O-lay; Developments in Offshore Pipeline Installation

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ABSTRACT

The O-lay offshore pipe lay method is a concept for offshore pipeline and girth welded riser installation which has many advantages compared with traditional installation methods. The method uses an onshore construction yard in which the pipeline is produced, then wound in a flat monolayer spiral floating on the water and finally towed to location to be installed with the help of a simplified lay barge.

Critics find that the spiralisation process is one of the limitations of the technology due to the high forces that are needed to build such a floating spiral and to keep it in shape. Furthermore criticism has been put forward that consumption of fatigue resistance for the orbital welds during storage and transport of the spiral influence the actual fatigue resistance during installation and finally the fatigue life of the pipeline in a way that is unacceptable for the pipeline quality.

In this paper I will refute the above points of criticism.
The O-lay technology has not been accepted by most of the offshore related companies. That this non-acceptance has not a technical or economic motivation but rather a strategic one has to do with the enormous change the methodology would have on the offshore pipeline and riser installation industry as a whole and especially the impact it will have on the revenue model for these capital intensive companies.
The method challenges the status quo in the pipeline industry by having a better product, having a lower cost structure, having a faster installation rate and having a safer working environment.

It has been said too often that innovation is necessary for the offshore pipeline industry and so far the steps taken are small. There is a big challenge for the offshore industry to develop technologies so that we can all benefit from these “out of the box” ideas. Disruptive innovations might look like a big hurdle for the short term, in the long term the oil and gas industry will benefit from it. Especially when you take in account, that the financial savings on several projects, of this annual 30 billion dollar industry of pipeline installation, will be 50% and more.

In the end we can all learn from each other by knowledge exchange and the discussion that would evolve to increase the speed of innovation in offshore pipeline and riser installation.

I trust sincerely that the transfer of knowledge about the O-lay methodology will help companies benefit in decision making processes.

KEYWORDS:
Offshore; pipeline; installation; fatigue; elastic bending; O-lay; deep water; shallow water; disruptive innovation; oil and gas industry.

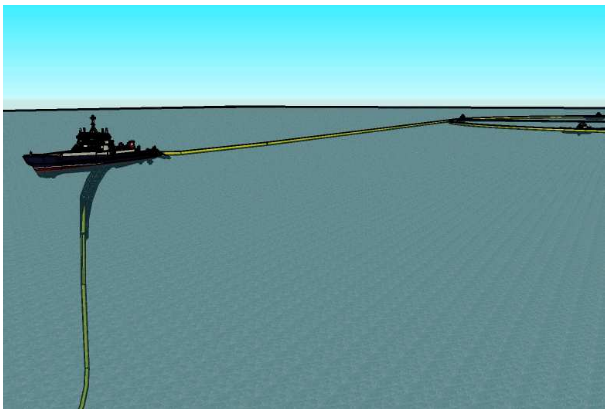


Fig. 1 Laying pipe from a large spiral has many advantages on the lay barge

INTRODUCTION

This paper will provide the reader some insight of a new concept to install pipelines for the oil and gas industry in deep and shallow waters.

The method of O-lay pipeline installation is originally developed specially for small offshore oil and gas fields for which the exploitation and especially the installation of pipelines is too expensive with the current pipeline installation methods. During the development of the method it became clear that the method is very efficient and effective for almost any pipeline installation till 36”.

One of the advantages is that the pipe and the welding can thoroughly be post weld treated and tested before it is installed on the seafloor.

With the O-lay installation method it is possible to use concrete weight coating around the pipe due to the specific bending characteristics of concrete.

The deep water operation and the possibility to prepare and construct the insulated “Pipe in Pipe” on an onshore location has several advantages compared to the preparation being done offshore and gives a lot of timesaving during offshore operations.

For shallow waters the method has many advantages. For waters with only a meter of depth, sometimes even as low as 50 centimeters, the O-lay method can be used.

Several tests in laboratory and under real conditions have shown that the method described is feasible for pipelines of all diameters. However, because of some practical restrictions, pipelines with diameters above 36 inch are not considered to be installed with the O-lay method at this moment.

O-LAY, OFFSHORE PIPELINE INSTALLATION

With O-lay the pipeline is fully prepared at its predefined length at an onshore location where the pipes are welded together, post weld treated, inspected, final coated, pulled in the water and stored in a floating O-shaped model in front of the construction yard.

From there it will be transported to the location where the pipe is lowered to the bottom with an advanced S-lay method using a simplified lay barge.

This paper will provide an idea of the advantages of the O-lay method compared to the existing traditional methods.

