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Elastic Clamp Type Connection SRWPE Sewage Pipe Construction Method

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ABSTRACT

SRWPE has advantages such as corrosion resistance, light weight, easy installation, good sealing performance, strong resistance to abnormal sudden load, low transportation and construction costs, large flow rate, and long service life (50 years). We have innovatively developed the construction technology of SRWPE sewage pipeline with elastic clamp connection, which can effectively improve the ring stiffness of the pipe connection and ensure the sealing of the connection, and has broad engineering application prospects.

Keywords: SRWPE; elastic clamp type; sewage pipe; tightness; construction method

1. INTRODUCTION

SRWPE Polyethylene plastic steel winding pipe is made of steel-plastic composite special-type strip by spiral winding welding (lap surface extrusion welding), its internal wall is smooth and smooth, the specification is DN200-DN2600mm, the length of 9m.

The kind of pipe with corrosion resistance, light quality, simple installation, good sealing performance, resistance to abnormal TuFa load capacity, transportation and construction cost, large flow, long life (50 years), can replace high energy consumption material (cement, cast iron, ceramics, etc.) made of pipe, belongs to environmental friendly green products, has a broad application prospect.

Combined with the application in our company's project, according to the research of this project difficulties, formed the elastic clamp connection SRWPE sewage pipe construction technology, which has obvious social and economic benefits. This construction method has been successfully applied in many projects, and has achieved good economic benefits and social benefits.

2. FEATURES

2.1 The inner layer uses a thin-wall rubber sleeve, which tightly seals the end of the pipe.

2.2 The middle layer is a foam rubber plate with good elasticity with a certain thickness, which plays a filling role. Through its deformation, the outer hoop pressure can be uniformly transferred to the inner sealing rubber plate, so as to eliminate the influence of the uneven

end surface, uneven height of the ribs and oval factors on the sealing performance.

2.3 The outer layer is an open stainless steel sleeve. Through the fastening bolt on the live sleeve, the live sleeve can adjust the tightening force of the inner rubber sleeve to ensure the sealing, and the stainless steel sleeve can play a role in compensating the ring stiffness of the pipe connection part, and ensure the same life of the stainless steel clamp and pipe.

3. SCOPE OF APPLICATION

3.1 Elastic clamp-type connection SRWPE sewage pipe construction method is widely used in road drainage and sewage pipe system engineering.

3.2 Elastic clamp type connection SRWPE sewage pipe construction method can also be used as cable, optical cable, communication signal cable protection pipe.

4. PROCESS PRINCIPLE

4.1 Polyethylene plastic steel winding drainage pipe is connected by elastic clamp: the connection requires that the pipe should have no less than two welded plastic sealing blocks in the spiral groove in the sealing area, and the height of the sealing block is the same as the height of the reinforcement.

4.2 The connection structure is composed of three layers, and the innermost layer is a thin-wall rubber sleeve, which tightly seals the pipe end;

The middle layer is a certain thickness of good elastic foam rubber plate, filling role, through its deformation can transfer the pressure of the outer stainless steel sleeve to the inner sealing plate evenly, so as to eliminate the pipe end surface is uneven, uneven height and elliptical and other factors on the sealing performance;

4.3 The outer layer is open stainless steel live sleeve, through the fastening bolt on the live sleeve can adjust the holding force of the inner rubber sleeve to ensure the sealing, and the stainless steel live sleeve can play the compensation role of the ring stiffness of the pipe connection part, in order to ensure the same life of the stainless steel clamp and pipe, the secondary anti-corrosion processing.

