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The Study of the Design of Closed Coal Yard in Thermal Power Plant

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Abstract: In China, there are many ways to generate electricity. Thermal power is used as the main way to generate electricity. Typically, thermal power mainly uses coal as primary power source; therefore it is often necessary to have coal storage. Currently a closed coal yard if compared to others coal storage building: its construction taken up small area, it has large storage capacity per unit area, it has high site utilization rate, it has no dust during storage and discard process, environmental friendly, centralized control program is used in the coal field system, high degree of automation, can be unattended and others advantages are increasingly being adopted. The structure design of a closed coal yard has a crucial role in the efficiency of the entire thermal power generation. Therefore, a reasonable design is of closed coal yard is necessary in thermal power generation. This paper will focus on the study of the design of closed coal yard in thermal power plant.

Keywords: Thermal power generation; Closed coal yard; Design research

Introduction

Thermal power generation is one of the major ways of power generation in China. Coal is the main fuel for thermal power generation, and coal is the primary energy source. The formation of coal takes hundreds of years, forming period is very long. Therefore, if coal is overused it will be contrary to the concept of sustainable development, which can be a huge obstacle to the sustainable development of society in China. Although China has a lot of new environmental friendly and sustainable power generation methods, but the thermal power generation is still the main power generation method. Coal is the main fuel in thermal power generation, and the amount of coal required is very large, so a closed coal yard for coal storage is needed. The main reason of closed coal yard is to avoid coal yard to be influenced by nature factors. Closed coal yard has a vital role in the protection of the coal in power generation plant. A closed coal yard is the main carrier of coal, if the design of a closed coal yard is unreasonable, inestimable serious consequences and economic losses will occur. Therefore, a strict design is need in the design process so that the entire power plant has a solid coal storage backup. This paper will focus on the explanation of the design research of closed coal yard in thermal power plant.

1. The component of closed coal yard

The main structure of a coal yard including coal retaining walls, steel space frame dome, cantilever stacker that rotates around the central pillar and scraper reclaimer. In the internal part of the coal yard, an inlet will be seen first, and this inlet is to transport coal from outside to inside of a coal yard, and then coal will be stacked inside the coal yard. The

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main machines are the cantilever stacker that rotates around the central pillar, and then coal is transported to the opening of pulveriser through conveyer belt to be crushed. After crushing is completed, crushed coal will be transported to delivery port through conveyer belt. The cantilever stacker and scraper reclaimer are the main machines in a closed coal yard, the main usage of these machines is to transport coal, which transport coal from outside of the coal yard, and transport coal to conveyer belt inside the coal yard. This is a complicated task but it is also the main structure in a coal yard.

i. Coal retaining wall

In the design of the coal retaining wall of a closed coal yard, under the bearing load of stacked coal, bearing load of upper roof, temperature and other main loads effect, to analyze the changes in the internal forces of coal retaining structure. While checking the loading effect, the high temperature resistance of wall materials has to be considered, in order to make sure that the coal retaining wall of the closed coal yard has a certain temperature resistance, this can be done by increasing the thickness of the wall or use high temperature resistance materials. The design of coal retaining wall is crucial in a closed coal yard. The height of the retaining wall can affect the amount of coal storage. On the contrary, the amount of coal storage will affect the design of the coal retaining wall, thus affecting the cost of the entire project. In general, coal retaining wall and its foundation accounted for about 50% of the total cost of a closed coal yard.

ii. Steel space frame dome

The usage steel space frame dome in a closed coal yard can give the sealing effect. In a closed coal yard, a sealed working space shall be achieved, because a sealed working space is environmental friendly. The steel space frame dome is currently the core of roof building technology. The method is used in vast majority of buildings. In fact, steel is used mainly because it can withstand relatively high pressure and its simple operation.

iii. Cantilever stacker that rotates around the central pillar

A stacker is mainly made up of its cantilever parts, running mechanism, hydraulic system, tripper car, rails, cable pit, power cable reel, cable control reel, and limit switch. It is the main stacking tool in a closed coal yard, which is appeared to be sloping and it requires relatively high electricity consumption, but it can improve the work efficiency of the closed coal yard.

iv. Scraper reclaimer

The main job scope of a scraper reclaimer in a closed coal yard is to deliver pulverized coal to outlet. Its main structures include portal frame steel structure, scraper reclaimer system, travelling beam mechanism, a system for pitching mechanism of reclaimer, and materials transport system, corresponding to the labels 1, 2, 3, 4, and 5 in *Figure 1*. The main role of portal frame steel structure is to return the portal frame to its original position when the travelling structure is ahead or left behind. The main role of the scraper reclaimer system is to force them to run synchronously. The materials transport system is based on the reclaiming capacity which can be set.

