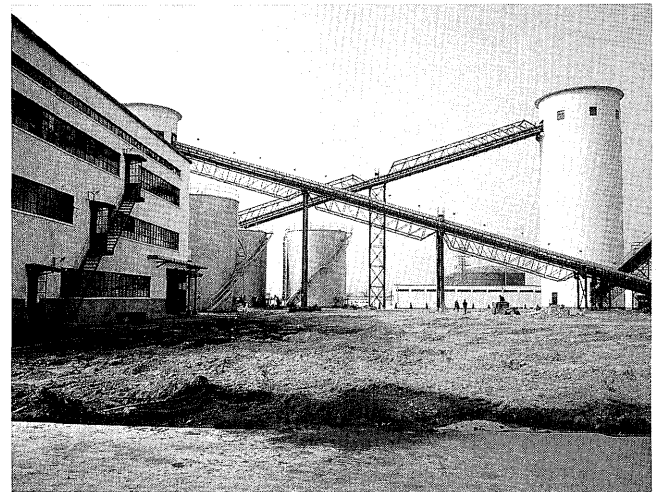


Fig. 1 CWM manufacturing process

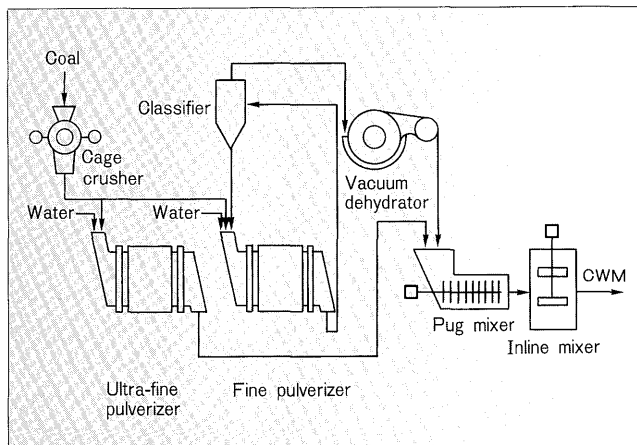
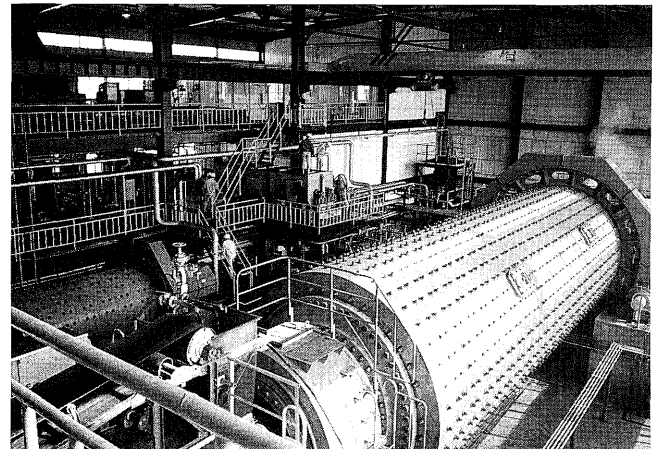


Fig. 3 The interior of manufacturing building



mixing particles which have gone through both stages of ball mills.

(3) Dehydrating process

The vacuum dehydrator dehydrates water added during crushing to a predetermined water level.

(4) Mixing process

The crushed coal particles and an additive agent are uniformly distributed with pug and inline mixers.

(5) Conditioning process

The manufactured CWM is accumulated in tanks and further stabilized by circulation using pipes.

(6) Shipping equipment

Shipping equipment consists of storage tanks, pipelines for shipping, and loading arms to load the CWM to tankers. Tankers used for foreign transportation are remodeled heavy oil tankers.

Figure 2 shows the exterior of the manufacturing plant, and Figure 3 shows the interior.

3. CWM Manufacturing Control System

Figure 4 shows the configuration of the CWM manufacturing control system. This system consists of CRTs for the distributed control system, which monitors and operates the plant; a process controller, which controls sequences and analog groups; a semi-graphic panel, which displays the operation status of all control units; and an ITV system, which displays an image of the site.

(1) Operator station (OCS-1500)

The operator station is a man-machine interface which monitors and operates the plant using keyboards and CRTs. The flow chart of the plant is shown onscreen, where the indications and the settings for processes such as levels, pressures and temperatures are displayed. The status of such equipment as valves and motors are displayed by different colors.