BENDING CONCRETE COATED STEEL PIPE

Steel pipe can be deformed in its elastic area and return to its original form after the applied forces are taken away. With the O-lay method pipe doesn’t get deformed over the 0.2% strain limit to remain elastic.

Also concrete can be bend elastically. The difference between the steel and the concrete is that concrete doesn’t have a yield point elongation or plastic deformation and therefore will break at its yield point.

For steel the elasticity modulus is 210.000MPa while for normal concrete this modulus is between 20.000 and 30.000MPa.
Ordinary concrete doesn’t have a yield point like steel. It has a good structural behavior when it is under compression. Under tension it doesn’t have these qualities.
When the right additives and fiber materials are added to the concrete mix, the concrete will withstand a larger tensile deformation before it will start cracking. (see Fig. 2). The additives play an important role by delaying the development of micro cracks while the fibers form a kind of matrix that strengthens the concrete. Another important factor for increasing the strain capabilities of the concrete is the size of the aggregate that is added. The smaller the size of aggregate the better performance the concrete will show.

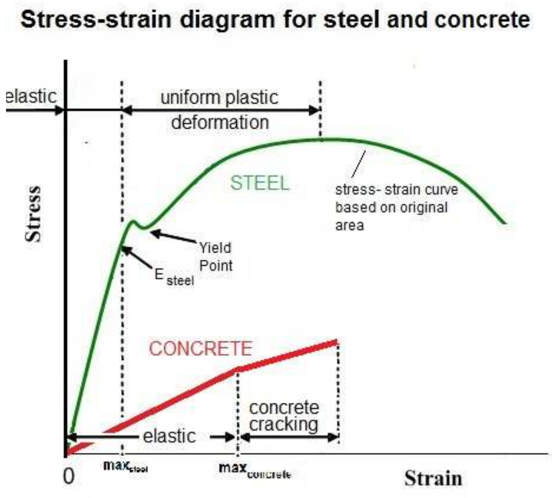


Fig. 2: Simplified stress curve for steel and special prepared concrete

By using additives in the concrete it is even possible to achieve more than 4% of tensile strain. This severe elastic deformation is 20 x higher than what is expected from steel . (University of Michigan, Li, VC (2003))

For coating the spiraling pipeline with concrete weight it is interesting to find the constraints of this elastic bending. According to the data in the graph in Fig. 2 the concrete is not the determining factor when we are bending steel with a concrete coating in the elastic area.

Fig. 3: Bending special prepared (ECC) -concrete

Due to the limitless tests that have been performed on steel and especially on pipeline it is easy to predict what the constraints for bend pipeline will be.
Plastic yield occurs when:

$$D_{spiral} / d_{pipe} > E / Y$$

where D_{spiral} = diameter of inner winding spiral
d_{pipe} = outside pipe diameter
Y = yield stress of the steel
E = modulus of elasticity or Young's Modulus

For a pipe X65 the values of E and Y are known.
$E = 2{,}06 \cdot 10^5$ N/mm^2 and $Y = 450$ N/mm^2.

$$D_{spiral} / d_{pipe} > 206000/450$$
$$> 458 \quad \Rightarrow \quad D_{spiral} > 458\, d_{pipe}$$

As in following sample;
For a pipe X65 (API 5L) with OD of 508 mm,
The spiral will be minimum when:

$$D_{spiral} > 508 \text{ X } 206000 / 450$$
$$> 233 \text{ meter}$$

With increasing steel quality the yield strength will become higher and the modulus for elasticity remains equal and therefor the spiral can be smaller.
However, to be on the safe side we consider that the diameter of the first layer of the pipeline spiral should be roughly 500X

the diameter of the pipe.

As long as the pipeline will stay within the elastic area the pipe diameter will remain round. Ovalisation will occur when a pipe is bend beyond the boundaries of elastic deformation. Ovalisation in the plastic area of the steel should not be accepted due to the strain hardening that will change the original pipe material .

CREATING THE SPIRAL

Welding the pipe

Before the offshore pipeline spiral can be formed the pipes will be welded in the onshore pipeline construction yard. Lengths of 100 metre or more will be prefabricated with sub-merged arc and/or hybrid laser and GMAW/MIGMAG automatic welding technology to obtain the highest quality. The welds will be inspected and stored. When the time has come to produce the spiral the pipe lengths are welded in the firing line at one or more stations using hybrid laser and GMAW/MIGMAG. Finally the pipe will be transported from the firing line in the water.

Pipe pull from shore

At first the pipeline will be pulled in a straight line from the shore floating on the water past point A as shown in Fig. 4.