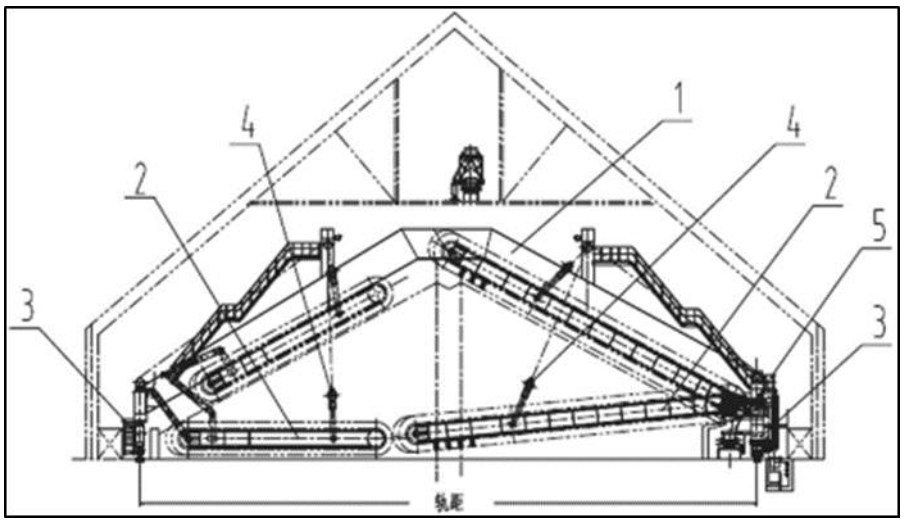

Figure 1.

2. Types of closed coal yard

Closed coal yard can mainly be divided into bar-type and round closed coal yard. A bar-type closed coal yard has relatively larger space, the interior orientation can be distinguished accurately, transport fuel to coal port when needed. However, the distance of some corners or the two sides is farther from coal causing difficulties in delivering coal to coal port. Large open space is one of the advantages of bar-type closed coal yard, in certain circumstances in term of cost; this can increase the storage space. The major drawback of the round closed coal yard is that it has smaller working space, but the distance from the center to anywhere will be equal. By installing a crane at the center of the round closed coal yard can help to deliver fuel which greatly facilitate the work, and improve the overall work efficiency. Both round and bar-type closed coal yard have its pros and cons, in particular the construction process shall be designed according to its specific emphasized points. The main structures of both the round and bar-type closed coal yard are basically the same, the main components including coal retaining wall, steel space frame dome, cantilever stacker that rotates around the central pillar and scraper reclaimer. *Figure 2* shows the structure of a round closed coal yard.

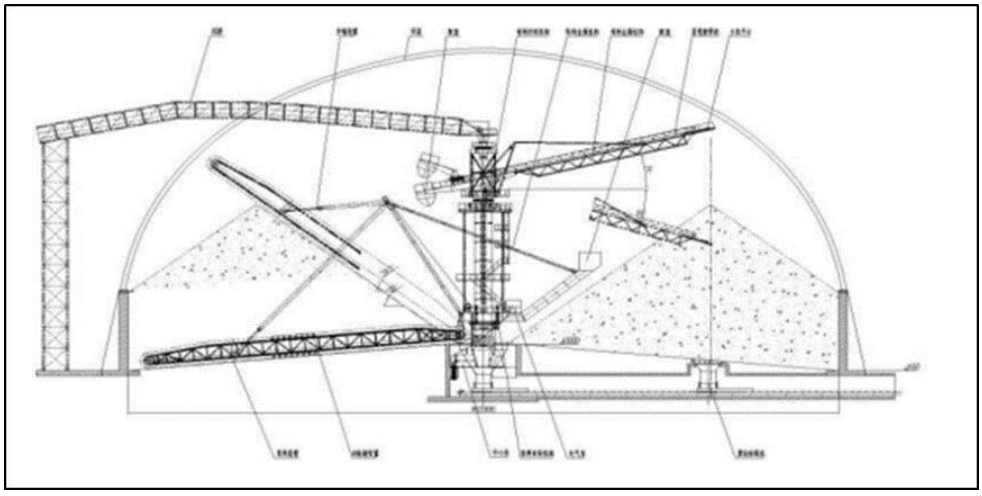

Figure 2.