“Line composition” (including sending off tanks, pumps, and lines) for transfer between the CWM tanks

and product shipment can be accomplished automatically by touching the CRT screen. Completed transfer lines are shown by a change in color; thus, this system is easy to recognize visually.

Figure 5 shows an example of the operation screen.

(2) Process controller (PCS-500)

Process controllers input the quantities of the process, and the control and sequence calculations. The control calculation controls the amount of coal fed to the cage crusher, ball mill, etc. The coal feed control regulates the amount of slurry to each device, and the additive agent control regulates the quantity of agent, which preserves CWM stability over a long period of time.

The amount of additive agent is calculated from the quantity of coal as well as water content, and the appropriate quantity of agent is distributed to two or more additional sites.

The automatic line formation control controls the automatic opening and closing of the valves, which connect the devices chosen by the operator on the screen. However, the line is not formed when the liquid level of the receiving tank is high or when the tank is being used for other purposes. After all lines have been formed and the opening or closing of the valves are confirmed by limit switches, it is possible to start the pumps.

The auto-sampling control automatically samples CWM at time of shipment. This calculates the sample quantity based on the sampling cycle and the quantity to be sampled at one time which are set on the screen. The shipment quantity is calculated by either the flow meters or a change in the liquid level of the tanks.

(3) Data base station (DBS-1500)

System information and system operation data are stored in a database station.

(4) Engineering workstation (EWS-500)

The engineering workstation is an apparatus for engineering the system. Among the functions of the EWS-500 is a “trend preservation system” which is very effective. This function records “trend graph” data of the process values on a floppy disk. This information can be analyzed with the use of a personal computer. At this time, the CWM demonstration test plant uses this trend

