Abrasion resistant ceramic lined pipes, bends and elbows

Specifications & size range

Collect Steel pipe and fitting Resources
Abrasion resistant ceramic lined pipe

SHS (Self-propagating High-temperature Synthetic process) ceramic lined steel pipe and elbow create a new generation of abrasion and corrosion resistant engineering pipeline. The composite steel pipe is composed of three layers: ceramic, intermediate, and steel layers. The ceramic layer is formed by molten alumina at a temperature above 2500 degree.

\[2\text{Al} + \text{Fe}_2\text{O}_3 = \text{Al}_2\text{O}_3 + 2\text{Fe} + 836\text{KJ}\]

\[3\text{Fe}_3\text{O}_4 + 8\text{Al} = 4\text{Al}_2\text{O}_3 + 9\text{Fe} + 3265\text{KJ}\]

Abrasion Resistant Ceramic Lined Pipes have been uniformly produced by a thermite reaction induced under the influence of a centrifugal force ("Centrifugal Thermite Process") without any high-temperature furnace facilities. The characteristic feature of the present process for forming uniform ceramic layers is in its reaction propagation as well as the reaction heat and centrifugal force. It is very important in improving the quality of the ceramic lined pipes to find the proper conditions of the reactant and centrifugal force; the former mainly determines the produced ceramic layer quality and the latter the achievement of layer separation and the mechanical properties of the pipes. Ceramic lined tube has great resistance against corrosion, abrasion and thermal shock.

Features and Advantages:

1). High Abrasion Resistant:

Vickers hardness of the corundum lining is HV1100 to 1500, as high as that of tungsten-cobalt hard alloys, and the abrasion resistance is 20 times as carbon steel pipes. The composite ceramic lined steel elbow was used in a mining plant for about fifty thousands hours. The general service life of common steel elbow is about 700 hours.

2). Corrosion Resistant:

Corundum is a neutral material, and is acid-proof and fouling-free.
3). Heat Resistant:
Ceramic lined composite steel pipe can work under circumstances of -50 to 800 Celsius degree.

4). Lower Weight and Convenient Installation:
The ceramic lined steel pipes are lighter than alloy pipes, cast iron pipes, and cast stone pipes and can be welded or connected through flanges, which reduces the expense of transportation and makes the pipes easier to install. For the pipes with the same sizes, types and length, the weight of ceramic pipe is about 1/2 of the wearable cast alloy steel pipe's, while the cost has reduced 10%~20% per meter. The weight of ceramic lined steel pipe is about 1/3 of the cast stone bent pipe's, 1/2 of the cast stone straight pipe's.

5). Lower Cost:
Ceramic lined pipes can take place of expensive stainless steel, titanium, nickel, cast stone or alloy pipes. Extended service life can also reduce maintenance cost.

Hoop strength is the resistance against radial pressure. The strength of the ceramic-lined steel composite pipe is 300 to 500MPa.

- **Size of Ceramic-Lined Steel Composite Pipe (CLSP)**
- **Use of Ceramic-Lined Steel Composite Pipe**
- **Size of 22.5 degree elbows**
- **Size of 45 degree elbows**
- **Size of 90 Degree elbows**
- **Size and Type of Composite Tee**
Ceramic (Corundum: a-Al₂O₃) lined abrasion resistant straight pipe and fittings are lined with highly abrasion resistant ceramic by SHS ------Self-propagating High-temperature Synthetic process.

**Physical Properties**

<table>
<thead>
<tr>
<th>Properties</th>
<th>Material</th>
<th>Thickness of ceramic layer (μm)</th>
<th>Density of ceramic layer (g/cm³)</th>
<th>Linear expansion coefficient (x10⁻⁵/°C)</th>
<th>Micro-hardness HV₀₂ (Kg/mm²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ceramic-lined steel composite pipes</td>
<td>≥2</td>
<td>≥3.40</td>
<td>12-13</td>
<td>1200-1600</td>
<td></td>
</tr>
</tbody>
</table>

**Mechanical Properties**

**Hoop Strength:**
Hoop strength is the resistance against radial pressure. The strength of the ceramic-lined steel composite pipe is 300 to 500MPa.

**Compression-Shear Strength:**
Compression-shear strength is the bonding strength at the interface between the ceramic layer and the steel pipe. The compression-shear strength of the ceramic-lined composite pipe is 15 to 20MPa.

**Resistance to Abrasion:**
The ceramic-lined steel composite pipe has exceptional resistance to abrasion. Its service life in materials transportation with hard abrasives is more than 20 times longer than in common steel pipe.

A composite elbow was used in a mining plant for about fifty thousands hours. The general service life of common steel elbow is about 700 hours.
**Resistance to Mechanical Shock**

The ceramic layer does not crack or flake off when the composite pipe receives a mechanical shock.

