Feature Article

Proven Mill Innovations - 1: Boiler Draught Control System Improvement

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While the author was working as the group electrical engineer in the Sime Darby's New Great Britain Palm Oil Mills in Papua New Guinea, he had good opportunity to look into the possibility of improving the electrical operating systems of many processing stages in palm oil mills. It is not usual for an electrical engineer to get this opportunity. He made full use of it and implemented improvements wherever he could subjected, to availability of funds for the desired improvements to materialise. What he did in his organisation can be replicated in other organisation as well, as it is not exactly an invention. He decided to disseminate the concept of his improvements through the *Palm Oil Engineering Bulletin* so that all palm oil mills in Malaysia can benefit from it. He thought the best way to put this across to the millers will be to publish the improvements as a series of short articles in a few issues of the *Palm Oil Engineering Bulletin*. All the improvements suggested by the author are proven ones installed in the NGB mills in PNG. In this issue, he will start with improvement in the boiler draught control.

THE CONVENTIONAL DRAUGHT CONTROL SYSTEM

The conventional boiler combustion draught system provides the mass of air for burning the fuel. It is a balanced draught design which comprises a forced draught (FD) fan pushing the combustion air under the grate and induced draught (ID) fan drawing the flue gas away from the combustion chamber. The over-fire system consists of a secondary air (SA) fan to induce turbulence for optimising the combustion and fuel feeder (FF) to force the fuel into the furnace through the feeder chutes and spread evenly on the grate.

The system is inclusive of the pneumatic actuated FD and ID damper in which the open/close is controlled by the FD and ID damper Controller governed by the boiler steam pressure set at pre-determined level or the boiler safe working pressure. The forced draught damper is controlled by the steam pressure so that the boiler can follow the load automatically by taking advantage of the responsive suspended firing furnace design. The induced draught damper is controlled by a bias controller (BC) linked to

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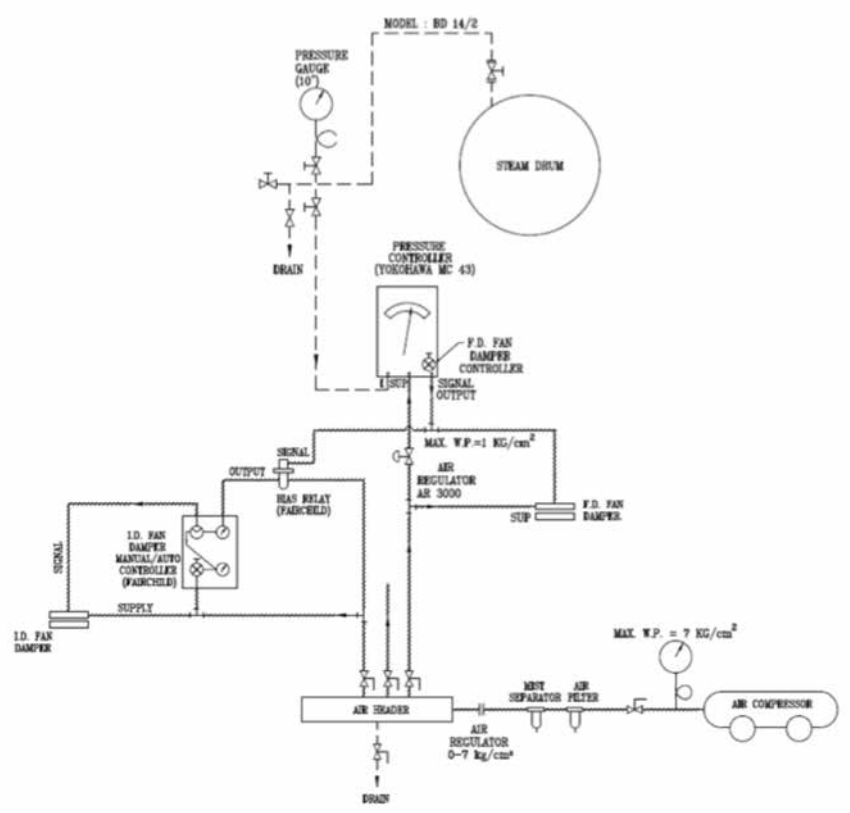

Figure 1. The conventional draft system comprising the ID and FD fans.

the forced draught controller so that induced draught will open more than the forced draught. In this way, puffing tendency is reduced. The conventional draught system is shown in *Figure 1*.

IMPROVED DRAUGHT CONTROL SYSTEM

While maintaining the fundamentals of the boiler draught control system, the improved control system adopts furnace pressure sensing. In this way, the boiler steam pressure is no longer used to govern the actuating of the cylinders that regulated the dampers. The ID fan is fully run by a variable frequency drive (VFD) thus eliminating higher ampere during start-ups and regulation of the dampers. The furnace pressure transmitter is used to transmit the 4-20 mA signal which will be used in an either PID or PLC based control system which in turn provides control signal l to the VFD to regulate the ID fan speed. The furnace pressure is maintained at vaccum pressure at a fine scale and this will avoid furnace back pressure or blow-back. The PID/PLC can be set to have faster response time to react with the furnace pressure. When the boiler steam pressure has reached the set value, the fuel feeding system would regulate down the fuel flow and so, the furnace pressure corresponds to the combustion gas and this will be translated to give a feedback to the control system to also regulate down the fuel gas flow which means lowering the speed of the ID fan.

The FD fan however, will be maintained using dampers as the static pressure is crucial. The speed of the FD fan is not to be regulated as it will affect the static pressure but the air flow (CFM) will be increased or decreased by the dampers. The damper is always well controlled by the control system which maintains the furnace pressure at vacuum. The bias gain which is used in the conventional system will be no longer needed. Please see the improved flow chart shown *Figure 2* for the process control.

COST IMPLICATION

The draught control system that uses PID/PLC would be less costly compared to fully mechanical system. The elimination of a few major hardwares such as MC43 controller, ID Fan Damper Controller, Bias Regulator and ID fan damper cylinder allow significant savings. The requirement to maintain and servicing the mechanical system is can also be partially omitted. Therefore, the improvised draught control system is relatively cheaper compared to conventional control system.

MAINTENANCE AND CARE

The draught control system that uses PID/PLC needs to be taken extra care in terms of internal control panel cleaniness. The vent holes in the control panel must be clean and should not be clogged by the mills common dirt-palm fibres carry over. This need to be ensured so that the control panel has proper ventilation and the operating temperature does not increased. This will make the system to have longer life-time and lesser down time.

OTHER ADVANTAGES

Other advantages that can be foreseen when using the improved draught control system:

- air to fuel ratio is controlled within finer scale which helps to have better combustion, leading to cleaner emmission;
- ID fan load reduces remarkably and thus, power demand can be reduced and therefore diesel usage is minimised when using diesel generators for start-up;
- longer life time for wearing parts such as dust collector due to cleaner emmission with lesser particulates; and
- quicker resonse time in varying air-fuel ratio requirement thus reducing black smoke emission.

MC43 Controller

ID Fan Damper Controller

BIAS Relay Controller

Conventional system

ID Fan Cynlinder

Conventional system

Improved System

Improved System

Improved System

Figure 2. The improved furnace draught system.