Dry bottom ash handling system — Improving maintainability and economic efficiency

Since 2002, Kawasaki has been receiving increased orders from customers around the world for its dry bottom ash handling system, which adopts a new process for handling clinkers in coal-fired power plant boilers.

Following initial deliveries, further improvements have been made to the system, including seals that require no maintenance, reducing its cost of ownership.

Preface

While conventional wet bottom ash handling systems used to process bottom ash, or clinkers, from coal-fired thermal power plant boilers use an enormous amount of water, today we are witnessing a shift to dry bottom ash handling systems designed to meet increasingly strict environmental requirements.

In these systems the bottom ash is air-cooled as it is being removed from a boiler and transported, eliminating

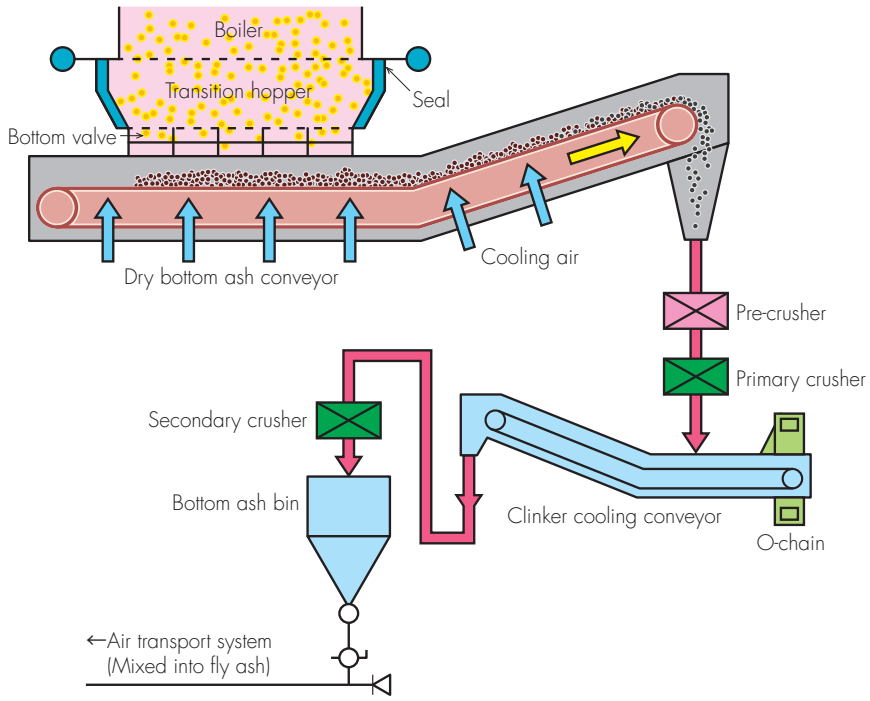

Fig. 1 Overview of dry bottom ash handling system

the need to use water. Kawasaki formed a technological alliance with Magaldi, the Italian firm that developed the dry bottom ash handling system, in 1994 and has been steadily building a solid track record since delivering the first system to a Japanese power plant in 2002.

This paper provides an overview of the system as well as the measures taken after its introduction with the aim of improving maintainability and economic efficiency.

1 Overview of the dry bottom ash handling system

This system, which does not use any water to handle bottom ash, boasts the following advantages over conventional hydraulic transport systems:

- Smaller environmental impact
- Wider and more effective uses of dry bottom ash
- Lower equipment and running costs

Figure 1 shows an overview of the dry bottom ash handling system. Bottom ash that fell from the furnace is cooled as it is transported downstream by a dry bottom ash conveyor. While downstream system components vary depending on user requirements, in the most commonly used system in Japan, bottom ash is transported via a downstream primary crusher, clinker cooling conveyor, and secondary crusher. It is then finally air-blown to be mixed with fly ash.

2 Improving maintainability and economic efficiency

Since launching the dry bottom ash handling system on the market, improvements designed to enhance maintainability as well as economic efficiency have been made. The following section describes three major improvements made to the system.

(1) Maintenance-free seal

Since the dry bottom ash handling system is installed under a boiler, the seal on the interface between the boiler and the system must be resistant to internal boiler pressure as well as thermal expansion.

When the dry bottom ash handling system was first introduced, a water seal similar to those used on conventional wet bottom ash handling systems was used for the boiler interface as shown in Fig. 2 (a), meaning the system was not entirely water-free. With an eye to further improving the system, a new mechanical seal was developed.

