Design and Analysis of Different Storage Cargo Station Project

Jiaxing Fu\textsuperscript{1,2,*}, Zhiming Ma\textsuperscript{1,2}, Jiyang Li\textsuperscript{1,2}, and Tong Wu\textsuperscript{1,2}

\textsuperscript{1}Tiandi Technology Co., Ltd., China
\textsuperscript{2}CCTEG Coal Research Institute, China

Abstract. This paper completed a program with a typical coal loading station analysis, coal systems, interior design by coal storage system loading stations will be expanded, it will be subject to the coal pit, different forms of storage bunker, coal storage shed, etc. specific technical parameters superior and its corresponding economic indicators combined standard to do a detailed comparison and determine the best technical and economic solutions Cargo station construction; focus on the application of matlab calculation program calculates the design reserves loading stations with coal shed aspect ratio, the relationship between the length of the curve values, verify the Cargo station design is reasonable to give a general rule of coal storage capacity design.

1 Introduction

Based on the Ordos City of God Yu Energy LLC Cargo Station program analysis of what the different coal storage mode, is to analyze the coal storage shed and storage bunker in Cargo station usage.

Ordos City of God Yu Energy LLC Cargo station project in Inner Mongolia, according to the geographical and administrative area of the project is the mountain Yijinhuoluo, loading stations designed annual shipment capacity of 10Mt/a, topographic characteristics of the project is very special place in a narrow strip, the length of 1042 m site, but the site is only an average width of 40 meters.

In the Cargo station design, select the economic aspect is a very important item of work. Arrangement of the entire loading stations, the coal receiving mode, coal storage methods are and its surrounding road transport conditions, site topography, external transport, and other closely related, and limited engineering geology and factors, so both economical and reasonable determine the economic aspect of a Cargo station, it is the key of the design. This article focuses on the way coal storage loading stations were analyzed.

2 System analysis

2.1 System Analysis by coal

Cargo station coal receiving system that is affected by coal pit coal shed. Mainly by coal pit forms-through and reverse two forms are used in the field there are advantages and
disadvantages Los applications need to be selected according to the actual situation of the site conditions, heavy-duty vehicles.

Flow-through heavy vehicles by the coal pit after weighbridge weighed straight into the room by the coal pit, since that is the coal pit lane after the exit beam position by parking were unloading operations. If the weight of the car by the side discharge at the coal pit stop side were unloading operations.

Advantages: Heavy vehicle without stopping or reversing to turn to a pointing position unloading; Enter smaller venues.

Disadvantages: the beam that is passed on coal pit coal product will take some time to clean up once with a bulldozer.

Reversing the process by type of coal pit is by car to straighten bent at right angles Abduction former coal pit stop after reversing the vehicle, the rear end of the car into the heavy subject before and after the coal pit were unloading operations. If the weight of the car is heavy Dropside car parking close to the edge of the coal pit by performing a lateral unloading operations.

Advantages: monocoque by the coal pit coal product less frequently.

Disadvantages: heavy vehicles need to turn or reversing position pointing unloading; need to set a large carriage space, are not well adapted Dropside job.

Depending on the circumstances of the present analysis of the project, because the project site is very long and narrow, not suitable for a U-turn of the vehicle, so that the coal pit arrangement Cargo station by using the formula by coal pit.

2.2 The ability of the system to determine the coal

The system is similar to the production of surface mine truck unloading solid Fixed type, its production capacity can reference to determine(1).

\[ Q_m = \frac{k_1 A_m}{d h_1} \]

where: \( Q_m \) - system capacity , \( Q_m = 2460 \text{t/h} \);
\( A_m \) - car by coal pit design capacity, \( A_m = 10 \text{Mt/a} \);
\( k_1 \) - imbalance coefficient, generally take \( k_1 = 1.3 \text{~} 1.5 \), taking 1.3;
\( d \) - On weekdays, \( d = 330 \);
\( h_1 \) - production system effective daily working hours, \( h_1 = 16 \text{h} \).

