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DESIGN OF ASH HANDLING CONVEYING SYSTEM

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ABSTRACT

The importance of ash handling systems in power plants, particularly in cases where headroom is limited under the boiler. It highlights the various components and functions of a Mechanical Ash Handling System, including Bottom Ash Handling, Fly Ash Handling, Ash Disposal, and Water Recovery. The introduction also touches upon the different methods of ash collection, conveying, and storage, such as hydraulic, pneumatic, and mechanical systems. It emphasizes the significance of managing ash, which constitutes a significant byproduct of coal combustion in power plants, comprising 30-40% of total coal consumption, necessitating proper handling for utilization. Of particular note is Bottom Ash, distinguished by its coarser and heavier particle composition compared to fly ash. The handling of bottom ash is an indispensable component of any solid fuel-fired system. Typically, before it enters the ash conveyor system, bottom ash undergoes crushing in clinker grinders to facilitate its efficient management and disposal.

Keywords: Ash Handling Conveying System, Ash Disposal, Solid Fuel Combustion, Bottom Ash Handling.

I. INTRODUCTION

The Mechanical Ash Handling System is often the best choice for fluidized bed ash where headroom is restricted under the boiler. The Mechanical Ash Handling System handles the ash by A Bottom Ash Handling System, Fly Ash Handling System, Ash disposal system up to the Ash disposal area and water recovery system from ash pond and Bottom ash overflow. The method of collecting, conveying, interim storing and loading of different types of residual ash from solid fuel combustion processes is known as Ash Handling. In ash handling systems, different processes may be used - hydraulic, pneumatic or mechanical. In pneumatic ash collection, ash is collected from several dust points and is then delivered to an ash storage silo for interim holding before it is either loaded out for disposal or reuse.

Ash conveying systems can help you with handling of all types of ashes that results from the combustion of wood, coal and other solid fuels such as bottom ash, bed ash, fly ash etc. Bottom ash mostly consists of heavier and coarser particles than fly ash. Bottom ash handling is required for any solid fuel fired system, and before being transferred in the ash conveyor system, bottom ash is often crushed in clinker grinders.

In Power Plant's coal is generally used as fuel and hence the ash is produced as the byproduct of Combustion. Ash generated in power plant is about 30- 40% of total coal consumption and hence the system is required to handle Ash for its proper utilization or disposal. Fly ash handling, on the other hand, includes pressure transportation or vacuum transportation system. It is collected using electrostatic precipitators (ESPs) and other apparatus in the flue gas processing stream. The collected fly ash is then transported either - hydraulically or pneumatically. In the pneumatic method, pressurized air is used to transport fly ash to silo. In thermal power plants, we use lot of coal for power generation. The coal has high amount of ash content, so these power plants generate lots of ash.

II. LITERATURE REVIEW

Mechanical Ash Handling Systems are indispensable components of power plants, addressing the challenge of efficiently managing ash generated during the combustion of solid fuels, primarily coal. This literature review aims to explore the key aspects of Mechanical Ash Handling Systems, their components, operational methods, and the critical role they play in the power generation industry. Mechanical Ash Handling Systems encompass several vital components, each serving a specific function. These include Bottom Ash Handling, Fly Ash Handling, Ash Disposal Systems, Water Recovery Systems from ash ponds, and mechanisms to manage Bottom Ash Overflow. Together, these components ensure the comprehensive collection, conveyance, interim storage, and ultimate disposal or repurposing of ash residues. Within the domain of ash handling systems, three primary methods are employed: hydraulic, pneumatic, and mechanical. Hydraulic systems utilize water for ash transportation, pneumatic systems rely on air pressure, and mechanical systems involve physical movement through conveyors, crushers, and other equipment. The choice of method depends on factors such as the type of ash, system efficiency, and environmental considerations. Mechanical Ash Handling Systems are fundamental to the seamless operation of power plants, facilitating the efficient management of ash residues generated during the combustion of solid fuels. These systems comprise various components and may employ different handling methods to suit the type of ash being managed. Given the substantial volume of ash produced in power plants, the proper handling of ash is imperative for environmental compliance, resource utilization, and the overall efficiency of power generation processes. Future research in this field may focus on enhancing the sustainability and efficiency of ash handling systems to meet evolving environmental and operational requirements in the power generation industry.

III. LIMITATIONS

3.1. Energy Consumption:

One significant limitation of Mechanical Ash Handling Systems lies in their energy consumption. These systems often require motor-driven conveyors, crushers, and other equipment, which demand a substantial amount of electrical energy. This increased energy consumption can contribute to higher operational costs and environmental concerns, particularly if the power source is not from renewable or clean energy.

3.2. Maintenance and Wear:

Mechanical systems involve moving parts, and as such, they are subject to wear and tear over time. The maintenance of these systems can be intensive, requiring regular inspections, repairs, and replacement of components. Frequent maintenance can result in downtime, affecting the overall efficiency of the power plant.

