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Design and Selection of Pipelines for Compressed Air Energy Storage Power Plants

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Abstract: The principle of Compressed-air energy storage is that the compressed air energy storage system uses compressed air as the energy storage carrier, which is a physical Energy storage that uses mechanical equipment to realize energy storage, transfer and utilization across time and space. At present, Compressed-air energy storage is the second largest technology that is considered suitable for GW level large-scale electric energy storage after pumped storage. Compressed air energy storage has outstanding advantages such as large scale, low cost, long service life, and short construction period. As a key link connecting compressors, expanders, and gas storage devices, the compressed air main pipeline has characteristics such as high operating pressure, low internal fluid temperature, large temperature difference between indoor and outdoor pipelines, and frequent start and stop. The design, calculation, and installation of the compressed air main pipeline will affect the economy and reliability of the entire system, and even bring serious destructive accidents. This article comprehensively introduces the selection method and process of compressed air energy storage pipeline design, and further verifies the feasibility and accuracy of the design method through case studies of specific projects. It provides convenience and calculation methods for the large-scale development of compressed air energy storage projects in the future[1].

1. Introduction

The compressed air energy storage system utilizes the peak valley electricity difference for energy storage and generation, achieving the transfer of electrical energy in time and space. As a key link connecting compressors, expanders, and gas storage devices, the compressed air main pipeline has characteristics such as high operating pressure, low internal fluid temperature, large temperature difference between the inside and outside of outdoor pipelines, and frequent startup and shutdown. The design, calculation, and installation of the compressed air main pipeline will affect the economy and reliability of the entire system, and even bring serious destructive accidents. Therefore, it is required that the selection of compressed air main pipeline should comprehensively consider the characteristics of safety, economy, corrosion resistance, oxidation resistance, aging resistance, cracking resistance, irritation resistance, etc. At the same time, the compressed air pipeline should meet the user's requirements for flow, pressure, temperature, quality, etc., while considering the needs of later expansion and renovation. Therefore, the design and selection of the compressed air main pipeline play a crucial role in the entire project[2].

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2. Material selection factors

2.1 Corrosion resistance

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Pipeline corrosion is divided into external corrosion and internal corrosion. Pipeline inner wall corrosion refers to the corrosion of the pipeline inner wall caused by factors such as temperature, pressure, flow rate, and alternating stress due to the presence of corrosive impurities in the pipeline medium.

The medium used in compressed air energy storage pipelines is high-pressure and normal temperature air, and the corrosion resistance of pipelines is an important factor and indicator that affects the selection of compressed air pipeline materials. The relative humidity in the atmosphere is generally over 65%. After being compressed and cooled by a compressor, the air becomes wet saturated air. The

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pressure dew point temperature range of saturated compressed air after cooling and drying treatment is generally -70 ℃~10 ℃. The more water content in the air, the higher the dew point temperature. When the ambient temperature is below the dew point temperature, liquid water will precipitate from the moisture in the humid air. The liquid water that has not been cooled and separated and is generated due to temperature reduction is carried by compressed air in the pipeline system, becoming the main cause of equipment, pipeline, and valve corrosion[3].

For pipeline materials with good corrosion resistance, the current national standard GB50029-2014 "Code for Design of Compressed Air Stations" has made specific provisions, clarifying that pipeline materials are related to the quality of compressed air transported, as shown in Table 1.

Table 1. Selection regulations for compressed air pipes

Solid particle level or humidity level	Regulations on the selection of pipes
≤5 level	Carbon steel pipes can be used
＞5 level, ≤3 level	Hot-dip galvanized steel pipes and stainless steel pipes can be used
＞3 level	Stainless steel or copper pipes should be used

This specification specifies the pipeline materials applicable to compressed air of various quality levels, and the selection principle is technical and economic, with the aim of ensuring stable gas supply quality and not being contaminated by the transmission pipeline.

2.2 Price

Pipeline prices are influenced by various factors, including raw material prices, production costs, quality control, transportation costs, maintenance costs, installation costs, etc. The purpose of price analysis is to understand the main components of price, in order to make wise decisions in the actual selection process.

2.3 Construction convenience

The connection of metal pipelines generally adopts welding, threaded connection, or clamp connection, while non-metallic pipelines generally adopt hot melt or electric fusion connection. The construction speed of welded connections is slower than that of threaded, clamp, or hot melt connections, but the sealing stability of welded connections is the most reliable, and the interface is not prone to leakage. The advantages of clamp connection are convenient installation and disassembly, fast construction, and the construction workload is only one-third of that of welding, and it is suitable for situations where on-site hot work is not allowed.

