

POLYMER CONCRETE PIPE WITH STEEL JACKET

FIELD OF INVENTION

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The present invention generally relates to polymer concrete pipes, particularly for polymer concrete pipes encased in a steel jacket and a method of production thereof.

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BACKGROUND OF THE INVENTION

Sewer and manhole pipeline components are typically made of concrete. The use of concrete pipes is advantageous to many because they are deemed as cost-effective, and as having sufficient strength for common underground pipeline applications.

The strength of a concrete pipe is proportional to its thickness, i.e., the thicker the concrete pipe the higher its ability to withstand external loads, and the longer it is able to withstand both biological and chemical corrosion. However, thicker concrete pipes are costlier to produce as well as heavier to transport. Installation of these thicker concrete pipes also requires higher energy because higher jacking strength is needed during the micro-tunnelling process.

Prior art US7334820B2 discloses a concrete pipe with a corrosion-resistant inner lining. The object of the prior art is to further develop the generic concrete pipes having a corrosion-resistant inner lining consisting of plastic such that they can be laid to form tight pipelines which also withstand a customary air pressure test. However, concrete pipes are prone to cracks, corrosion, and dislocation due to external loads, environmental corrosion, and other defects during manufacturing. It is also known in the art that concrete pipes can be

reinforced by further installing a steel sleeve or jacket around the external diameter of the concrete pipes, but the process requires a separate jacking of steel sleeve or jacket followed by the jacking of said concrete pipes into the internal diameter of the steel sleeve or jacket. Therefore, the installation of
5 concrete pipes having steel sleeves or jackets consumes more energy and time, and produces more soil wastes.

There are certain micro-tunnelling applications which require a very strong pipe capable of enduring high jacking strengths as well as high vertical loads,
10 such as when installed under a subway line, or high-density building sites.

Hence, there is a need for providing improved concrete pipe which allow for optimising thickness, mass, spatial configuration, and on-site installation of underground sewer pipelines. There is also a need in providing additional
15 compressive strength, and protection against corrosive agents typically present in soil environments.

SUMMARY OF THE PRESENT INVENTION

The present invention features a polymer concrete pipe, comprising an external column and internal column forming a mould, wherein the mould has a cavity; a plurality of locking mechanism on the external column for securing said external column; and a polymer concrete mixture comprising resin binder, aggregates, and auxiliary ingredients, characterised in that, the external column of the mould is a steel jacket, wherein the polymer concrete mixture is casted into the cavity of the mould, and cured to form an overlay of one part of the locking mechanism, wherein the steel jacket confers additional strength for load bearing, and protection against external corrosion to the polymer concrete pipe.

Preferably, resin binder content of the polymer concrete pipe is 9-18%.

Preferably, an aggregate content of the polymer concrete pipe is 82-91%.

Preferably, auxiliary ingredients of the polymer include at least one catalyst, polymerisation inhibitor, and additive.

Preferably, the aggregate of the polymer concrete pipe comprises sand, gravel, or crushed stones.

Preferably, the steel jacket of the polymer concrete pipe is made of corrosion-resistant alloy including stainless steel and mild steel.

Preferably, the locking mechanism is an anchorage comprising a nut and a locking screw disposed on an inner wall of the steel jacket.

Preferably, the polymer concrete pipe comprises an internal glass-reinforced plastic (GRP) liner for additional protection to an internal wall of said polymer concrete pipe.

- 5 Preferably, the polymer concrete pipe is connected to another polymer concrete pipe via a steel sleeve or a GRP sleeve.

Further, an embodiment of the present invention provides a method for producing a polymer concrete pipe, comprising steps of preparing an external
10 column and an internal column to form a mould, wherein the mould has a cavity, securing a plurality of locking mechanisms on the external column, mixing resin binder, aggregates, and auxiliary ingredients for obtaining a polymer concrete mixture, pouring the polymer concrete mixture into the cavity of the mould, casting the polymer concrete mixture in the mould, vibrating the
15 mould for compaction and air removal, and curing the polymer concrete mixture for obtaining the polymer concrete pipe, characterised in that the external column of the mould is a steel jacket, wherein the steel jacket confers additional strength for load bearing, and protection against corrosion the polymer concrete pipe.

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The present invention consists of features and a combination of parts hereinafter fully described and illustrated in the accompanying drawings, it being understood that various changes in the details may be made without departing from the scope of the invention or sacrificing any of the advantages
25 of the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

To further clarify various aspects of some embodiments of the present invention, a more particular description of the invention will be rendered by references to specific embodiments thereof, which are illustrated in the appended drawings. It is appreciated that these drawings depict only typical embodiments of the invention and are therefore not to be considered limiting of its scope. The invention will be described and explained with additional specificity and detail through the accompanying drawings in which:

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Figure 1 illustrates the perpendicular and parallel cross-sections of a polymer concrete pipe with a steel jacket having a locking mechanism.

