The present invention provides a nodular cast iron foundation pile pipe and a method for preparing same, including following steps: (1) preparation before pipe casting: including molten iron preparation, spheroidization and coating spraying on an inner wall of a pipe mold; (2) pipe casting process: including centrifugal casting and pipe drawing; (3) annealing process; (4) finishing process. The present invention further provides the foundation pile pipe manufactured with the above-mentioned method wherein the flange and the foundation pile pipe are integrally cast or welded. In the present invention, the nodular cast iron is used as the material of the foundation pile pipe instead of Q345 steel used in the prior art. As a result, the overall strength is enhanced. The present invention possesses advantages such as corrosion resistance, long service life, low manufacturing cost, low labor intensity, short construction period and being suitable for mechanized construction.
The present invention relates to a foundation pile pipe and a technology for preparing same, particularly relates to a nodular cast iron foundation pile pipe and a technology for preparing same.

BACKGROUND

A pile pipe is a foundation pipe of the pile, which is struck underground to work as a foundation. A flange thereof is used to connect with a pole on the ground generally by bolts. The pile pipe is used to replace the traditional reinforced concrete foundation. To construct the reinforced concrete foundation, it is necessary to dig a big hole, pre-bury reinforcing steel bars and grout cement mortar, and the foundation can only be used after being cured for a predetermined time. It requires high labor intensity and long construction time. However, the pile pipe foundation is a foundation formed by striking the pile pipe into the ground with a pile driver, and the pole on the ground can be directly mounted thereto. This technology is suitable for mechanized construction, with low labor intensity and short construction time.

In the prior art, a welding process is used to connect a pipe body of the pile pipe with the flange. Q345 steel pipe is used as the material of the pipe body, and Q345 steel plate is used as the material of the flange. The Q345 meets the requirement of “High strength low alloy structural steels” GB/T1591-94. During the preparation process, firstly, the Q345 steel plate is used to form the flange, on which bolt holes are processed according to the needs of design, and then the flange and the Q345 steel pipe is welded together after butt joint, thus a pile pipe with flange is prepared after a preservative treatment.

SUMMARY OF THE INVENTION

In view of the above-mentioned technical problems, the present invention provides a nodular cast iron foundation pile pipe and a technology for preparing same. In the present invention, the nodular cast iron is used as the material of the foundation pile pipe instead of the Q345 steel pipe used in the prior art, the flange and the foundation pile pipe are integrally cast or welded, and the foundation pile pipe is produced by combining with the nodular cast iron pipe process, so as to achieve enhanced overall strength of the production and good corrosion resistance. The nodular cast iron is widely applied to industry, such as the fields including automobile, metallurgy, and water and gas pipe lines. The characteristics thereof are as follows: tensile strength $\sigma \geq 500$ MPa, compressive strength $\sigma_{c} \geq 700$ MPa, bending strength $\sigma_{b} \geq 590$ MPa, yield strength $\sigma_{y} \geq 320$ MPa, percentage elongation $\delta \geq 7\%$, Brinell Hardness HBS being 170–230, and after the annealing treatment, the metallographic structure of the base body becoming ferrite+pearlite.

The technical means of the present invention are as follows:

A technology for preparing a nodular cast iron foundation pile pipe, the technology comprises following steps:

1. Preparation before pipe casting: including molten iron preparation, spheroidization and coating spraying on an inner wall of a pipe mold,

2. Pipe casting: including molten iron preparation, spheroidization method or pure magnesium spheroidizing method to spheroidize the molten iron, mass fractions of main chemical compositions in the spheroidized molten iron are:

   - C: 2.9-3.2%, Si: 1.4-1.6%, Mn: 0.5%, Ti: ≤0.04%, P: ≤0.06%, S: ≤0.02%;
   - the spheroidization includes using any of pour-over method, wire feeding spheroidizing method, and the spheroidized molten iron is conveyed to a casting process after slag removal;
   - the pipe mold is the die used for pipe casting, when casting the first and second pipes, temperature of the pipe mold needs to be preheated to 180°C–260°C; in case of continuous production, it is unnecessary to preheat the pipe mold every time before casting, since there is residual heat thereon.