2.4 Design temperature

《 The 20G steel and other metal pipes specified in Seamless Steel Tubes for High Pressure Boilers 》 （ CB5310-2017 ） are mainly used for pipes and components with high pressure and temperature. Due to its good oxidation resistance, plastic toughness, welding performance and other cold and hot processing properties, and considering economic factors, this material is often used at about 400C. However, in the cold regions of northern China, the average monthly minimum temperature over the years has even been lower than the minimum design temperature of -20C. If the device encounters a startup and shutdown process and corresponding process measures or operating rules cannot be taken to avoid the simultaneous occurrence of low temperature and high stress conditions, considering the impact of low temperature conditions in the atmospheric environment on metal temperature, according to national standards, the use of 20G steel and other metal pipelines will be restricted. If the design temperature of the pipeline exceeds 350 ℃ after the device is started, only materials with a wider temperature range such as stainless steel can be selected, which will inevitably increase costs and affect economic efficiency.

2.5 Other factors

The selection of pipes is also influenced by factors such as supply cycle, maintenance cycle, pipeline installation and lifting conditions, pipeline working environment, aesthetics, etc. Among them, pipeline maintenance refers to matters such as strengthening the external anti-corrosion of pipelines and replacing vulnerable parts of pipe joints.

The following table provides a comprehensive comparative analysis of 9 different specifications of pipelines, and their advantages and disadvantages are described in the table 2[4-5].

Table 2. Comparative analysis of pipelines of different specifications

Serial Number	Piping Standards	Pipe Material	Connection method	Pipeline price/(¥/m)	advantage	Disadvantages
1	GB/T3091-2015《 Welded steel pipes for low-pressure fluid transportation 》	Q235-B steel	Welding threaded connection flange connection	8~220	Low price	Easy to rust and high resistance

2	GB/T8163-2018《 Seamless steel tubes for liquid service 》	20 steel	weld flange connection	9~260	Low price and wide application	Easy to rust and high resistance
3	GB/T8163-2018《 Seamless steel tubes for liquid service 》	20 steel, galvanized	weld flange connection	15~420	Relative corrosion resistance	Zinc coating is prone to damage and corrosion
4	GB/T14976-2012《 Stainless steel seamless steel pipes for fluid transportation 》	06Cr19Ni10	weld flange connection	35~1000	Corrosion resistance and high strength	High price
5	GB/T4437.1-2015 《 Aluminum and aluminum alloy hot extruded tubes - Part 1: Seamless circular tubes 》	aluminum alloy	Clamp connection flange connection	10~200	Fast construction, corrosion resistance, and low resistance	Pipe fittings are expensive
6	CJ/T184-2012 《 Stainless steel lined plastic composite pipes and fittings 》	Stainless steel lined plastic composite pipe	Hot melt socket sleeve connection flange connection	28~530	Anti corrosion, low resistance, beautiful and hygienic	High price
7	CJ/T151-2016 《 Thin walled stainless steel pipe 》	06Cr19Ni10	Compression connection welding	14~460	Corrosion resistant and aesthetically pleasing	low strength
8	CJ/T321-2010《 Aluminum alloy lined plastic composite pipes and fittings 》	Aluminum alloy lined plastic composite pipe	Hot melt socket	35~850	Anti corrosion, low resistance, beautiful and hygienic	High price
9	GB15558.1-2015 《 Buried polyethylene (PE) pipeline system for gas use 》	PE100 polyethylene	Hot melt socket and electric melt socket	5~200	Corrosion resistance, good toughness, and low price	Low intensity, visible light aging

2.6 Comparison of Pipe Materials

Among the 9 common pipes mentioned above, items 1-4 are commonly used. The pressure bearing capacity of items 5-9 of the pipeline is below 1.6MPa, among which aluminum alloy seamless pipeline has been promoted and applied due to its advantages of low corrosion resistance and fast installation speed. Items 6-9 are less commonly used for compressed air pipeline transportation.

Taking into account various factors such as working environment, corrosion resistance, price, construction convenience, and design temperature, the compressed air energy storage power station delivers non clean air supply quality. Under indoor and outdoor overhead or underground laying conditions, 20G is preferred as the compressed air energy storage power station gas pipeline.

20G seamless steel pipe is widely used in high-pressure boiler, heating heat exchanger, petroleum, chemical industry, electric power, shipbuilding, paper making, food and other industries. The advantages of 20G seamless steel pipe mainly include high strength, high temperature resistance, corrosion resistance, and other characteristics, which are suitable for high temperature and high pressure environments.