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Figure 2 illustrates the process of producing the polymer concrete pipe with a steel jacket having a locking mechanism.

DETAILED DESCRIPTION OF THE INVENTION

The general principles of the present invention relate to an external steel jacket for polymer concrete pipes to solve problems associated with increased pipe
5 thickness required for special installations requiring the ability to sustain high loads, long lifespan, and increased external protection.

Polymer concrete is a composite of aggregates and Unsaturated Polyester Resin (UPR). The manufacturing of polymer concrete does not require cement
10 and water. A cured resin binder effectively binds aggregates and fillers together giving polymer concrete a strength three times greater than conventional cement concrete.

Polymer concrete can be cast into various shapes, making it ideal for producing
15 prefabricated structures. Polymer concrete has high strength and is highly resistant to corrosion inflicted by sewage and ground water, therefore ideal for sewer and manhole applications.

There are two conventional options that are typically considered for providing
20 protection and additional strength to sewer pipes. The first option is using a very thick pipe (example: 100 mm increased thickness over the normal pipe thickness). This option is costly in terms of pipe material, and pipe handling due to the greatly increased weight. The installation of thick pipes requires a larger and more expensive machine. Consequently, this increases the amount of
25 native soil to be removed, and emissions of carbon dioxide. The second option is using sleeve pipes to provide additional protection. However, this option increases installation time, and material cost.

Polymer concrete does not adhere well to any type of steel jackets that are
30 typically used for concrete pipes. The present invention provides a locking mechanism that secures the steel jacket to the polymer concrete successfully.

The present invention provides a polymer concrete pipe having a steel jacket. The steel jacket may be made of stainless steel or mild steel. The polymer concrete pipe is suitable for installation using the pipe jacking or micro-tunnelling (trenchless) method. A locking mechanism using locking screws is incorporated within the steel jacket for providing anchorage of the steel jacket to the polymer concrete pipe. The number of locking screws may be increased or decreased depending on the pipe diameter, and anticipated jacking loads. The locking mechanism would be sufficiently strong to withstand friction during the jacking process.

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Further, a locking mechanism is disposed to the steel jacket to ensure said steel jacket remains attached to the polymer concrete pipe at all times.

The preferred embodiment of the present invention provides a polymer concrete pipe having a 10-mm steel jacket. The jacket material may be mild steel or stainless steel. Therefore, a maximum thickness of 10 mm is sufficient for its intended application. However, the thickness of the steel jacket may be adjusted to suit the needs of different pipeline applications. The amount of native soil required to be removed during the jacking process is minimal, i.e., up to 10%. This provides substantial savings in machine costs due to the reduced size requirement, and reduced amount of native soil removed during jacking.

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The present invention is also economical and versatile because it makes jacking of a combination of pipes possible, i.e., enables a connecting of standard polymer concrete pipes to polymer concrete pipes with steel jackets.

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Another embodiment of the present invention provides a polymer concrete pipe comprising an internal glass-reinforced plastic (GRP) liner which provides additional protection to the polymer concrete pipe against corrosion as well as improved flow properties, and a steel jacket having a locking mechanism for anchoring said steel jacket to the polymer concrete pipe, wherein the locking mechanism ensures that the steel jacket withstands friction during the jacking

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process of the polymer concrete pipe. This steel jacket provides additional strength to the polymer concrete pipe.

Preferably, the resin binder content of the polymer concrete pipe is 9-18%.

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Preferably, the aggregate content of the polymer concrete pipe is 82-91%.

Preferably, the resin binder is an unsaturated polyester resin (UPR).

10 Preferably, the polymer concrete pipe comprises auxiliary ingredients including at least one catalyst, polymerisation inhibitor, and additive.

Preferably, the aggregate of the polymer concrete pipe comprises sand, gravel, or crushed stones.

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Preferably, the steel jacket of the polymer concrete pipe is made of corrosion-resistant alloy including stainless steel and mild steel.

20 Preferably, the locking mechanism is an anchorage comprising a nut and a locking screw disposed on the inner wall of the steel jacket.

Further, the polymer concrete pipe comprises an internal GRP liner for additional protection to the internal wall of the polymer concrete pipe against sewage and corrosion, as well as for improved flow.

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Preferably, the polymer concrete pipe is connected to another polymer concrete pipe via a steel sleeve or a GRP sleeve.

30 Referring to Figure 1, the preferred embodiment of the present invention provides a polymer concrete pipe (101) that is protected by a steel jacket (103) secured with at least one locking mechanism (102). The polymer concrete pipe (101) is to be connected to another via at least one steel sleeve (104) having a

rubber ring disposed at the spigots of each polymer concrete pipe (103). The perpendicular cross section of the present invention demonstrates that the steel jacket (103) forms the outermost or external layer, while the polymer concrete pipe (101) is disposed to the internal diameter of said steel jacket (103).
5 Therefore, the diameter of the steel jacket (103) is larger than that of the polymer concrete pipe (101). The steel jacket (103) is attached and secured to the polymer concrete pipe (101) using the locking mechanism (102) which comprises a nut (102a) and a locking screw (102b). The parallel cross section of the present invention demonstrates a preferred embodiment of the steel
10 jacket (103) secured to the polymer concrete pipe with multiple locking mechanisms (102) around the external diameter or external wall of said steel jacket (103) for reducing stress exerted on said locking mechanisms.