3. In the coating spraying step, driven by a pipe mold rotating mechanism, the pipe mold with a residual heat of 180°C–260°C is caused to rotate at a low speed, the coating spraying trolley enters inside of the pipe mold along an axis of the pipe mold, and a spraying system starts to spray qualified mixture coating, after the thickness of the coating and the surface of the coating is inspected and qualified, a sand core is mounted at a socket part of the pipe mold for casting;

4. Main components of the coating include diatomite, bentonite and water, and the coating is used after being uniformly stirred.

The thickness of the coating is 0.5 mm–1.0 mm.

(2) Pipe casting process: including centrifugal casting and pipe drawing,

in the centrifugal casting, the spheroidized molten iron is poured into a fan-shaped casting ladle, then slags are removed and the temperature is measured, after the temperature reaches up to 1330°C–1350°C, the casting process is to be started; when a rotating speed of the pipe mold reaches to a predetermined value, the casting is started, an instantaneous inoculation with respect to the molten iron is carried out, and a secondary inoculant is instantaneously added into the molten iron while casting; the casting trolley draws back at a predetermined speed, after the casting is finished, the pipe mold is caused to continuously rotate for about 3 to 5 minutes and then water cooling is started, when the temperature of the pipe is lower than 600°C, the pipe drawing is started;

the inoculant is FeSiBas, the granulare thereof is 0.1 mm–0.7 mm, the addition amount is 0.1%–0.25% (mass fraction).

The components of the inoculant are as follows:

<table>
<thead>
<tr>
<th>Element</th>
<th>Ba</th>
<th>Si</th>
<th>Ca</th>
<th>Al</th>
<th>Mn</th>
<th>Cr</th>
<th>P</th>
<th>S</th>
<th>Fe</th>
</tr>
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<tbody>
<tr>
<td>Content/ Mass fraction</td>
<td>5</td>
<td>67</td>
<td>2</td>
<td>&lt;0.4</td>
<td>&lt;0.4</td>
<td>&lt;0.04</td>
<td>&lt;0.02</td>
<td>Remainder</td>
<td></td>
</tr>
</tbody>
</table>

The pipe drawing includes drawing the pipe out of the rotating pipe mold by pipe drawing pliers after the casting is finished, when the pipe is drawn out, two axial supporting rollers at a lower portion of a centrifugal pipe casting machine lift up respectively, and when the pipe is completely drawn...
out, the pipe drawing pliers disengage from the pipe. The supporting rollers are lowered and the pipe is placed on a fixed rotating roller for continuous rotating and cooling, so as to prevent elliptical deformation, and then the pipe is conveyed to an annealing furnace with a rotary sling to carry out an annealing process:

(0021) (3) annealing process: carrying out annealing treat-
mment to the pipe at a temperature of 720° C.-750° C. for 3 minutes, and the metallographic structure of the base body after annealing becoming ferrite-pearnite.

(0022) (4) finishing process: after annealing, carrying out shot blasting treatment to the coating and slag on a surface of the pipe, and carrying out finishing, hydrostatic test and pres-
ervative treatment, wherein the finishing includes cutting pipe, straightening round and grinding, and the pressure of the hydrostatic test is 2.5 MPa, the pressure holding time is 10 s.

(0023) The present invention further relates to a nodular cast iron foundation pile pipe prepared by the above preparation technology, wherein the foundation pile pipe includes a pipe body and a flange disposed at an end portion of the pipe body.

(0024) Preferably, the diameter of the pipe body is 600-
2000 mm and the length thereof is 600-13000 mm, the diameter of the flange is 1000-2400 mm, and the thickness thereof is 25-50 mm.

(0025) Preferably, the flange and the pipe body are inte-
grally cast or welded. In case of welding the flange, a cast iron electrode is to be used, and the welding portion is welded after being preheated.

(0026) The usage of pile pipe in the present invention is the same as that in the prior art, that is, the pipe body of the pile pipe is arranged underground with the flange exposed on the ground, so as to function as the foundation, and the pole is connected with the flange by bolts to form a whole.

(0027) Compared with the prior art, the present invention uses nodular cast iron as the material of the pile pipe. In the nodular cast iron, spheroidal graphite is obtained by spheroidization and inoculation, thereby the mechanical properties of the cast iron being effectively improved, especially the plasticity and toughness being improved, and thus a strength higher than that of carbon steel being obtained. The comprehen-sive property of the nodular cast iron is close to steel, therefore, it is used to cast components that bear complicated forces and require high strength, toughness and abrasion resistance.