**Resistance to Thermal Shock**

The ceramic layer does not crack or flake off when heated to 800°C and then quenched.

**Good Weld Ability**

The ceramic-lined steel composite pipe can be joined by welding the steel pipe layer.

**Light Weight**

The ceramic-lined steel composite pipes are lighter than alloy pipes, cast iron pipes, and cast stone pipes, which reduces the expense of transportation and makes the pipes easier to install.

![Good weld ability](image1)

![The relative weight of the composite pipe](image2)

Convenient Installation

The ceramic-lined steel composite pipes can be easily connected by welding, or with flanges and soft easy connectors.

![Convenient installation](image3)

The composite pipes have good corrosion-resistant. There is no evidence of corrosion filling the composite pipes with bitter for one year (left), but the common steel pipe under the same condition is corroded seriously (right).
The liquid pipe transport has been widely used in the industries of electric power, metallurgy, coal, petroleum, chemical engineering, building materials, mechanism and so on.

**Wear-resisting comparative table of ceramic lining pipe**

<table>
<thead>
<tr>
<th>Material</th>
<th>Volume diminution (cm³)</th>
<th>Material</th>
<th>Volume diminution (cm³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ceramic lining</td>
<td>0.0022</td>
<td>Ceramic lining</td>
<td>3</td>
</tr>
<tr>
<td>Steel pipe</td>
<td></td>
<td>Steel pipe</td>
<td></td>
</tr>
<tr>
<td>Ceramic pipe</td>
<td>0.0025</td>
<td>S45C</td>
<td>25</td>
</tr>
<tr>
<td>Al₂O₃ 97%</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The liquid pipe transport has been widely used in the industries of electric power, metallurgy, coal, petroleum, chemical engineering, building materials, mechanism and so on. And it has developed rapidly. When transporting the materials with the harder abrasion (such as ash dregs, slag, coal powder, mining dregs, the rest mines, cement, etc), it will exit the problem that the abrasion of pipes is too rapid. Especially, the abrasion of bent pipes is greatly more rapid. When transporting the special abrasion materials or erosive materials, it will exit the problem that the damage of pipes is too rapid.

When transporting the materials with comparatively high temperature, it will exit the problem that the anti-hot steel pipes are very expensive. Since the ceramic steel pipe has gone into the market, the above problems have been settled down easily.

The ceramic steel pipes are widely used for the transporting of mining fillings, mining power, and the rest mines with hard abrasion; for the pipe lines of hardening slag, blast furnace dregs, steel-making red-clay, agglomerated whitewash, dust cleaning of steel & iron companies; for the pipe lines to transport powder, to clean dregs, to clean sulfides, to clean dust for the thermal power plants; for the transport pipe lines of green stock, clinker, cements, coal powder and collective dust in the industry of cement. The ceramic steel unbent pipes are also the ideal pipelines for transporting the materials with erosive matter.

The ceramic steel unbent pipes, the ceramic steel bent pipes, reducers, three-path pipes, four-path pipes, multi-path pipes and others manufactured in our factory have been used in over 200 thermal power plants, more than 50 mines and the industries of coal, building materials, mechanism, petroleum and so on. For example, in the condition of hard abrasion, the ceramic steel unbent pipes have been used for several years. But, at present, there is no any ceramic steel unbent pipe has been worn through. Even the ceramic steel unbent pipes with hardest abrasion, their use life is 10 times longer than the cast stone bent pipes and wearable alloy steel bent pipes, 15 times longer than the toughened plastic bent pipes and toughened latex bent pipes.
The ceramic steel pipe has captured the market rapidly. Besides the high quality and the wonderful capability, it's also because its capability price ratio is higher than other wearable, anti-abrasion & anti-hotness pipes.

For the pipes with the same sizes, types and length, the weight of ceramic pipe is about 1/2 of the wearable cast alloy steel pipe's, while the cost has reduced 10%~20% per meter; the weight of ceramic pipe is about 1/3 of the cast stone bent pipe's, 1/2 of the cast stone unbent pipe's.

The cost per meter is equal to the unbent pipe's, 5%~15% less than the bent pipe's.

Remarks:
1. Under the direction of the arrow diagram for the export direction.
2. Bend radius is usually 1.5-5 times the diameter of steel pipe (1.5-5D).
3. Other specifications of the composite pipe can be manufactured according to the user requirements.
4. The weight is calculated by theoretics, maybe have some tolerance, the real weight will be weighed after they finished.

Hoop strength is the resistance against radial pressure. The strength of the ceramic-lined steel composite pipe is 300 to 500MPa.

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