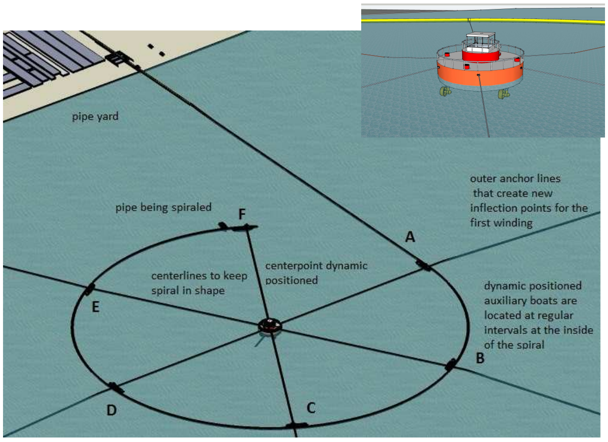
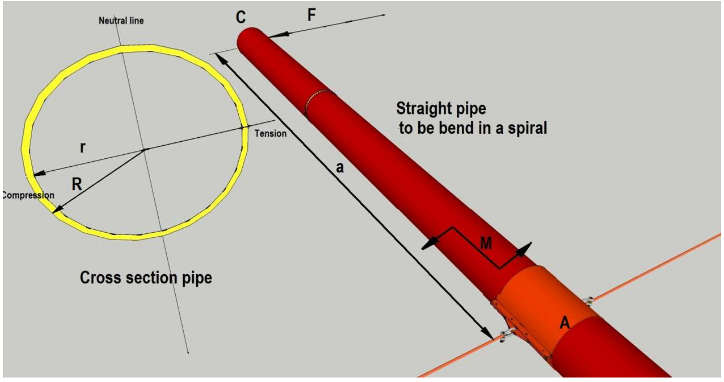


Fig. 4. The O-lay Method . First part of the floating spiral being produced**.** The dynamically positioned auxiliary boats together with winches on the centre barge perform the initial bending and rotation of the spiral. The inserted picture shows the central barge that is either dynamically positioned or put in place with anchor lines

When a sufficient part of the pipeline has been pulled past point A, (more than 2/3 of the length of the circumference of the spiral diameter) the pipe will be connected, at point A to the centre line and outer anchor line in such a way that the pipeline cannot move sideways.

Bending the pipe in its elastic area

To bend the pipe it is necessary to create a momentum (M). (fig 5) This momentum (M) is created by applying a force (F) at the end of the pipe with the help of a tugboat. The further the bending point is away from the applied force the larger momentum is created and the larger the curvature in the pipe at that location. So a bend pipe is created with a maximum bending radius at the inflection point A.



Fig, 5 Bending a straight pipe

This will work out well except for the first part of the inner winding and the last part of the outer winding of the spiral. Since there is no momentum at the pipe ends because the distance a is equal to zero.

To solve this problem a tool is prepared that exist of a piece of pipe that has been plastically deformed in such a way that the radius at one of the pipe ends is equal to the radius of the winding it is in and the other pipe end has a maximum radius (straight).

An example of such a pipe is shown in figure 6.

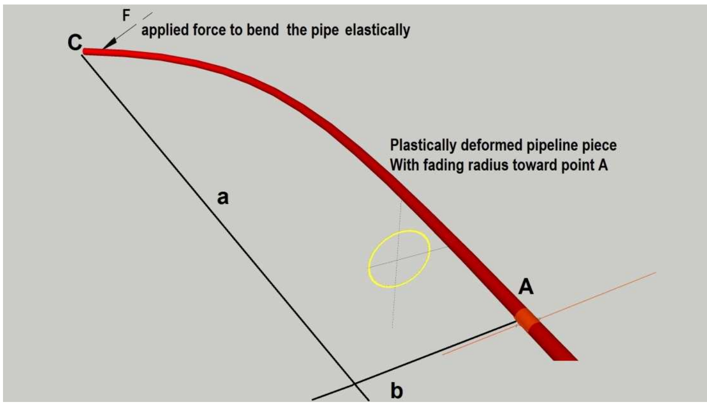


Fig. 6 Plastically piece of pipe acting as a tool to create an even radius when applying a force at on end.

When now a force will be applied on the pipe at point C the pipe will bend in an equal radius.

The force to be applied at the pipe end

To calculate the force that needs to be applied at point C, the pipe end, we use the following simplified model of the bending

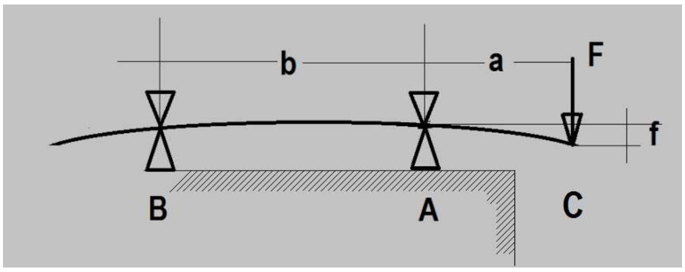


Fig. 7 Model used to calculate amount of force is needed to bend the pipe according a radius.

characteristic of the pipe as is shown in figure 7 with below the corresponding formulas.