(0028) In the present invention, the nodular cast iron is used as the material of the foundation pile pipe instead of QT45 steel used in the prior art. Further, the flange and the foundation pile pipe are integrally cast or welded, thereby the overall strength being enhanced. The present invention is featured with advantages such as corrosion resistance, long service life, low manufacturing cost, low labor intensity, short construction period and being suitable for mechanized construction and scale production by adopting centrifugal casting process.

BRIEF DESCRIPTION OF THE DRAWINGS

(0029) The present invention is to be described in detail in combination with the drawings and embodiments.

(0030) FIG. 1 is a structural schematic diagram of the founda-tion pile pipe welded with the flange of the present invention.

(0031) FIG. 2 is a structural schematic diagram of the inte-grally formed foundation pile pipe and the flange of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

(0032) A nodular cast iron foundation pile pipe and a tech-
nology for preparing same, the technology comprises follow-
ing steps:

(0033) (1) preparation before pipe casting: including mol-
ten iron preparation, spheroidization and coating spraying on an inner wall of a pipe mold.

(0034) wherein the molten iron preparation includes heating the molten iron with medium frequency furnace to a temperature of 1460° C.-1500° C., and mass fractions of main chemical compositions in the molten iron are:

(0035) C: 2.9-3.2%, Si: 1.4-1.6%, Mn<0.5%, Ti≤0.04%, P<0.06%, S≤0.02%; the spheroidization includes using any of pour-over method, wire feeding spheroidizing method or pure magnesium spheroidizing method to spherize the molten iron, mass fractions of main chemical compositions in the spheroidized molten iron are:

(0036) C: 3.0-3.3%, Si: 1.9-2.4%, Mn<0.5%, P≤0.06%, S≤0.02%, Mg: 0.03-0.06%, Ti≤0.04%; and the spheroidized molten iron is set aside for later use after slag removal;

(0037) the pipe mold is a die used for pipe casting, when casting the first and second pipes, temperature of the pipe mold needs to be preheated to 180° C.-260° C.; in case of continuous production, it is unnecessary to preheat the pipe mold every time before casting, since there is residual heat thereon.

(0038) In the coating spraying step, driven by a pipe mold rotating mechanism, the pipe mold with a residual heat of 180° C.-260° C. is caused to rotate at low speed, the coating spraying trolley enters inside of the pipe mold along an axis of the pipe mold, and a spraying system starts to spray qualified mixture coating, after the thickness of the coating and the surface of the coating is inspected and qualified, a sand core is mounted at a socket part of the pipe mold for casting;

(0039) main components of the coating include diatomite, bentonite and water, and the coating is used after being uniformly stirred.

(0040) The thickness of the coating is 0.5 mm-1.0 mm.

(0041) (2) pipe casting process: including centrifugal cast-
ing and pipe drawing.

(0042) in the centrifugal casting, the spheroidized molten iron is poured into a fan-shaped molten iron ladle, then slags are removed and the temperature is measured, after the temperature reaches up to 1330° C.-1350° C., the casting process is to be started; when a rotating speed of the pipe mold reaches to a predetermined value, the casting is started, an instantaneous inoculation with respect to the molten iron is carried out, and a secondary inoculant is instantaneously added into the molten iron while casting; the casting trolley draws back at a predetermined speed, after the casting is finished, the pipe mold is caused to continuously rotate for about 3 to 5 minutes and then water cooling is started, when the temperature of the pipe is lower than 600° C., the pipe drawing is started.

(0043) the inoculant is FeSiBas, the granularity thereof is 0.1 mm-0.7 mm, the addition amount is 0.1%-0.25% (mass fraction).
The components of the inoculant are as follows:

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The pipe drawing includes drawing the pipe out of the rotating pipe mold by pipe drawing pliers after the casting is finished, when the pipe is drawn out, two axial supporting rollers at a lower portion lift up respectively, and when the pipe is completely drawn out, the pipe drawing pliers disengage from the pipe. The supporting rollers are lowered and the pipe is placed on a fixed rotating roller for continuous rotating and cooling, so as to prevent elliptical deformation, and then the pipe is conveyed to an annealing furnace with a rotary sling to carry out an annealing process.

(3) Annealing process: carrying out annealing treatment to the pipe at a temperature of 720° C-750° C for 30 minutes, and the metallographic structure of the base body after annealing becoming ferrite+pearlite.