3. Pipeline Design

The compressed air pipeline of the compressed air energy storage power station should meet the user's requirements for compressed air flow rate, pressure, and quality, and appropriately consider the needs of later expansion and renovation[6].

3.1 Pipeline design pressure and temperature

The design pressure and temperature of compressed air pipelines shall be taken according to the following regulations:

1. The design pressure is taken as the maximum value of the following three items:

1) 105% of the compressor outlet design pressure;

2) 105% of the design pressure at the inlet of the expander;

3) The design pressure at the compressor outlet plus the pressure drop in the pipeline from the compressor outlet to the gas storage tank;

4) Design pressure at the inlet of the expander plus pressure drop in the pipeline from the expander inlet to the gas storage tank;

2. The design temperature should be based on the rated working temperature at the inlet and outlet of the gas storage tank, plus the allowable temperature deviation value during normal operation of the power plant. When the host factory does not provide temperature deviation, the temperature deviation value can be taken as 5 ℃.

3.2 Internal diameter of pipeline

With reference to the requirements of relevant specifications 《Code for Design of Steam and Water Piping in Fossil fuel power station 》(DL/T5054-2016), the pipe diameter of single-phase fluid such as compressed air can be calculated according to the following formula:

$$Di = 594.7\sqrt{\frac{GV}{v}}$$

In the formula:

Di—Inner diameter of compressed air pipeline, mm;

G — Calculated flow rate of pipeline under normal temperature and pressure, t/h;

V— cut-off specific volume, m3/kg;

v—flow rate of compressed air in the pipeline, refer to relevant regulations in 《Code for Design of Oil and Gas Pipeline in Fossil fuel power station》 (DL-T5204-2017). table 3

Table 3. Recommended Flow Rates for Compressed Air Pipelines

Fluid type	Pipeline type		velocity of flow（m/s）
compressed air	Compressor intake pipe		～20
	Compressor air storage tank		～30
	General pipeline	d≤50	≤18
		d≥50	≤15

3.3 Pipeline components and materials

1. The material selection of compressed air pipelines should comply with the following regulations

1) The steel used for the pipeline should comply with the current national standards or power industry standards;

2) The selection of foreign materials should be based on the latest relevant foreign material standards and confirmed to be suitable for use conditions through analysis before use;

3) The selection of pipes should be based on the properties and parameters of the medium inside the pipes, as well as the safety and economy of operation under various working conditions.

4) Pipeline components should be selected from units that have obtained the qualification for manufacturing pressure pipeline components.

5) For compressed air pipelines without drying and purification requirements, carbon steel pipes can be used;

6) For pipelines with general purification requirements, galvanized steel pipes can be used;

7) For pipelines with a nominal diameter less than or equal to 150mm, welded steel pipes (galvanized) for low-pressure fluid transportation can be selected, and the material is Q235B;

8) For pipelines with a nominal diameter greater than 150mm, seamless steel pipes (galvanized) for fluid transmission can be selected, made of 20G (20 # steel);

9) For conveying pressure with a dew point below -40 ℃ or dust containing particle size less than or equal to 1 μ The purified compressed air pipeline of m can be made of stainless steel or copper pipes[7].

3.4 Pipeline accessories

3.4.1 Bends and Elbow

1. The main pipeline should use a bend, and the bending radius of the bend should be 3-5 times the outer diameter of the pipe. According to the layout, hot-pressed elbows that meet national or industry standards can also be used.

2. Pipes with nominal pressure below PN10 and nominal size below DN50 can use cold bending bends;

3. Long radius elbows should be used. Short radius elbows are only used for special arrangements;

4. Seamless hot pressed elbows should be used on pipelines with a nominal pressure greater than PN16, and straight pipe sections should be included.

3.4.2 Flange

The applicable pressure and temperature of flanges and accessories should comply with the provisions of the current national standard "Steel Pipe Flanges" GB/T 9124 regarding pressure temperature levels. When connecting flanges of different pressure levels, the usage conditions of flanges and accessories should be based on the lower level flange. [8]

3.4.3 Valves

Valves should be selected based on system parameters, diameter leakage level, opening and closing time, etc., and should meet the requirements of system shutdown, regulation, operation, and layout design. The form and operation mode of the valve should be selected based on the structure, installation, operation and maintenance requirements of the valve.