3.3. Space Requirement:

Mechanical Ash Handling Systems, especially those using conveyor systems, demand significant space within the power plant facility. In situations where space is limited, the installation of these systems can be challenging. Additionally, the need for extra space can impact the overall layout and design of the power plant.

3.4. Environmental Concerns:

Fly ash, a byproduct of combustion, often contains fine particles that can become airborne if not handled properly. Mechanical systems, while effective in handling fly ash, can still pose environmental concerns if dust containment measures are not adequate. Airborne ash particles can contribute to air pollution and pose health risks to workers if not properly managed.

3.5. Noise Pollution:

The operation of mechanical equipment in ash handling systems can generate significant noise levels. This noise pollution can be a concern, especially in power plants located in urban or residential areas. It may necessitate additional noise control measures to ensure compliance with environmental regulations and reduce disturbance to nearby communities.

3.6. Initial Capital Costs:

The installation of Mechanical Ash Handling Systems typically involves substantial initial capital investments. This can be a deterrent for smaller or budget-constrained power plants. The cost of purchasing and installing conveyors, crushers, storage silos, and associated equipment can be a significant portion of the plant's overall budget.

3.7. Limited Applicability Mechanical Ash:

Handling Systems may not be suitable for all types of ash generated in power plants. Some ashes may have unique properties or require specialized handling methods that mechanical systems may not efficiently address. This limitation may necessitate the use of alternative or supplementary ash handling methods.

IV. RESULTS AND DISCUSSION

As dry fly-ash conveying systems has been extensively chosen at the thermal power plants, there perhaps trouble shooting in the conveying systems such as – pipeline blockage - moisture in line – cold air- erosion –

chocking were hinder difficulties experienced in these systems. These papers will contribute the promising explanation/ resolution to conquered these difficulties in dry fly-ash conveying systems.

A conveying system for fly ash must also be designed properly. Often times, pneumatic conveying systems are used to transfer fly ash from the collection hoppers to the storage silos. While the equipment used for pneumatic conveying has advanced significantly over the years, it is still not uncommon to encounter problems with insufficient conveying capacity, plugging, erosive wear in elbows and build up in the line, particularly when emissions control systems are changed (such as after the introduction of an acid or mercury capturing sorbent system, which will increase the quantity of ash generated). A pneumatic conveying system must be designed based on required minimum conveying velocities to avoid plug gages, while providing the needed air pressure and flow rate to move the material through the line

In these situations, the pipeline diameter can be used as a design variable, with step increases made over the line length to minimize conveying velocities to reduce line wear while increasing the line's capacity.

Standard cyclone dimensions

	Cyclone Type					
	High Efficiency		Conventional		High Throughput	
	(1)	(2)	(3)	(4)	(5)	(6)
Body Diameter, D/D	1.0	1.0	1.0	1.0	1.0	1.0
Height of Inlet, H/D	0.5	0.44	0.5	0.5	0.75	0.8
Width of Inlet, W/D	0.2	0.21	0.25	0.25	0.375	0.35
Diameter of Gas Exit, D_e/D	0.5	0.4	0.5	0.5	0.75	0.75
Length of Vortex Finder, S/D	0.5	0.5	0.625	0.6	0.875	0.85
Length of Body, L_b/D	1.5	1.4	2.0	1.75	1.5	1.7
Length of Cone, L_c/D	2.5	2.5	2.0	2.0	2.5	2.0
Diameter of Dust Outlet, D_d/D	0.375	0.4	0.25	0.4	0.375	0.4

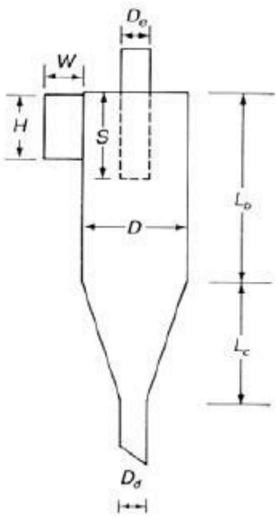

Figure 1: Standard Cyclone Dimensions.

V. CONCLUSION

All Ash handling systems will always require frequent maintenance and repair. But by investing in a well-designed system, manufacturers can reduce the cost of replacements and increase the lifespan of the conveyor. By allowing wear on low-cost parts, the price of replacements goes down. Making these parts easily accessible results in less downtime. A strong box and rust-resistant materials ensures the integrity of the systems remains, increasing how long the system can be used before needing replaced. In the realm of power generation, the efficient management of ash residues remains a critical challenge, especially considering the substantial quantities produced as byproducts of solid fuel combustion, primarily coal. Mechanical Ash Handling Systems have emerged as integral components in addressing this challenge. This project has delved into the multifaceted landscape of Mechanical Ash Handling Systems in power plants, shedding light on their components, operational methods, and the vital role they play in the industry. However, it is essential to recognize that these systems are not without their limitations. They entail significant energy consumption, maintenance demands, space requirements, and environmental considerations. Addressing these limitations necessitates a multi-faceted approach, encompassing the exploration of energy-efficient components, robust maintenance strategies, innovative design solutions, stringent environmental controls, and noise abatement measures.

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