Fig. 4 System configuration of CWM manufacturing plant

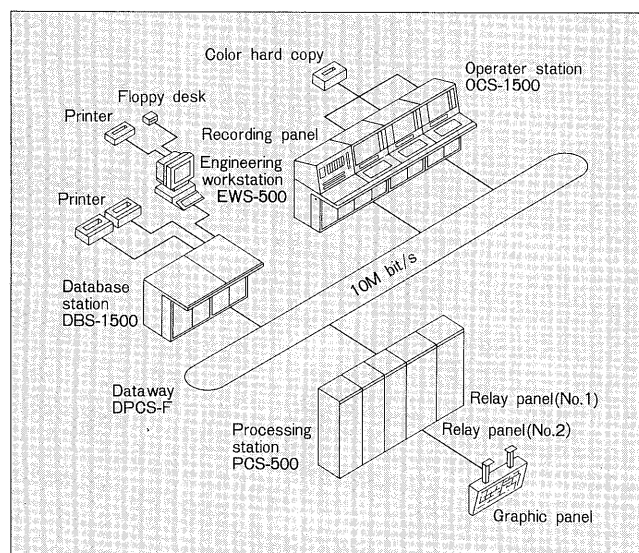


Fig. 5 An example of the operation screen

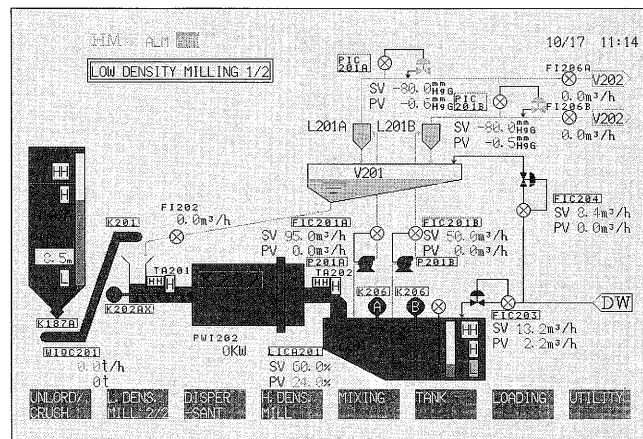


Fig. 6 CWM transit base

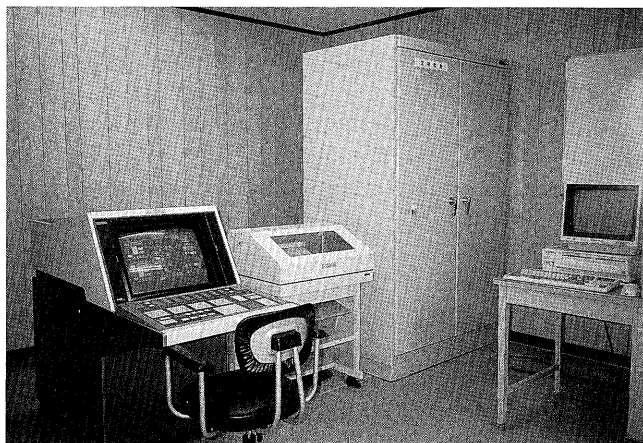
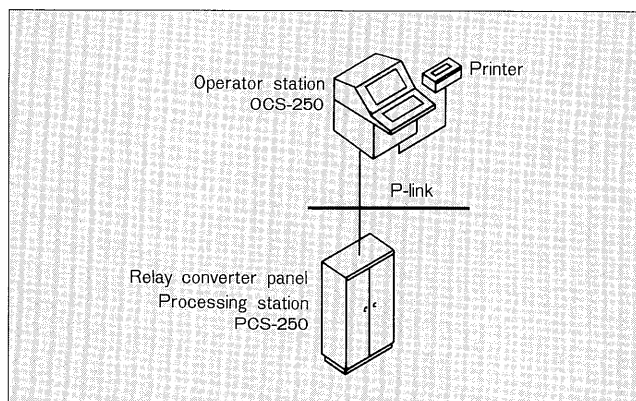


Fig. 7 System configuration of CWM transit base



preservation system for research as a large amount of process data is necessary.

(5) Auto-sampler

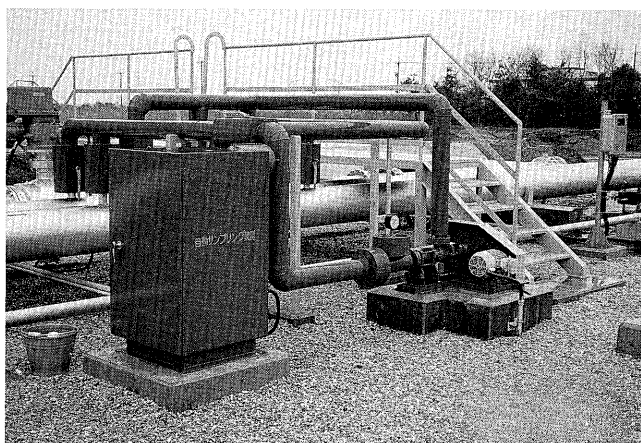
This device consists of a sampling valve, a quantity measuring meter, and a controller (PCS).

This device gathers identical samples of the shipped CWM. Therefore, a predetermined quantity can be automatically gathered at any time by changing the sampling interval, the quantity of sampling at one time, etc. according to the gross quantity shipped.

(6) Sensor

Selection of the flow meter for measuring the CWM flow rate is very difficult because of such factors as the CWM's physical properties and composition. Yanri's electromagnetic flow meters, taking into account lining material, electrode size, and internal compensation calculation, were chosen based on operation data from field and analysis simulation. They have been installed and are operating satisfactorily.

Fig. 8 Auto-sampling device



4. CWM Transit Base

This CWM manufacturing plant is in Rizhao City of Shandong Province, China. The produced CWM is transported to Japan by tanker, and received by CWM West Japan Co., Ltd. in Wakamatu-Ku, Kitakyushu City.

This CWM transit base was subsidized by the Coal Utilization Technology Promotion Subsidy from MITI (Ministry of International Trade and Industry) under the guidance of MITI and the Center for Coal Utilization, Japan (CCUJ). This base supplies CWM to domestic users of CWM.

The control and managing system of the receipt and shipment at this base uses MICREX-MS, a distributed control system for small and medium-sized processes. The control system is shown in Fig. 6; and system configuration of the CWM transit base is shown in Fig. 7.

An automatic line formation control and an auto-sampling control, similar to the CWM manufacturing plant's, are performed by MICREX-MX at the CWM transit base. Figure 8 shows the auto-sampling device.

Records of receipt and shipment of CWM are kept by a batch report system, which prints information including work time, quantities, etc. at the end of each operation.

5. Conclusion

We at Fuji Electric believe that CWM is a product which people are taking notice of due to its easy handling of coal, which in the past has not been very well managed. CWM will be further developed in the future.

We sincerely acknowledge the cooperation of JGC Corporation, Yanri CWM Company Ltd. and CWM West Japan Co., Ltd. for construction of the control system for these new processes, the improvement in controllability and supervision of the field tests.