The commonly used shut-off valves on compressed air pipelines include butterfly valves, gate valves, globe valves, and ball valves.

1) When the nominal diameter is greater than or equal to 100mm, butterfly valves should be selected;

2) When the nominal diameter is less than 100mm, gate or globe valves can be selected;

3) Stop valves are often used in situations where appropriate flow regulation is required;

4) Ball valves are quick to open and close, with high reliability, and are commonly used in situations that require frequent opening and closing.

3.5 Water pressure test

Hydrostatic testing can be used to verify the strength of pipeline components and the tightness of pipeline systems.

1. The tightness test of pipeline system shall meet the relevant requirements of 《Code for Design of Steam and Water Pipeline in Fossil fuel power station 》 (DLT5054-2016) and 《Technical Code for Construction of Electric Power Construction Part 5: Pipes and Systems 》 (DL/T5190.5).

2. The strength test of pipeline components should comply with the following regulations

1) The strength test pressure (gauge pressure) of pipeline components should be calculated according to the following formula and the maximum value of both should be taken:

$$P_t = 1.25P\frac{[\sigma]^T}{[\sigma]^t} \text{ or } P_t = 1.5P$$

$$P_T = 0.1 + P$$

In the formula:

Pt— test pressure, MPa;

P—Design pressure, MPa;

[σ]T—allowable stress of steel at test temperature, MPa;

[σ]t—allowable stress of steel at design temperature, MPa.

2) Under the hydraulic test, the circumferential stress value inside the specimen should not exceed 90% of the material's yield limit at the test temperature. The circumferential stress should be calculated using the following formula:

$$\sigma_t = \frac{P_t\left[D_i + (S - C - C_1)\right]}{2\,(S - C - C_1)\,\eta}$$

In the equation:

σ^t— circumferential stress of pipeline components under test pressure (MPa);

P_t—Test pressure, MPa;

D_i— Pipe inner diameter, mm;

S— Pipe wall thickness, mm;

C—additional thickness considering corrosion and wear, mm;

C_1- additional value of negative deviation of wall thickness, mm;

3. After the pipeline installation is completed, the tightness of the pipeline system should be inspected;

1) The pressure of the hydraulic test is the gauge pressure, which should not be less than 1.5 times the design pressure and should not be less than 0.2MPa;

2) The circumferential stress of the pipeline under hydraulic testing, as well as the axial stress caused by internal pressure, live load, and dead load during pressure testing, should not exceed 90% of the material yield limit at the test temperature.

3) The temperature of water used for hydraulic testing should not be lower than 5 ℃ and should not exceed 70 ℃. The test environment temperature should not be lower than 5 ℃, otherwise measures should be taken to prevent freezing and cold brittle fracture;

4) The water quality for hydraulic testing should be clean and have minimal corrosion to pipeline system materials;

5) All welds of large-diameter pipes can also be tested for tightness by nondestructive testing instead of hydrostatic testing. The specific requirements of nondestructive testing should comply with the current power industry standard Technical Specification for Welding of Fossil fuel power station DL/T869

6) Tightness testing is not required for exhaust pipes and other pipelines leading to the atmosphere[9].

3.6 Corrosion allowance

According to the properties of soda and related research reports, for 20 G, the corrosion rate is 0.12mm/a. In the calculation process, the corrosion is considered based on a 30 year design life.

3.7 Pipeline Layout

1. Compressed air pipelines should be laid overhead and generally not buried. Indoor pipelines should be installed along the factory building, corridors, walls, and columns, while outdoor pipelines should be laid along cable trays or shared with other pipelines. Generally, single independent supports are not used for installation[10];

2. The pipeline layout should be combined with the equipment layout and building structure of the main plant, and the pipeline direction should be consistent with the axis of the plant. In areas where horizontal pipelines intersect more, it is advisable to delineate the elevation range of vertical and horizontal directions according to the pipeline direction, and arrange the pipelines in layers. The pipeline layout should not cause the main flow of the medium to change direction within the tee;

3. The pipeline system should prevent the occurrence of strain concentration in local areas due to elastic transfer of parts with high stiffness or low stress;

4. The pipeline installation should have a drainage slope of not less than 0.002. The low point of the pipeline should be equipped with a drainage pipe, and a DN15 ball valve should be installed on the drainage pipe. The distance between the drainage pipe mouth and the ground or platform should not be less than 150mm; High points of pipelines with a nominal diameter greater than or equal to 32mm should be equipped with exhaust ports. The exhaust port should be equipped with a pipe cap with a nominal diameter of no less than 15mm, or a DN15 ball valve should be connected to the ground. Thermal compensation should be considered for overhead compressed air pipelines in the factory area. Thermal compensation methods include natural compensation and compensator compensation, and in practical applications, natural compensation is generally used;

5. When pipelines pass through walls and floor panels, galvanized steel sleeves should be installed. Flexible

waterproof materials should be used to fill the gap between the steel sleeve and the pipeline, and cement mortar should be used to fill the gap between the sleeve and the wall. The end face of the sleeve should be flush with the wall or extend 30mm beyond the floor.