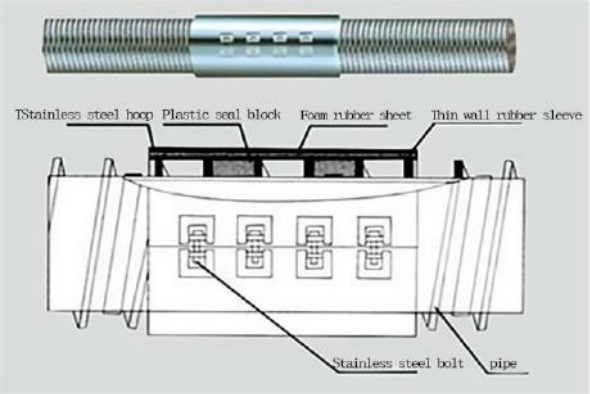

Fig 1: SRWPE sewage pipe device

5. PROCESS FLOW AND OPERATION POINTS

5.1 Process flow

Construction preparation survey lofting excavation trench construction drainage and pipeline foundation pipeline installation and connection pipeline and inspection well connection closed water test backfill repair and acceptance.

5.2 Operation key points

5.2.1 Excavate of the trench

The trench form should be determined according to the construction site environment, tank depth, groundwater level, soil quality, construction equipment and seasonal influence factors.

The elevation of the foundation shall be strictly controlled and the base surface shall not be disturbed. The original soil above the design elevation of the bottom of the groove should be retained first and manually cleaned to the design elevation before pipe laying. When overdigging or disturbance of the base surface occurs, replace natural graded gravel or gravel with the maximum particle size less than 40mm, and

leveled and compacted, and its density should meet the requirements of relevant specifications.

The net width of the groove bottom can be determined according to the specific situation of each region and the size of the pipe diameter, buried depth, construction technology and so on. When the pipe diameter is less than or equal to 0.45m, the clear distance of each side of the pipe shall not be less than 0.3m; when the pipe diameter is greater than 0.45m, the net distance of each side shall not be less than 0.5m.

5.2.2 Construction drainage

When the groundwater level needs to be reduced, the following requirements should be met: When the drainage pipe near the building, preventive measures should be taken to prevent the impact on the adjacent building; The method of reducing the groundwater level should be selected according to the penetration capacity of the soil layer, precipitation depth and equipment conditions.

The quality of construction precipitation should meet the following requirements: water should not be accumulated in the trench, and construction with water is strictly prohibited. In areas where the groundwater level is above the bottom elevation of the excavated trench, the groundwater level shall be lowered to 0.5m below the lowest point of the trench bottom; after the pipeline laying, the groundwater lowering shall not be stopped. Reducing the groundwater can only be stopped after the pipeline is stable.

5.2.3 Pipeline foundation

Polyethylene plastic steel winding drainage pipe is made of medium coarse sand foundation and medium coarse sand, with a thickness of 200mm.

After the sand backfill during construction, it should be leveled manually and compacted with electric vibrator to ensure that the compaction of the foundation is not less than 90%.

5.2.4 Pipe Interface

The polyethylene plastic steel winding drainage pipe shall be connected by elastic clamp type, which shall meet the following requirements:

According to the geological survey report, the clamp takes anti-corrosion measures to ensure the service life. The performance of the elastic rubber sleeve should comply with the current industry standard GB / T21873-2008 "Rubber seal for water supply and drainage pipe and sewage pipe interface sealing ring material specification";

The stainless steel sleeve shall comply with the current corresponding national standards;

The appearance of rubber sleeve, foaming rubber plate and stainless steel sleeve should be smooth and smooth, with no rolling folds, breakage and other defects.

Clamp type elastic connection structure, the rubber sleeve is divided into two layers, the inner thin rubber sleeve, the outer foam rubber plate, on the outside of the rubber plate with stainless steel cover tightened, the pipe end before the factory prefabricated plastic sealing block.

Polyethylene stainless steel sleeve, foam rubber board, rubber sleeve, plastic sealing block, connecting bolts, due to the corrosion of groundwater, in the stainless steel sleeve and then seal a layer and the pipe material of the same polyethylene.

5.2.5 Pipeline installation

Before polyethylene plastic steel winding drainage pipe clamp elastic connection, check whether the pipe surface, the top surface of the rib sheet is smooth and damaged, whether there is convex or exposed steel strip. Check whether the plastic sealing block is welded firmly, and whether there is a gap between the pipe body and the rib. If there is any problem, it should be repaired in time. Remove the debris in the tube, and clean the pipe end connection part.