Figure 2 (b) shows the structure of the mechanical seal. Composed of a multilayer metal fabric and other materials connecting the bottom of the boiler with the dry bottom ash handling system, the mechanical seal can absorb the thermal expansion of the boiler. Since the

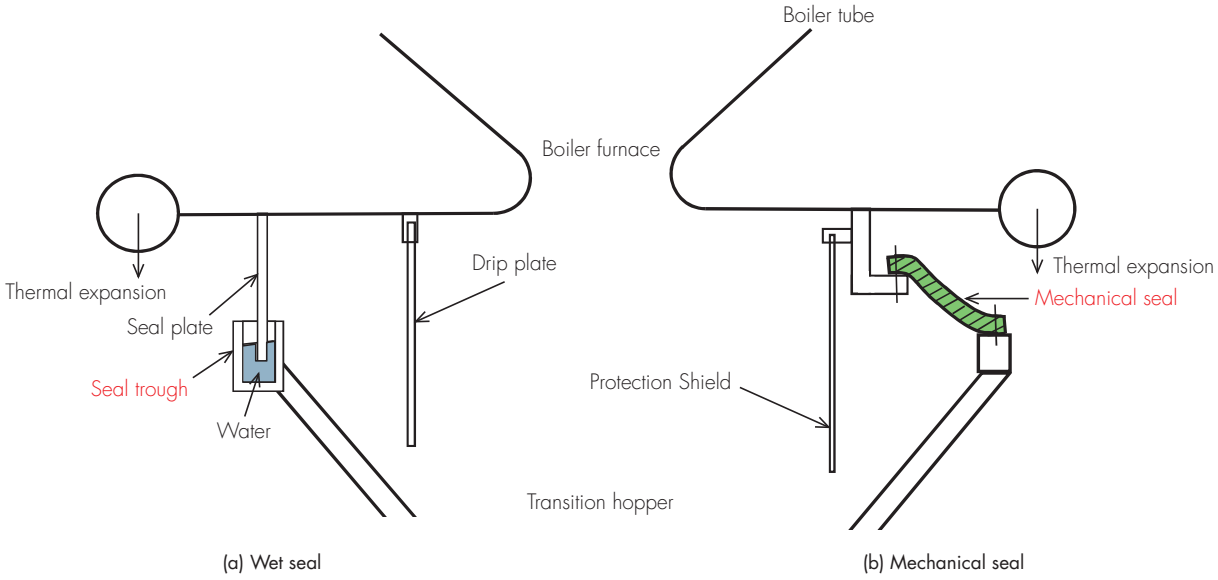

Fig. 2 Boiler interface overview (water/mechanical seal)

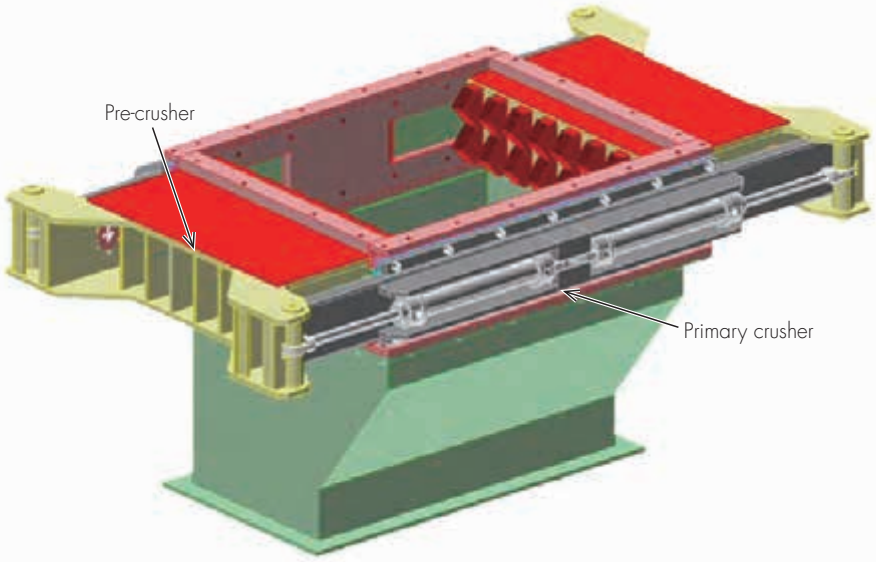

Fig. 3 Hydraulic pre-crusher

mechanical seal is essentially maintenance-free, it eliminates the cost of maintaining and running the kind of circulating water system employed by conventional systems. Replacing the wet seal, it has been adopted as the standard seal since the latter half of 2000.