3.8 Pipeline Welding

1. Welding rods, wires, and fluxes should be selected based on the chemical composition and mechanical properties of the base material, as well as the crack resistance of the welded joint, carbon diffusion, pre welding preheating, post welding heat treatment, welding process qualification results, and usage conditions;

2 The selection of welding materials and relevant technical requirements shall comply with the relevant provisions of the current industry standard of《Technical Specification for Welding in Fossil fuel power station》（DL/T 869）and《Technical Specification for Welding of Dissimilar Steel in Fossil fuel power station 》（DL/T 752）.

3.9 Pipeline insulation and identification

External insulation treatment is required for pipelines in the northern region. External insulation can be achieved through three methods: rock wool insulation, steam tracing, and electric tracing insulation. Compressed air pipelines are generally insulated with rock wool. The thickness of the rock wool outer insulation layer is 30mm, and the protective layer is made of 05mm thick galvanized iron sheet.

To facilitate the identification of pipelines within the factory area, it is necessary to label the pipelines. For pipelines with a nominal diameter greater than or equal to 50mm, pipeline markings should be applied at approximately 20 intervals near the valve, branch, intersection with other pipelines, workshop entrance, and straight section of the pipeline. For pipelines with a nominal diameter less than 50mm, marking plates should be hung near the valve, branch, intersection with other pipelines, workshop entrance pipelines, and straight section every 30~100m.

3.10 Pipeline Construction

3.10.1 Pipeline construction process

Construction preparation→inspection and cleaning of pipeline sections and accessories→removal of equipment nozzle closures→installation of pipeline supports and hangers→assembly and welding of pipelines→welding of pipeline interface welds→weld inspection and non-destructive testing→tightening and displacement inspection of equipment piping handles→pipeline pressure testing→internal cleaning, blowing, and airtightness testing of pipelines→adjustment of supports and hangers→bolt tightening.

3.10.2 Common problem handling

During pipeline construction, when it needs to pass through walls or floors, steel sleeves should be added according to the on-site situation. The inner diameter of the sleeve should be more than 50mm larger than the outer diameter of the pipeline, and the sleeve should be flush with the wall; When passing through the floor slab, the exposed length of both ends of the casing should not be less than 30mm to prevent water seepage.

When the direction of local pipelines needs to be changed due to construction site reasons, the pipeline direction should be adjusted under the principle of not affecting the passage of personnel, equipment, vehicles, and equipment maintenance, ensuring that the drainage slope of the pipeline is not less than 0.002. An exhaust outlet should be added at the local high point of the pipeline (when the nominal pipe diameter is greater than or equal to 32mm), and a drainage pipe should be added at the local low point.

Since there are many kinds of Industrial gas and liquid pipelines in the plant area, and there are many specialties of pipeline design, the medium pipelines of different specialties are easy to interfere in the details. When interference occurs between pipelines with different media, it is common to choose pipelines with smaller diameters and partially redirect them to avoid pipelines with larger diameters. At present, many enterprises have introduced BIM 3D collaborative design, which involves modeling different media pipelines within the same factory building model. This allows for early detection of any interference between pipelines or between pipelines and buildings, and provides the location of the interference to facilitate timely adjustment of pipeline layout before construction, thereby ensuring construction progress.

4. Case analysis

Case Overview

A 300MW/1800MWh compressed air energy storage project is located in the northwest region of China, with an average annual temperature of 10℃(extreme maximum temperature of 37℃, extreme minimum temperature of -23℃).

The underground gas storage capacity of the project is approximately 370000m3, with a design pressure of 10 MPa, a design temperature of 40℃, and a design flow rate of 2.7 million Nm3/h.

4.1 Design pressure

The selection shall be made according to the system flow chart, referring to the requirements of 3.2.7 in the 《Code for Design of Steam and Water Piping in Fossil fuel power station》 (DL/T5054-2016) and the Chemical Design Manual.