Place the pipe on the foundation, align the pipe, and dig the operation pits suitable for the connection operation on the foundation at the pipe connection.

Cover the 1.5mm rubber sleeve into the end of the pipe, cover the first half of the length of the rubber sleeve, and then fold the other half back to the same pipe end.

Set the ends of two pipes (straight axis) and leave a expansion gap of not less than 10mm, and then turn the rubber sleeve back to the other side of the pipe end.

The foaming rubber board wrapped on the outside of the rubber sleeve, the foaming rubber board should be naturally and evenly fit outside the rubber sleeve, the opposite naturally and in the middle of the pipe top, stick and fixed with tape.

Cover the stainless steel live sleeve ring over the rubber plate. During the bending forming process of stainless steel live sleeve (supplied state is flat plate), continuous circular deformation shall be maintained with no dead bending or wrinkle. After the stainless steel sleeve is in place, put on and gradually tighten the bolts. When tightening, knock the outer surface of the stainless steel sleeve with a rubber hammer to ensure that the steel sleeve and the rubber sleeve are even close, and the percussion force should be moderate, and do not make the plastic depression on the plate surface.

5.2.6 Connection of pipeline and inspection wells

When the pipe is connected with the concrete or brick inspection shaft, the rigid connection shall be adopted.

When the pipe has been laid in place, it is advisable to check the well wall with cast-in-place concrete into the end of the pipe of the well wall. The thickness of concrete sealing should not be less than 100mm, and the strength grade should not be lower than C20.

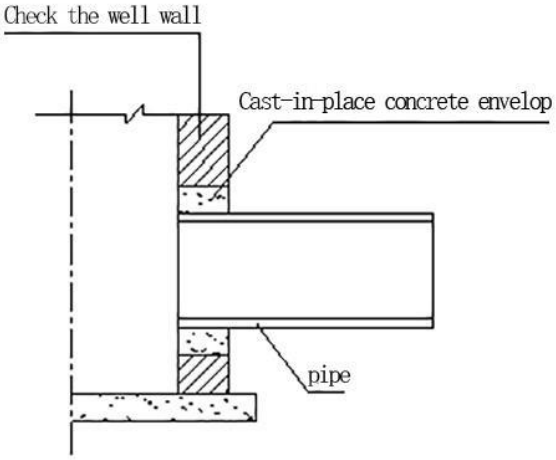

Fig2: Cast-in-place concrete sealing connection diagram

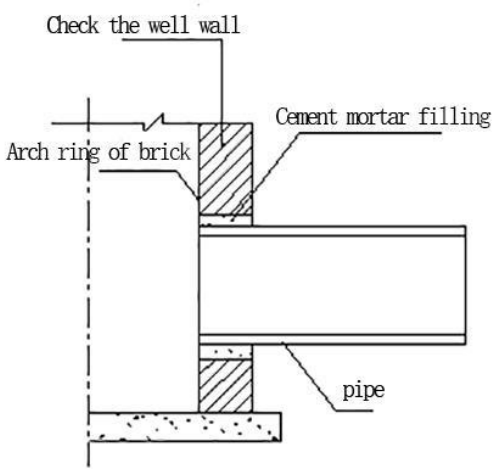

Fig3: Connection of pipes and reserved hole in the inspection well

When the pipeline is not laid, in the masonry inspection well, the hole should be reserved on the shaft wall according to the pipeline axis elevation and pipe diameter. The inner diameter of the reserved hole should not be less than the outer diameter of the pipe and add 100mm. Fill with cement mortar and insert the gap between the pipe end and the hole. The mix ratio of cement mortar shall not be less than 1:2, and the mortar should be mixed with micro-expansion agent. The reserved openings on the brick well wall shall be built along the circular arch circle.