In this model we assume that the maximum stress will develop in point A since this is the first fixed point at a maximum distance from end point C where the force is applied.

Hence we can make use of the following set of formulas

$\sigma_{bmax} = M_b / W$

$M_b = F \times a$

$W = \pi/32 \times (D^4 - d^4) / D.$

$f = (F \times a^3 + F \times a^2 \times b) / (3 \times E \times I_p)$

$I_p = \pi/32 \times (D^4 - d^4).$

Where

σ_{bmax} is the maximum allowable bending stress at point A

M_b is the bending moment at point A

F is the applied force at end point C

a is the projected distance from point A to point C

W is the section modulus for the pipe

D is the outside diameter of the pipe

d is the internal diameter of the pipe

f is the bending travel at distance a from the inflection point A

E is the elastic modulus (Steel 210 kN/mm^2)

I_p is the second moment of area (or polar moment of area)

With these formulas we are able to calculate the force necessary to bend the pipe in the elastic area into a circle. (table 1)

D Pipe (inch)	WT (mm)	D Spiral (m)	a (m)	F (kN)
8	12	100	50	2,8
12	14	150	75	5,1
16	15	200	100	7,6
20	16	250	125	10,3
24	18	300	150	12,9
28	20	350	175	18,2
32	21	400	200	22,0
36	22	450	225	26,0
40	24	500	250	32,0

Table 1. Forces to be applied to reach required bending travel at point C for different pipe diameters and wall thicknesses

Forming the spiral

The spiral is created with the help of a central barge which has the capability to stay in a determined spot due to its dynamic positioning system or applied anchors. This barge is the centre point (or central mooring system) of the method and will act as a pivot in a later stage of creating the spiral.
Around this central barge are minimum 2 auxiliary boats that support in a later stage the manoeuvring and rotation of the spiral.

After the lines in the outer periphery have been released the bent pipeline can freely rotate around the centre barge that will act as an pivot. The centre lines that are connected to the centre barge and the pipeline give the pipeline its round shape with a pre determined radius.

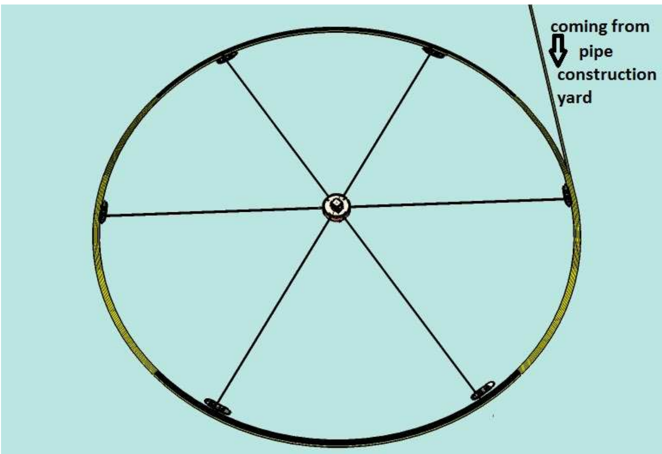


Fig. 8. The auxiliary boats are used to rotate the pipe and form the spiral or 'O'

Many layers of pipe can be produced following this method, all floating in the plane at the surface of the water.

It is possible to create more than 100 km of pipe in one piece in the spiral while the band of floating layers is still workable by the boats that create the spiral. The maximum total length of the pipe is mainly determined by the weight of the spiral and the strength of the tug boats. When the set length of the pipeline has been created into a floating spiral, the pipeline is ready for transport. In a later stage pipes from different spirals can be welded together whilst installing the pipe and so transmission lines of several hundreds of kilometres can be installed with the O-lay method.

Transportation stage

Consider the pipeline has been spiralled over its complete length of several kilometres. "Transport" ropes can be attached between the centre ropes to reduce the movement of the pipeline ("breathing" from round to oval and back again) during its voyage.