To meet the system \( 10 \text{Mt/a} \) capacity requirements, it is to set up two coal receiving system, select:

One by transporting coal storage capacity of the system to \( 1500 \text{t/h} \).
II by transporting coal storage capacity of the system to \( 1500 \text{t/h} \).

2.3 Determined by the number of coal pit

After investigation truck unloading average time of \( 4 \sim 6 \text{min} \), according to \( 40 \text{t} \) truck unloading a car \( 6 \text{min} \) calculation.

The total number of coal and bits: \( 1500 / 60 \times 40 = 3.75 \text{ points} \approx 4 \text{ months} \).

One by four by the coal pit coal shed, each subject to a capacity of 70 tons of coal pit.
II coal shed 4 affected by the coal pit, each subject to a capacity of 70 tons of coal pit.
2.4 Coal Storage Systems Analysis

Depending on the circumstances of the present analysis of the project, due to coal cars and trains Sinotrans affected by weather factors, transportation conditions are more restrictive there is a big uncertainty, storage capacity Cargo station general requirements cacheable 3-7 days Cargo station design Road warehouse loading capacity required foot skin 1 to 2 train carrying amount. And because the source of coal mine more, regardless Cargo station management mode after sub-storage reservoir or sub-sub-delivered blending Sinotrans storage facilities are required to meet the sub-species or sub-users to store, several site use more coal storage warehouse, field can meet these two requirements:

(1). silo
This kind of storage is widely used in the form of China's coal industry has the smallest footprint, high reliability system equipment, long service life, ease of production management, conducive to future expansion of coal storage capacity and many other advantages. The main disadvantage is the higher cost per ton of coal, another warehouse bins cylindrical body can only meet the needs of a user of coal storage, such as to meet the multiple users need to build multiple positions.

(2). coal storage shed
Coal yard advantage of coal storage field can be arbitrarily divided into a plurality of regions by the owners meet multiple users to store tons of coal a low cost, long service life, short construction time. The disadvantage is that a larger area, poor system reliability of the equipment, management more complex, high production costs and low back the amount of coal, the need for secondary operations, such as large machinery.

Scenario 1: coal storage mode using the storage bunker, set up five ten thousand tons of coal storage warehouse, up to ten thousand tons to meet the five users.

![Figure 1. By coal storage bunker system.](image1)

![Figure 3. Sectional view of a storage bunker.](image2)

The total project cost is 151 million yuan. Of which: 92 million yuan civil engineering, equipment and instruments purchased 42 million yuan, 1230 yuan installation works, other costs 4.7 million yuan.

Late project operating costs 2.07 yuan per ton to remove equipment depreciation, cash flow of 1.57 yuan per ton.
Scenario 2: coal storage mode using coal storage shed, set up two coal storage shed set the width of 22.5 meters and a length of 250 meters, a single shed coal reserves of 3.4 million tons, to meet up to six 10,000 users.

![Figure 4. Coal storage shed by the coal system.](image)

![Figure 5. Coal storage shed loading system.](image)

The total project cost is 123 million yuan. Wherein: civil engineering 63.8 million yuan, equipment and instruments purchased 43 million yuan, 1250 yuan installation works, other costs 3.7 million yuan.

Late project operating costs 2.35 yuan per ton to remove equipment depreciation, cash flow of 1.79 yuan per ton.

![Figure 6. Sectional view of a coal storage shed.](image)  
![Figure 7. Storage bunker scheme renderings.](image)

3 Determine the program

The main points of discussion on the choice of two programs in the coal storage mode and economic conditions. First, because the field conditions, if the coal storage shed programs, in order to meet fire code requirements, both sides must be left out of the fire exits, so the maximum width of the coal storage shed can only be set at 22.5 meters, the owner reserves to meet demand, it is to lengthen the length of the coal storage shed to 250 meters, and coal storage shed substantially fills the entire space program, the impact of other buildings and arrangement of floor space can be used during the construction, and coal storage bin program is completely well adapted to site conditions. Secondly, in the investment comparison it can be seen, although the total investment program was slightly lower than
coal storage shed storage bunker program, but the program back to the coal storage shed coal rate can only reach about 45%, is the need for a large number of loading auxiliary jobs, the coal storage shed operating costs than coal storage bin scheme, although one-time investment of high storage bunker, but a high degree of automation, saving the latter part of the operating costs. Second, the business model of the major owners of overall Cargo loading station is the main transit, rather than to store coal, coal storage bin so here once again to quickly fed the material characteristics won the favorite of owners and experts. The final selection of programs based storage bunker set quality programming transport stations.