At the connection between the inspection well wall and the inserted pipe end, the circular section of the pipe

end shall not be distorted when pouring concrete or filling with cement mortar. When the pipe diameter is large, temporary support can be set inside the pipe end during construction. When the special pipe fittings are connected with the inspection well, the special pipe fittings shall be supplied by the pipe manufacturer.

After the connection of the pipeline and the inspection shaft, the waterproof layer must be made on the inner and outer well wall of the connecting part of the pipe end, and meet the requirements of the overall leakage resistance of the inspection shaft.

The overdug (hollowed) part of the pipe bottom connecting the inspection well with the upstream and downstream pipelines must be backfilled with sand and stone immediately after the pipeline connection, and the backfill shall be compacted according to the support corner of the designed soil arc foundation.

5.2.7 Closed-water test

During the test, the upper and downstream inspection Wells of the inspection section will be blocked and closed, and the irrigation water will avoid the socket gas in the pipe. The soaking time of the test pipe section after filling with water shall not be less than 24h. When the test head reaches the specified water head, keep the water seepage of the pipe until the observation, and keep the test pipe head constant.

The observation time of water seepage shall not be less than 30min, and the measured water seepage shall be calculated according to the following formula: q=W / (T * L) q is the measured water seepage amount (L / (min. N), W is the supplementary water quantity (L), T is the measured water seepage observation time (min), and L is the length of the test pipe section (m). The closed water test head is 2 meters higher than the inner top of the downstream pipe. If the well height is less than 2 meters, the inspection well height shall prevail.

1) When the designed water head at the upstream of the test section does not exceed the inner wall of the pipe head, the test head shall take the inner wall of the upstream pipe top of the test section as the standard test head.

2) When the design head in the upstream of the test section exceeds the inner wall of the pipe top, the test head shall add 2m at the upstream of the test section.

3) When the calculated test head is less than 10m but has exceeded the upstream inspection well wellhead, the test head shall be the height of the upstream inspection well wellhead, but shall not be less than 0.5m.

The soaking time of the test pipe section after filling it with water should not be less than 24h.

5.2.8 Pipeline backfilling

1 Pipeline installation shall be backfilled immediately after passing the closed water test. Thick sand backfill from 1 / 4 of the pipe bottom foundation; the rest can be backfilled with debris, gravel less than 40mm, medium sand, coarse sand or excavated fine soil.

2 The filling is carried out in two times: the first is manual backfilling, starting from the foundation of the bottom of the pipe at the same time, the backfill should be symmetrical and compacted to ensure that the pipeline and inspection well do not produce displacement; the second is mechanical auxiliary backfill to the design elevation. Backfilling is in strict accordance with the current regulations, the backfill thickness of each layer is not more than 0.2m, layered compaction.

6. MATERIALS AND EQUIPMENT

6.1 Main materials required by this construction method

Polyethylene plastic steel winding drainage pipe is made of steel and plastic composite special-type strip by spiral winding welding (lap surface extrusion welding), its inner wall is smooth and smooth, and the

appearance is: black. Specification: DN200-DN2600mm.

6.2 Mechanical equipment required by this construction method

In the construction of clamp type elastic connection (the connection method is suitable for plastic steel winding pipe diameter Dn 1200mm) materials are polyethylene stainless steel card sleeve, foaming rubber plate, rubber sleeve, plastic sealing block, connecting bolts.

7. QUALITY CONTROL

7.1 Quality control standards

7.1.1 This construction method follows the following specifications:

1 Code for Construction and Acceptance of Water Supply and Drainage Structures GB50141-2008

2 Polyethylene Steel WDrainage Pipe and Connections CJ / T270-2017

3. Unified Code for Construction Safety Technology GB50870-2013

4. Building Construction Safety Inspection Standard JGJ 59-2011

7.1.2 The quality standard of this construction method shall meet the following requirements:

1 The pipe shall not be cracked or damaged.

2. The pipeline laying is smooth and stable, and the slope of the pipe bottom shall not appear in reverse slope.

3 The drainage pipe with leakage prevention requirements should be inspected for airtightness, and the water seepage amount of the pipe in 24h should meet the calculation results.