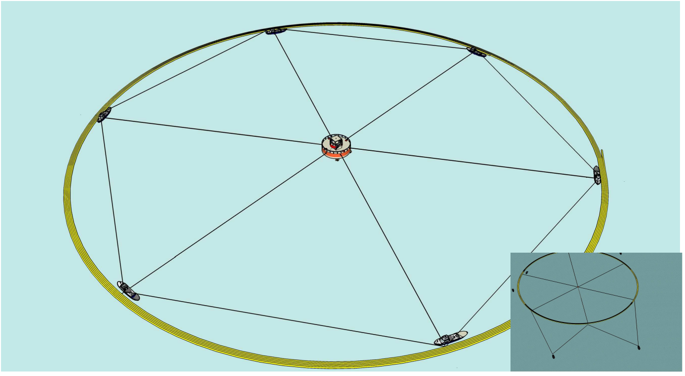


Fig. 9 Transport of the spiral to the laying location with the aid of the centre barge with the auxiliary boats and connected "transport" ropes or with a couple of tugboats (as shown in insert).

These ropes will form triangles with the centrelines
When the anchor lines are detached from the centre point the spiral can be towed to the installation location. The pipeline can be propelled by the centre barge and the auxiliary boats (See Fig. 9) or by some extern tugboats.
The spiralled pipe can withstand for a short period of time rough waves (up to a certain limit the spiral can stand waves up to 4-5 meter, ($H_{1/3}$)) The wave actions reduce the fatigue resistance, hence it is important to consider the weather

forecasts when the pipe is being transported.

Fatigue

During transport the spiral is exposed in the open water to waves that collide with the spiral. These frequent poundings of the waves reduce the fatigue resistance. Fatigue is an important factor to calculate with. The wave height and the frequency of the waves are the parameters that will affect mostly fatigue resistance.

With the traditional pipe lay operations pipes are welded and entered in the cold water after only a very short period with the result that the pipe cools down at a very fast rate. This result in fast shrinkage of the heat affected zones (HAZ) inducing high local tensile stresses in the HAZ of the circumferential welds. Fatigue crack propagation tests have shown that fatigue initiates or propagates often from these local spots where the tensile stresses are high. These spots with high tensile stresses can produce local plastic strain and develop from the fast cooling down of the weld together with irregular surface geometry at the weld and from places where planar defects in the welds exist.
Due to the organisation of the installation process it is difficult to eliminate these high stress locations in the HAZ.

With the O-lay method we have the advantage that because the pipeline is prepared onshore the circumferential welds have ample time to cool down after the welding process is finished. The process of slowly cooling down of the HAZ prevents a fast shrinkage of the weld and a severe build-up of local spots with high tensile stresses.
Further action to increase the fatigue resistance can be taken in the process after the welding. Many techniques are available which are shown in figure

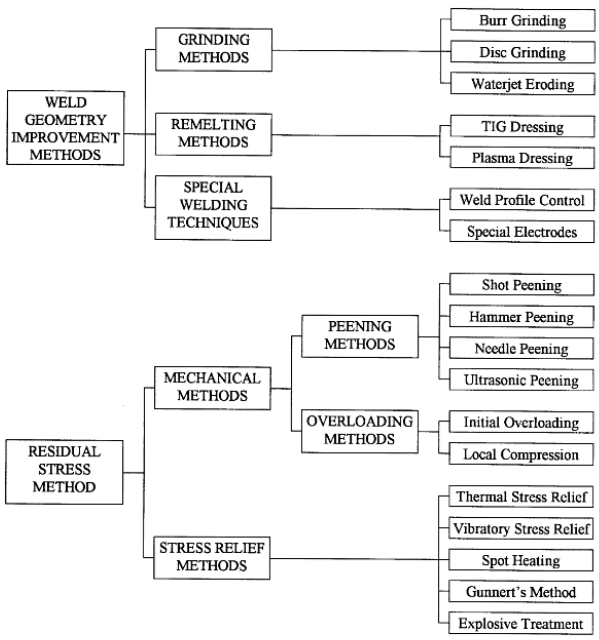


Figure 10 Classification of some weld improvement methods.
From Kirkhope K.J. et al, Marine structures 12 (1999) 447-474

Choosing the correct welding method for the orbital welding procedure may reduce the propagation of fatigue during the pipeline life but will never eliminate it fully. SAW welding for double joint or quadruple joints could improve the quality of the welds assuming that the cooling down is taken care for.
A possible applied welding technology for the string could be hybrid laser for the root pass with GMAW for the other passes. The relative low heat input in the root can have positive effects. The fatigue resistance may be favourably influenced by the lower residual stress levels and the limited weld reinforcement that often characterise the laser welds

The post weld treatment or weld fatigue life improvement techniques that can be used in the pipeline industry can exist of