According to relevant regulations, the design pressure of the pipeline should not be lower than the maximum continuous working pressure that may occur in the internal medium during pipeline operation; At the same time, the design pressure should consider the maximum deviation of the equipment, and the design pressure should also include the static pressure of the water column. When it is less than 3% of the rated pressure, it may not be included.

Therefore, for the compressed air main pipeline, the design pressure of the gas storage tank is set at 10MPa. Considering the possible maximum pressure deviation, the design pressure of the compressed air main pipeline is set at 12MPa.

4.2 Design temperature

According to relevant regulations, the design temperature of the pipeline should not be lower than the maximum continuous working temperature of the internal medium during pipeline operation; At the same time, the design temperature should consider the maximum deviation that may occur in the equipment.

Therefore, for the compressed air main pipeline, the design temperature of the gas storage is set at 40℃; Considering the possible maximum temperature deviation, the design temperature of the compressed air main pipeline is set at 50℃.

4.3 Internal diameter of pipeline

The inner diameter of the compressed air pipeline can be obtained from the following equation:

$$D_i = 594.7\sqrt{\frac{GV}{v}}$$

$$D_i = 594.7\sqrt{\frac{3483 * 0.00793}{15}} = 806.99mm$$

4.4 Pipeline wall thickness

The pipe diameter and wall thickness of this project shall be calculated according to the Code for Design of Steam and Water Piping in Fossil fuel power station (DL/T 5054-2016).

(1) Calculation of straight pipe wall thickness

When Do/Di ≤ 1.7, the minimum wall thickness calculation of straight pipes under internal pressure should comply with the following regulations:

Wall thickness determined based on the inner diameter of the pipe:

$$S_m = \frac{PD_i + 2[\sigma]^t\eta C + 2YPC}{2[\sigma]^t\eta - 2P（1 - Y）}$$

In the formula,

Sm—minimum wall thickness of the pipe, mm;

Di—inner diameter of the pipe, taking the maximum inner diameter including the positive deviation of the pipe diameter, mm;

Y—Temperature correction coefficient, as shown in Table 4 below;

η—The allowable stress correction coefficient is taken as 1.0 for seamless steel pipes;

C—Additional thickness required for corrosion wear and mechanical strength;

P— Design pressure, MPa;

$[\sigma]^t$—allowable stress of the material, MPa.

(2) The calculated wall thickness of the pipe should be calculated using the following formula:

$$S_c = S_m + C_1$$

In the formula,

C1—additional value of negative deviation of pipe wall thickness, mm.

For pipe specifications based on outer diameter × The steel pipe with wall thickness identification shall be calculated according to the following equation:

$$C_1 = \frac{m}{100 - m}S_m$$

In the formula, m—the allowable negative deviation of wall thickness specified in the technical conditions of the pipe product, taken as a percentage.

Table 4 Temperature Correction Factors

Material	Temperature（℃）					
	≤482	*510*	*538*	*566*	*593*	*621*
Ferritic teel	0.4	0.5	0.7			
austenitic	0.4				0.5	0.7

After calculation, the wall thickness of the compressed air main pipeline in this project Sc=42mm.

Therefore, the pipeline specification DN900×42.

4.5 Pipeline components and materials

Refer to 《Typical Design of Parts and Components of Steam and Water Pipelines in Fossil fuel power station》 (GD2016), according to the design pressure of compressed air pipe 12MPa, design temperature 50 ℃, pipe specification DN900×42. Seamless pipe fittings are used, with a material of 20G and a nominal wall thickness of no less than 42mm.

5. Conclusion

(1) In this paper, a design and material selection method of compressed air pipeline is proposed by referring to relevant design specifications such as Fossil fuel power station, and various links such as pipe fittings, test, construction, etc. are comprehensively considered;

(2) This article focuses on a 300MW/1800MWh compressed air energy storage project located in the northwest region of China, with an average annual temperature of 10 ℃. The underground gas storage capacity of the project is about 370000 m3, with a design pressure of 10MPa and a design temperature of 40℃. The design pressure of the compressed air main pipeline is set at 12MPa and a design temperature of 50℃. By referring to Typical Design of Parts and Components of Steam and Water Piping in Fossil fuel power station (GD2016), the pipe specification is DN900 × 42. Seamless pipe fittings are used, with a material of 20G and a nominal wall thickness of no less than 42mm.

(3) This article discusses and analyzes the design and selection of compressed air energy storage pipelines in the design of compressed air energy storage power plants, which can provide design and construction reference for the large-scale application of compressed air energy storage power plants in the future.

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