Tab1: Allowable Deviation of pipeline installation

Item times	inspection item	Specified value or allowable deviation (mm)	Inspection frequency		method of calibration
			scope	check the number	
1	The midline displacement	≤10	Between the two Wells	2	Use the size of the middle line
2	≤1000	±10		2	Level meter measurement
	＞1000	±15		2	Level meter measurement
	inverted siphon	±20	Each way	4	The level measures the upstream and downstream pipe ports of the inlet and outlet well

7.2 Quality Assurance measures

7.2.1 Establish a technical review system to avoid errors, review and check the construction projects before the commencement or before the construction of the sub-project. Do a good job in the inspection and acceptance of concealed works and sub-projects, do a good job in technical disclosure and the implementation of quality management plan.

7.2.2 The technical disclosure system shall be strictly implemented. The construction shall be signed and approved by the delivery person after the disclosure is completed, and the construction shall be carried out in accordance with the technical disclosure content and technical measures.

7.2.3 Implement the quality inspection system, conduct self-inspection, handover inspection and special inspection between the teams, and make the handover inspection records and sign.

7.2.4 Collect the technical data carefully and timely, so that the completed technical data is complete and accurate.

7.2.5 The positioning of the project should be accurate, and the site construction staff should check the axis and elevation before construction.

7.2.6 Raw materials and semi-finished products must have the factory qualification certificate, test report, etc.

7.2.7 Raw materials such as steel bar, cement and sand shall be sampled for inspection according to the regulations, and unqualified products are strictly prohibited from entering the construction site.

7.2.8 Stup, mark, store and carry qualified materials according to the procedure documents.

7.2.9 Long-term sunlight should be avoided in the use of the winding pipe. During the construction process, the pipe without a lower groove should avoid direct sunlight to prevent thermal deformation.

7.2.10 For pipe storage, handling and transportation, belt, sling or lifting rope shall be used for loading and unloading. There should be at least two nodes during lifting, and pipe lifting is strictly prohibited.

7.2.11 When storing and handling pipes and fittings, they should be carefully placed and arranged neatly, and should not be thrown or dragged along the ground.

7.2.12 In the process of the pipe, it is strictly prohibited to roll the pipe from the top down, and prevent heavy objects such as stones from hitting the pipe body.

7.2.13 The backfill soil shall not contain stones, bricks and other miscellaneous hard objects to avoid scratching the pipe.

7.2.14 Drainage ditch and water retaining dam should be set around the foundation pit (groove), and the excavated horse path should be closed to prevent rainwater from flowing into the foundation pit.

7.2.15 If the pipe is not laid immediately after the excavation of the trench, the original soil of 200mm above the design elevation of the trench bottom should be left, and the design elevation shall be dug before the pipe is lowered.

7.2.16 Rainproof facilities shall be installed during electric welding construction.

7.2.17 Pipeline construction should be backfilled in time to prevent drift pipe accidents.

8. SAFETY MEASURES

8.1 All personnel entering the construction site must wear safety helmet correctly, and external miscellaneous personnel are prohibited from entering the construction site.

8.2 Special engineering personnel such as electricians and excavator operators must work with certificates.

8.3 When the depth of the foundation pit and trench exceeds 1.5, meters (including 1.5 meters), support and protective measures must be taken in advance.

8.4 A large amount of materials and equipment are not allowed to be piled up within half the depth of the ditch. Cars are not allowed to walk within three meters. If materials and equipment really need to be piled up due to site restrictions, ultra-high collapse shall not be allowed.

8.5 Do not excavate the scaffolding column, steel derrick, construction lift and tower crane foundation, ditch and pit, and pay attention to the settlement of nearby buildings.

8.6 Protect each working face of dug ditches and pits, and set up safety signs such as "pay attention to safety" and "beware of falling" and red light warning at night.

8.7 If the groundwater is rich for pumping, submersible pump, do not plug into the socket first, not allowed to power first, should wait for the personnel below to come up, plug the socket and then switch on according to the program. After pumping water, first pull the power plug the submersible pump and then go down to work. It is strictly prohibited to send electricity before people come up.