-weld geometry improvement methods like weld toe grinding, weld dressing (TIG or Plasma dressing) and waterjet eroding.
These techniques improve a smoother transition profile between the parent material and the weld material, hence reducing the possible stress build up at surface imperfections.
-residual stress methods like hammer and needle peening, "ultrasonic impact peening technology" (UIT) and shot peening.
These techniques will transform areas with a regime of high tensile stresses into areas with a compressive stresses hence reducing the possible initiation and propagation of fatigue crack.
-stress relief heat treatment

A combination of the welding technology and the post weld treatments will have an impact on the fatigue life. For the post weld treatment the use of a multiple spread like the weld geometry improvement and residual stress technology would significantly improve the fatigue resistance. Expected is that an improvement of 200% and more is possible.
The post weld treatments are difficult to apply on the lay barges that utilize the welding stations together with S-lay or J-lay for the obvious reason that the time for controlled cooling down nor the time or place for applying the post weld treatment is available.

It is certain that more research needs to be done on the combined technologies to elongate the fatigue life but with the O-lay it seems there are opportunities to develop these without constraints.

Fatigue crack initiation and propagation with the spiral pipeline that is for a longer period on open water with severe waves needs more investigation. Although the O-lay method needs a relative small weather window, it is considered at this moment for geographical area's where the weather and sea state can be forecasted with reasonable certainty for the period the transport and installation takes place. Tests in the North Sea have shown that workable conditions are best when the wave height during transport and installation are below 1,5 meters ($H_{1/3}$).
For logistic reasons it is recommended to choose a pipe yard that is in the vicinity of installation location and not more than 1000 km away since the expected speed of travel of the spiral with maximum 2-3 knots is relatively low.

Installation stage.

The unwinding and the installation of the pipeline will occur at the same time. To have no constraints at installation, the part of the pipeline between the spiral and the installation barge should have a minimum length as a work buffer. This length depends on the pipe diameter, the number of windings in the spiral, the water currents and the speed at which the installation barge can install the pipe.

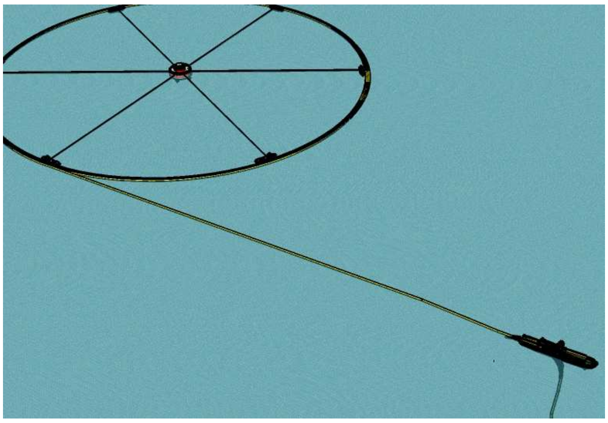


Fig. 11 Lay barge with central stinger laying pipe from spiral. The central stinger gives the lay barge better stability and therefore the pipe can be laid to a greater depth.

Compared to the traditional methods of laying larger diameter pipe the speed of laying with the O-lay method is considerable higher. The basis for this is that no welding and ultrasonic inspection has to be performed on the pipe while the pipe is being transferred over the lay barge since these procedures have been done in the onshore pipeline construction yard.

The barge is relatively simply in its lay out.
Instead of a stinger at the bow it is possible to lower the pipe at the centre of the barge. The weight of the pipe under the barge is better distributed and the angle of the heavy stinger can be accurately positioned and better supported by the barge.

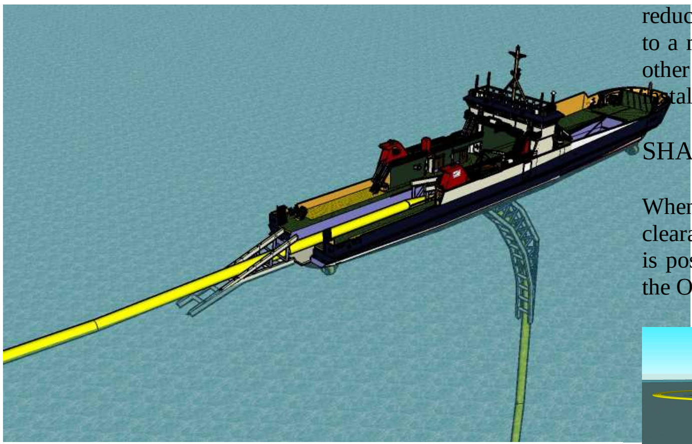


Fig. 12. Model of lay barge with central stinger for deep water and stinger at stern for picking up the floating pipeline from the spiral

An option is to have a single welding station and coating station on the barge in case the pipeline has to be repaired or the pipeline to be installed is for a project with a longer distance. As a consequence the pipeline can then be delivered in several lengths (more spirals).