4 Advantages of different ways in the coal storage cargo station

Cylinder storage coal in China has been widely used, but in the Cargo station usage is not very high, especially in the Ordos region, most of the loading stations are mainly coal storage shed.

Cargo station using generally cylindrical compartment will be because of its construction investment is large, but by the barrel of engineering geological conditions significantly affected, storage and other reasons are not flexible multi criticized the owners and designers. But in this project silo just become the best choice.

It can be seen that the advantages of silo loading stations in use are:
1. accounting for a small ground in a bad case of site conditions can effectively reduce the footprint.
2. although high silo construction costs, will increase the use of coal storage shed more auxiliary working volume, and silo high degree of automation, can effectively reduce operating costs at a later stage.
3. in the owner's business model as a transit mainly when loading, silo demonstrate its continuing ability to convert advantage.

Coal storage shed now as the most efficient loading stations, the most widely used storage methods, it has its own unique advantages:
1. lower investment coal storage shed, structure simple.
2. coal storage flexible, more users can be assigned multiple users to their own needs.
3. suitable for long-term storage of coal and coal transshipment Sinotrans different business model.

However, the characteristics of this project can be seen, and the obvious advantages of such a widely used way of storage of coal, in particular in the case also has its unsuitability.

According to the characteristics of the project and the coal storage shed to form associations, coal storage shed I long, wide impact on the reserves to do a bit of quantitative analysis system, first define a rectangular area of a certain coal storage shed $S = 6400$ square meters, setting a width of a length b reserves $V$, $C = b / a$ is the aspect ratio, the angle of repose of the coal is coal storage shed $45^\circ$, the stack height of 12.8 m, the reserves of formula $V$:

$$V = (b-a)ha - \frac{1}{2}(b-2h)h^2 - \frac{2}{3}h^3$$  \hspace{1cm} (2)
Figure 8. Reserves $V$ and the width of a relationship. Figure 9. Relations between the reserve $V$ and $C$.

Whereby the curve can be seen, the relationship between a storage and $V$, in $a = 56.6$ m, the reserves reached 6.408 m$^3$ $V$ peak. And in the width continues to increase until the length and width are the same, namely coal storage shed form a square, $V$ reserves in a slow downward trend, and when the width of a reduced, $V$ reserves dropped sharply, indicating a certain time when the area $S$, the width Effect of reserves gradually decreases significantly.

Whereby the curve can be seen, when the aspect ratio at close to 2 $C$, reserves of coal storage shed to peak. Aspect ratio is close to 1 in $C$ stocks declined, while the aspect ratio is less than 2 $C$ after reserves decreased significantly.

It can be seen that when a certain area of the coal storage shed, the aspect ratio reaches 2, can maximize the reserves, but the aspect ratio is less than 2:00 sharp decline in reserves, in consideration of the increase in the span of civil structures lead to increased investment and construction difficulty, so when a certain area of the construction of coal storage shed is not only in the aspect ratio of 2 to 3, to meet the storage

Quantity is not particularly at higher utilization improve civil investment.

The above analysis only focuses on the quantitative analysis of reserves, different designs of various loading stations according to their situation even faith and reasonable process, focusing on the actual local conditions in order to carry out the principle of conservation investment, get the maximum benefit for the investment units.

5 Conclusions

(1) energy technology portfolio God Yu limited liability company Cargo Station program by the formula by adding coal pit coal storage bin type is the best combination of technologies.

(2) Cargo station design when the aspect ratio of 2 to 3, the coal storage capacity can reach the largest reserves, and construction investment will not increase because of the increase of the span.


References


3. Hu success, Zhao Qi. Several coal yard of coal storage in the form of advantages and disadvantages. Opencast Mining Technology .2013-2