Referring to Figure 2, the preferred embodiment of the present invention
15 provides a method producing a polymer concrete pipe having a steel jacket. Firstly, the steel jacket is prepared by securing a plurality of locking mechanisms to said steel jacket (201). A mould is prepared for casting (202), in which the mould comprises elongated internal and external columns for forming a cavity. A polymer concrete mixture comprising resin binder, aggregates, and auxiliary
20 ingredients is to be casted (203) in between the internal and external columns of the mould. The external part of the mould is the steel jacket secured with the locking mechanisms. The internal column is either a removable steel cylinder, or a GRP liner/pipe which would become an inseparable part of the polymer concrete pipe. The polymer concrete mixture can be casted into the mould of
25 any chosen diameter and thickness. During the casting process, the entire setup of polymer concrete mixture casted into the mould is vibrated (204) continuously to compact the material and remove air pockets. After casting, the polymer concrete mixture is left to cure (205) at room temperature between 30 minutes to 2 hours depending on the type of resin used. During the curing
30 process, an exothermic reaction takes place; thus heat is generated. As the temperature of the polymer concrete mixture reaches its peak, it begins to solidify as well as cool down gradually. Once it is strong enough, the cured

polymer concrete pipe together with the steel jacket can be removed from the internal column of the mould.

5 The present invention may be embodied in other specific forms without departing from its essential characteristics. The described embodiments are to be considered in all respects only as illustrative and not restrictive. The scope of the invention is, therefore indicated by the appended claims rather than by the foregoing description. All changes, which come within the meaning and range of equivalency of the claims, are to be embraced within their scope.

CLAIMS

1. A polymer concrete pipe (101), comprising:
an external column and internal column forming a mould, wherein the mould
5 has a cavity;
a plurality of locking mechanism (102) on the external column for securing said
external column; and
a polymer concrete mixture comprising resin binder, aggregates, and auxiliary
ingredients,
10 characterised in that,
the external column of the mould is a steel jacket (103), wherein the polymer
concrete mixture casted into the cavity of the mould, and cured to form
an overlay of one part of the locking mechanism (102), wherein the steel
jacket (103) confers additional strength for load bearing, and protection
15 against external corrosion to the polymer concrete pipe (101).
2. The polymer concrete pipe (101) according to claim 1, wherein resin binder
content of the polymer concrete pipe is 9-18%.
- 20 3. The polymer concrete pipe (101) according to claim 1, wherein an aggregate
content of the polymer concrete pipe is 82-91%.
4. The polymer concrete pipe (101) according to claim 1, wherein said polymer
concrete pipe (101) comprises auxiliary ingredients including at least one
25 catalyst, polymerisation inhibitor, and additive.
5. The polymer concrete pipe (101) according to claim 1, wherein the
aggregate of said polymer concrete pipe (101) comprises sand, gravel, or
crushed stones.

6. The polymer concrete pipe (101) according to claim 1, wherein the steel jacket of said polymer concrete pipe (101) is made of corrosion-resistant alloy including stainless steel and mild steel.
- 5 7. The polymer concrete pipe (101) according to claim 1, wherein the locking mechanism (102) is an anchorage comprising a nut and a locking screw disposed on an inner wall of the steel jacket (103).
8. The polymer concrete pipe (101) according to claim 1, wherein said polymer
10 concrete pipe (101) comprises an internal glass-reinforced plastic (GRP) liner for additional protection to an internal wall of said polymer concrete pipe (101).
9. The polymer concrete pipe (101) according to claim 1, wherein said polymer
15 concrete pipe (101) is connected to another polymer concrete pipe (101) via a steel sleeve or a GRP sleeve.
10. A method for producing a polymer concrete pipe (101), comprising steps of:
20 preparing an external column and an internal column to form a mould, wherein the mould has a cavity;
securing a plurality of locking mechanisms (102) on the external column;
mixing resin binder, aggregates, and auxiliary ingredients for obtaining a polymer concrete mixture;
pouring the polymer concrete mixture into the cavity of the mould;
25 casting the polymer concrete mixture in the mould;
vibrating the mould for compaction and air removal; and
curing the polymer concrete mixture for obtaining the polymer concrete pipe (101);
characterised in that,
30 the external column of the mould is a steel jacket (103), wherein the steel jacket (103) confers additional strength for load bearing, and protection against external corrosion to the polymer concrete pipe (101).