When arrived at the installation location the spiral will be unwound using the centre barge and auxiliary boats connected to the spiralled pipe.
The speed of laying the pipe is independent of the diameter of the pipe or on the depth of the seabed. However a very good cooperation between the lay barge crew and the team unwinding the spiral is of high importance. Especially the unlashing of the links which keep the layers on the spiral together should keep pace with the speed of installation. Speed of installation can be expected to reach 20 to 25 kilometres per day.

Flotation devices which are used to keep the spiral afloat during storage and transport have to be released before the pipe enters the lay-barge. They will be shipped back tyo be stored or to be re-used on a following operation.

DEEP WATER OPERATIONS

With the O-lay methodology it is possible to install pipe at extreme depths.
The stinger will have special adaptations to prevent that pipe will be overstressed in the over-bend. Because the stinger is located in the centre of the lay barge it will be fully supported by the barge to assure sufficient fixation of the radius. The stinger will have a sufficient radius to prevent the pipeline to deform plastically.
An option to place a tensioner at the end of the stinger to relieve stress from the pipe hanging below the barge has to be looked at.

“Pipe-in-pipe” operations

“Pipe-in-Pipe” systems claim to provide high thermal performance at deep water operations, largely due to insulation between the two pipes.
The choice of pipe-in-pipe for projects depends on expected flow assurance and offshore installation factors. The traditional pipe installation vessels installing “Pipe in Pipe” are slowed down due to the preparation and installation of two pipes that have to be organized in instead of one.

The jointing process for “Pipe in Pipe” with the O-lay technology can be performed totally onshore and therefore reduces the time of the offshore pipe laying and thus leading to a much faster lay rate for “Pipe in Pipe” compared to any other traditional lay methods and therefore making the pipe installation window relatively small and so reducing the cost.

SHALLOW WATER OPERATIONS

When the lowest part of the floating pipeline has sufficient clearance with the bottom where the pipe will be installed, it is possible to install pipe at depths of less than 1 meter with the O-lay technology.

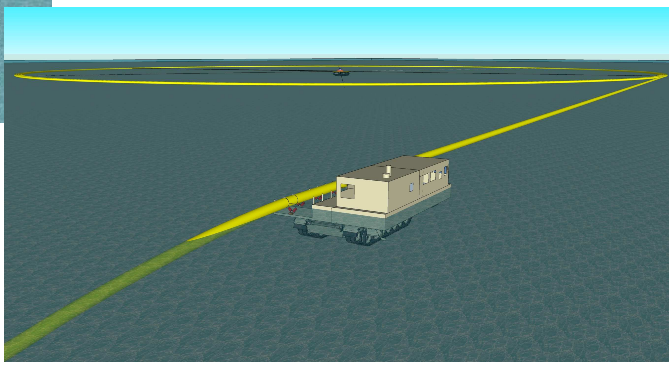


Fig. 13. At very shallow depths specially designed tractors can take over the duties of the lay barge

Instead of using a lay barge it is possible to use specially designed tracked vehicles to transport and install the pipeline while at the same time other vehicles will bury the pipe at the predestined depths. The fast method of installation makes it possible that only a very short time exists between the trenching and installation of the pipeline.

Areas like the Caspian Sea can really benefit from this method to install pipelines in a fast and accurate way.
The enormous advantage of the O-lay method in the shallow waters is that there is no need for supply ships to transport the pipes due to the floating capacity of the pipeline itself.

ARCTIC AREAS

In arctic regions it is important leave a footprint as small as possible in a time period as small as possible. A scenario could be a large floating platform to be used as the O-lay storage area. This floating platform will be in an area where the pipes will be welded, tested and launched to form the spiralled pipeline. This platform should be in a protected area where the spiral can wait for the right weather window. When the time has come to transport the platform with the pipe during any available weather window that is long enough the pipe can be transported to location and installed in a very short period of time.

TESTS

So far several tests have been performed by the Dutch company Bogey, the German company Europipe and a Dutch branch office of Wintershall. The tests have been mainly focussed on the spiralisation and transportation of the pipeline. Much information has been obtained from these tests and it became clear that keeping the pipeline afloat during transport is a fundamental issue that needs more real size testing. We strongly recommend the industry to invest more in research programs because the savings in the short term, but even more in the long term, are significant.
Industrial Innovations BV in the Netherlands has done further engineering on the concept and worked out a practical technique for pipeline installation with the O-lay method for which interested parties are required to cooperate and do further research.

ECONOMICS

Using the O-lay method has logistical, technical and economic advantages.
Physical pipe handling and logistical management is less complicated when we compare the O-lay method with the traditional method of pipeline installation using the S-lay or J-lay technique.