8.8 Falling objects should be prevented during construction. During hoisting operation, no one should be allowed below the vertical lifting objects.

8.9 Electrical equipment shall be equipped with leakage switch, and its effectiveness shall be tested before the shift. It shall not be used if invalid, and lighting equipment shall be prepared for night construction.

8.10 Site materials are stacked neatly. Cable and wire rationalization, not disorderly, two joints wrapped, and insulation support up.

8.11 Do a good job of fire prevention and theft prevention on the site and dormitory.

8.12 When using the melt welding machine, observe the operation rules of electrical tools, pay attention to waterproof and moisture-proof, and keep the tools clean.

8.13 When the frog tamping machine is used to fill the earthwork, the operator should wear insulating gloves and must operate by two people.

9. ENVIRONMENTAL PROTECTION MEASURES

9.1 The construction site shall be reasonably arranged, and the waste materials generated during the construction shall be concentrated and cleaned up in time to prevent pollution.

9.2 Hardten the roads on the construction site and sprinkle the roads often on sunny days to prevent flying dust and pollute the surrounding environment.

9.3 On-site sewage and drainage shall be precipitated through the sedimentation tank before being discharged into the municipal pipe network. The Precipitation tank should be cleaned regularly.

9.4 Advanced environmental protection machinery is preferred.

9.5 Cut pipes and surplus materials are recycled in time, and do not throw them at will.

9.6 Construction roads should be often sprinkled with water to prevent dust.

10. BENEFIT ANALYSIS

10.1 Economic benefits

10.1.1 The comprehensive cost of the selected Φ 600 reinforced concrete drainage pipe and the DN600 polyethylene plastic steel winding drainage pipe is compared as follows:

Tab2:plastic steel winding drainage pipe compared

tubing	**Reinforced concrete pipe**	**Polyethylene plastic steel winding drainage pipe**	**remarks**
caliber (mm)	Φ 600	DN600	

Line length (m) and buried depth	100m	100m	
Earthwork cost (RMB)	1253	1089	
Backfill soil (sand) fee (yuan)	1202	1034	
Basic cost (RMB)	9814	7500	
The laying cost	1800	800	
Total cost	14069	10423	
Save cost	3646		

10.1.2 The total cost of installing polyethylene plastic steel winding drainage pipe saves 3646 yuan / 100m.

10.1.3 The three projects applying this technology will create a total economic benefit of 291,680 yuan.

10.2 social benefits

10.2.1 The construction technical quality of SRWPE sewage pipe meets the design and specification requirements, and the performance is much higher than that of reinforced concrete pipe (especially the interface is good, which avoids leakage), which is recognized by the owner, and the customer satisfaction is high

10.2.2 APPLICATION INSTANCE

In the process of construction, the application of elastic clamp connection SRWPE sewage pipe construction technology, the middle layer for a certain thickness of good elastic foam rubber plate, filling effect, through the deformation to the inner sealing plate, so as to eliminate the pipe end surface uneven, uneven ribs and oval factors on the sealing performance.

In the process of construction, the application of elastic clamp connection SRWPE sewage pipe construction technology, the outer layer for open stainless steel sleeve, through the fastening bolts on the sleeve can adjust the inner rubber sleeve to ensure the sealing, and stainless steel sleeve can compensate the pipe connection part of the ring stiffness, ensure the life of stainless steel clamp and pipe.

11. REFERENCES

[1]. Licheng Y, Wenju L. Construction Technology of Clamp Pressure Connection of Galvanized Pipe[J]. Construction Technology, 2018, 47(S1): 384-386.

[2]. GuoLiang Z. On application of SRWPE in municipal drainage projects [J]. Shanxi Architecture, 2013, 39(07): 126-127.

[3]. Rupeng Z. H Polyethylene plastic steel wound drainage pipe (SRWPE) construction technology [J].Architectural Engineering Technology and Design, 2016, 08: 312-312.