There are many precautions in the design process of the roof of a closed coal yard, especially the bearing load capacity value of the roof. Some of the load related data is as follows:

No.	Name	Data
1	Dead load of roof top chord is determined through bidding in accordance with existing norms	Not less than 0.30kN/m^2 (excluding grid weight)
	Live load of roof top chord	0.50kN/m^2
2	Load of roof bottom chord is determined through bidding in accordance with specified design	Shall consider installation, bridleway, maintenance, and necessary lighting, load of fire control facilities (which the electrical lighting hoist not less than 0.1kN/m^2, maintenance not less than 1.0kN/m^2)
3	Earthquake resistance Intensity	7 degrees
4	Building' s earthquake resistance category	Type B
5	Site Classification	Type II
6	Ground roughness category	Type B
7	Basic wind pressure (50 years)	0.5kN/m^2
8	Basic snowing pressure (50 years)	0.35kN/m^2
9	Fouling load	Shall be considered
10	foundation	Shall consider load of stacked coal
11	Construction load	Considered by bidders themselves

For grid design, the effect of deformation on the lower part of retaining wall to grid internal forces (consider the fire control load).

3. Precautions for closed coal yard

In thermal power plant, the main issue that needs to pay attention to is to have regular inspection for the components of the closed coal yard because they are controlled by machines, an error can cause inestimable losses. In addition, emergency systems need to be established. In case of emergency power outage, emergency system shall be started to improve work efficiency.

To ensure the safety work in the closed coal yard is at its best, particularly measures such as heat preservation, thermal insulation and fire control shall be taken. 1) To control the FIFO of coal, and control the numbers of days for coal stacking, which means that coal that delivered first into the coal yard should be delivered out first before the coal that is delivered in later, to ensure that the coal is stored in the coal yard for a certain number of days. 2) Control the moisture of coal in the closed coal yard, to ensure the humidity and moisture of the coal are reasonable, so to reduce the possibility of spontaneous combustion of coal. 3) Set up fire sprinkler pipe in coal retaining wall. If there is spontaneous combustion of coal, inject water into the gap between coal retaining wall and coal using fire sprinkler pipe, to ensure the safety of coal retaining wall structure.

4. The importance of the design of closed coal yard in thermal power plant

i. Energy saving, environmental friendly

The closed coal yard has a significant role in thermal power plant. The operation by using closed coal yard for coal blending is simple, and it can eliminate the need for blending tank, dosing and other large equipment. The coal that

is stored in the coal yard is not affected by climatic conditions, and dosing is uniform, which reduce the coal blocking phenomenon in crushing and filtering equipment and coal chute, to ensure that the plant internal system can operate for a long time, which can reduce the amount coal used to some extent, so as to achieve the purpose of energy saving. And the most important thing is to improve the work efficiency, and use commensurable amount of coal to generate more electricity. At the same time, because of closed coal yard, storage and discard by a storage system in sealed space is achieved, where no dust is escape in the process, and coal bearing waste water can be used, which is environmental friendly.

ii. Promote the development of thermal power generation

At current situation, there are many powers generating ways in China. In modern power generation, secondary energy is used in almost of all the methods to generate power, which causes the disadvantage in thermal power generation. Thermal power generation shall be improved in order to improve its competitiveness. Building a closed coal yard is a good improvement method for thermal power generation. By building a closed coal yard, the amount of coal used is saved fundamentally. Although the amount of coal saved in thermal power generation is small, but the total amount of coal saved in all thermal power plant is China is large, and this allows the thermal power generating to develop effectively.

5. Conclusion

Construction of a closed coal yard is not only solved the problem of open air coal yard, but also bring significant benefits to economy and social. Therefore, the research in closed coal yard design shall be deepened, and continuously improved, optimized, to solve the problems caused by coal power plant at current stage.

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