That the pipeline is constructed on a land base pipeline construction yard has a considerable advantage compared to construction at sea. Preparations like welding and inspection operations can be done long before the lay barge arrives at location.
Rental period for barges will be shorter. Personnel cost and transportation costs (employees and goods) are lower, cheaper accommodations and less expensive living cost and finally but not the least important is that a reduction of people offshore are all part of the cost reduction.

Equipment is not as capital intensive as the traditional installation barges with complete pipe management systems, large storage places for pipes, several welding stations, inspection stations and coating stations. The “new” type of lay barge will be less complicated and smaller, therefore they can be build for a specific project or for multiple projects in the same range of pipe, depth or area. In some cases a typical lay barge doesn’t have to be utilized.
Transport of the spiralised pipeline requires less handling of the pipe.
Pipeline installation with reel lay barges will lower the cost of operation 50 to 70%. The maximum diameter at this moment for reel laying is 16-18 inch and the pipe is twice mechanically deformed in its plastic area. With reel laying it is not possible to install concrete coated pipe. With O-lay it is possible to install up to 36 inch. It is plausible, that when using the O-lay method, the economic advantages in various projects with smaller diameter pipelines (smaller than 18 inch) are substantial compared with reel lay.

RISK

New systems and procedures in any industry always entail a certain risk.
Especially in the offshore industry this risk has to be well defined and calculated because there can be safety and environmental consequences.
With this method a large part of the procedures have been moved from offshore to land based operations, therefore we expect smaller risks at a smaller operational cost. New procedures should be looked at with great effort.
Due to the reduced number of personnel required to lay the pipe, lowering the risk of accidents is an important contribution of this new method.

In this paper we have not looked specifically at the risks. Nonetheless it is well believed that this new method will have a great future.
Safety, economy and ecology are important issues in the oil and gas offshore industry. These are considered to improve with this new technology.

DISRUPTIVE INNOVATION

The O-lay method is challenging the status quo in offshore pipeline construction and changes the paradigm how pipeline owners look at offshore pipeline installation. The offshore pipeline industry and especially the offshore pipeline installation contractors are not yet prepared for this paradigm change. High investments have been made over the last years in traditional S-lay and J-lay vessels for deeper waters.
If the traditional offshore pipeline installation companies will not start exploring the O-lay technology, new companies will be formed to implement the concept in the industry. The traditional barrier of high investment to enter the pipeline installation market is for a part taken away due to the simplicity of the lay barge being used. Onshore pipeline contractors can now use their skills for constructing offshore pipeline in onshore construction yards. Time will learn how long it will take before the oil and gas industry will adopt this technology to install pipes to small oil and gas fields.

CONCLUSIONS

Although the O-lay method was originally developed for small offshore oil and gas fields it has many advantages for installation and de-installation of other subsea pipelines and girth welded risers.

Pipes up to 36" can be installed with this method. A floating spiral of pipeline which is within the elastic boundaries will have a diameter of 500x the diameter of the pipe itself.

Because of the high speed of installation (20-25 km/day) the O-lay method needs a relatively small weather window for the installation of the pipe and can stand waves up to 1,5 meters ($H_{1/3}$) during installation.
The O-lay method is a relative low cost, high quality method for installation of subsea pipeline in water depths from less than a metre to several thousands of meters while the offshore installation operations are faster compared to those with conventional installation methods.

The pipelines are constructed in an onshore construction yard. One of the advantages of working onshore is that there is more time to apply post weld treatments to increase the fatigue life of the pipelines and risers that will be installed with the O-lay technology. This increased fatigue life depends on the welding technology used for the orbital welding and the post weld treatment that is applied on these welds An increase of minimum 200% for longer fatigue life is expected by applying the right post weld treatments.

The reduced number of personnel required for the offshore operations, lowers the risk of offshore accidents. This is an important contribution of this new method.

The offshore pipeline industry operates in a global setting where each year around thirty billions dollars are spent on installation of offshore pipelines.
The current players have invested huge amounts in every time bigger traditional vessels and therefore hesitate to support disruptive innovations like the O-lay technology.
By investing in the O-lay method the industry can save tenths of billions of dollars in the coming years.

A project like the 1300 km Oman-India pipeline that has been planned for many years now and will take the traditional J-lay method 2,5 years to install while with the O-lay method the pipeline can be installed in 150 days.
The economic advantage on this project is that there will be savings of over 500 million US$.

Projects in the Northern Caspian can be executed with `Pipe in Pipe` within budget while due to the fast installation times the time for trenching has become less critical.

The O-lay method needs further research in the field and preferably a demonstration project with qualifying procedures in order to have it accepted.

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