(2) Preventing bottom ash from clogging

The dry bottom ash handling system uses a primary crusher installed downstream from the dry bottom ash conveyor that coarsely crushes bottom ash. Clinkers of certain sizes and shapes would sometimes build up in the

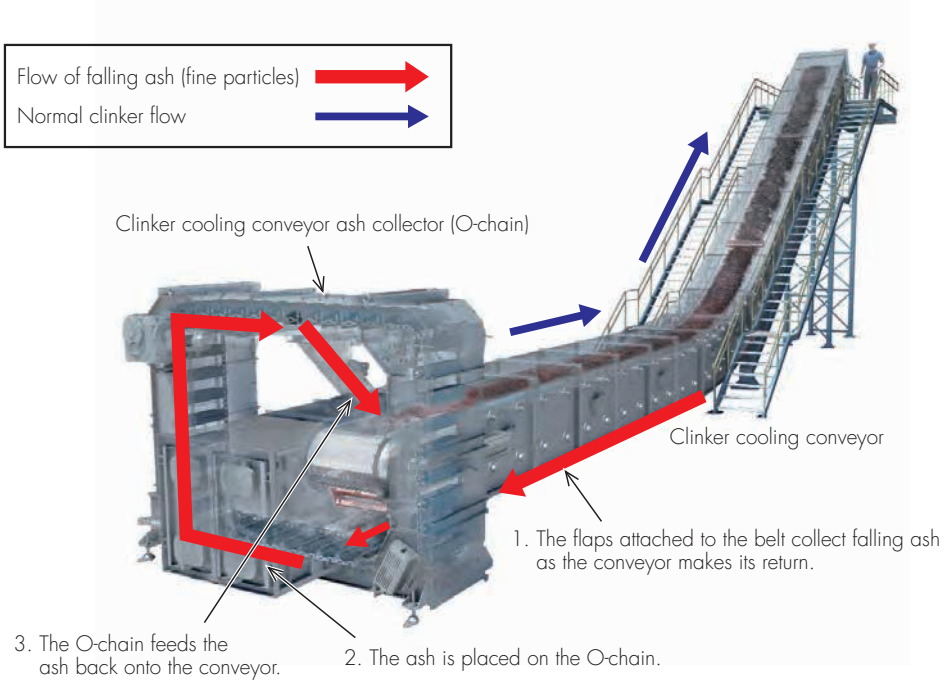

Fig. 4 Clinker cooling conveyor ash collector

primary crusher, blocking the flow and clogging the system. A hydraulic pre-crusher was developed in order to solve this problem. Figure 3 shows a schematic diagram of the hydraulic pre-crusher.

The hydraulic pre-crusher features a set of jaws (the red area shown in Fig. 3) that open and close to crush lumps of bottom ash. It is installed below the outlet of the dry bottom ash conveyor and crushes any ash that accumulates in the primary crusher. Before installing the hydraulic pre-crusher, ash lumps had to be removed manually by operators whenever they clogged the conveyor outlet. The new feature significantly reduces operators' workload and has earned high marks from customers.

(3) Reduced maintenance cost for the clinker cooling conveyor ash collector

The clinker cooling conveyor, a component of the dry bottom ash handling system, originally had a scraper conveyor installed under the main conveyor to collect falling ash. Since the scraper would wear out relatively quickly, it proved to be a major obstacle to providing a long lasting system. As a solution to this problem, a new ash collector (O-chain) was developed to replace the scraper conveyor.

The O-chain is installed at the tail end of the cooling conveyor as illustrated in Fig. 4. Fine ash particles that have collected at the bottom of the conveyor are swept up by the conveyor belt flaps and onto the O-chain, which puts them back on the cooling conveyor. Eliminating the use of sliding parts that can wear out easily, the O-chain will significantly reduce maintenance costs. Furthermore, O-chain has several merit below: increase the clinker cooling conveyor slope, provide a more compact and cost-effective solution, have the possibility to offer longer conveyor etc.

Postscript

Since Japan's first dry bottom ash handling system was installed at Kobe Steel, Ltd.'s Shinko Kobe No. 1 Power Station, the system has been widely adopted by utilities as well as independent power plants across the country and has set a new standard for bottom ash handling systems. As of April 2015, Kawasaki has delivered seven units in Japan and eight units overseas (South Korea and the Philippines). Add in those delivered by Magaldi and the tally comes to over 150 in use around the world.

The system is in high demand due to its clear advantages over wet systems and is expected to remain the coal ash handling equipment of choice. Kawasaki looks forward to harnessing its years of experience as it continues to deliver optimal systems tailored to customers' needs.

Yasutaka Ozeki / Yoshihiko Takemura

Contact information
Ash Handling Project Office,
Industrial Plant Engineering Division,
Plant & Infrastructure Company
Tel: +81-78-682-5057 Fax: +81-78-682-5058