(4) Finishing process: after annealing, carrying out shot blasting treatment to the coating and slag on a surface of the pipe, and carrying out finishing, hydrostatic test and preservative treatment, wherein the finishing includes cutting pipe, straightening round and grinding, and the pressure of the hydrostatic test is 2.5 MPa, the pressure holding time is 10 s. The foundation pile pipe prepared by the above-mentioned nodular cast iron foundation pile pipe preparation technology includes a pipe body 1 and a flange 2 disposed at one end portion of the pipe body 1, and the flange 2 and the foundation pile pipe 1 are integrally cast (as shown in FIG. 2) or welded (as shown in FIG. 1). The diameter of the pipe body 1 is 600-2000 mm and the length thereof is 600-13000 mm, the diameter of the flange 2 is 1000-2400 mm, and the thickness thereof is 15-50 mm.

Two examples of the foundation pile pipes prepared by the above-mentioned technology are as follows. A common size of the foundation pile pipe is not limited to the following two examples. And other sizes are determined according to actual requirements, which are not to be listed here.

(1) The diameter of the pipe body 1 is 800 mm, and the length thereof is 8000 mm; the diameter of the flange 2 is 1200 mm, and the thickness thereof is 32 mm.

(2) The diameter of the pipe body 1 is 1100 mm, and the length thereof is 8000 mm; the diameter of the flange 2 is 1580 mm, and the thickness thereof is 30 mm.

The above descriptions are only preferred embodiments of the present invention, and they are not intended to limit the scope of the present invention. Any equivalent substitution or modification made in the disclosed technical scope of the present invention by a person skilled in the art, based on the technical proposal and the inventive concept of the present invention should be encompassed in the scope of the present invention.

1. A method for preparing a nodular cast iron foundation pile pipe, the method comprises following steps:
   (1) Preparation before pipe casting: including molten iron preparation, spheroidization and coating spraying on an inner wall of a pipe mold, wherein the molten iron preparation includes heating the molten iron with medium frequency furnace to a temperature of 1460° C.-1500° C., and mass fractions of main chemical compositions in the molten iron are:
   C: 2.9-3.2%, Si: 1.4-1.6%, Mn≤0.5%, Ti≤0.04%, P≤0.06%, S≤0.02%;
   the spheroidization includes using any of pour-over method, wire feeding spheroidizing method or pure magnesium spheroidizing method to spherize the molten iron, mass fractions of main chemical compositions in the spheroidized molten iron are:
   C: 3.0-3.3%, Si: 1.9-2.4%, Mn≤0.5%, P≤0.06%, S≤0.02%, Mg: 0.03-0.06%, Ti≤0.04%; and the spheroidized molten iron is set aside for later use after slag removal; the coating spraying step includes spraying prepared coating on the inner wall of the pipe mold, and mounting a sand core at a socket part of the pipe mold for casting;
   (2) Pipe casting process: including centrifugal casting and pipe drawing, wherein the centrifugal casting includes adding a primary inoculant into the molten iron after the slag removal and temperature measurement, pouring the molten iron into a fan-shaped casting ladle, adding a secondary inoculant instantaneously into the molten iron at the time of casting, and carrying out water cooling treatment after the casting is finished; the pipe drawing includes drawing the pipe out of the pipe mold by pipe drawing pliers after the casting is finished, the pipe continuously rotates during and after the drawing process, and the pipe is conveyed to an annealing furnace with a rotary sling;
   (3) Annealing process: carrying out annealing treatment to the pipe at a temperature of 720° C.-750° C. for 30 minutes;
   (4) Finishing process: after annealing, carrying out shot blasting treatment to the coating and slag on a surface of the pipe, and carrying out finishing, hydrostatic test and preservative treatment.

2. The nodular cast iron foundation pile pipe prepared by the method according to claim 1, wherein the foundation pile pipe includes a pipe body and a flange disposed at an end portion of the pipe body.

3. The nodular cast iron foundation pile pipe according to claim 2, wherein a diameter of the pipe body is 600-2000 mm and a length thereof is 600-13000 mm, a diameter of the flange is 1000-2400 mm, and a thickness thereof is 15-50 mm.

4. The nodular cast iron foundation pile pipe according to claim 2, wherein the flange and the pipe body are integrally cast or welded.