

**PIPELINES CONSTRUCTED OF ANACONDA™
REINFORCED POLYETHYLENE PIPES**

V.S. PEPELYAYEV – Director of Tekhnologiya Kompozitov OOO

A.I. TARAKANOV – Doctor of Sciences (Engineering), Deputy Director of Tekhnologiya Kompozitov OOO

The most part of material damage to oilfield pipeline network is caused by corrosion which leads to decrease of service life of steel pipes, to emergency situations, to increase of operation and maintenance costs, to loss of transported products, decrease of their quality and to pollution of the environment. Experience in operation of steel pipelines transporting highly corrosive oilfield mediums shows that the average service life of steel pipelines decreases from 12...15 years to 2...3 years.

In the 80-s, the use of polyethylene pipes designed for up to 4 MPa working pressure and reinforced with steel working parts, commenced in order to substitute steel pipes. However, the experience in operation of pipelines constructed of such pipes showed that the corrosion of reinforcement parts could not be avoided and their secure and tight connection could not be guaranteed.

ANACONDA™ PIPES

Pipes of new generation are reinforced with corrosion resistant extra strong synthetic yarns. Anaconda™ pipes – produced from PE80 polyethylene and reinforcement polyester yarns – manufactured by Tekhnologiya Kompozitov are the first to be mentioned.

Anaconda™ polyethylene pipes reinforced with synthetic yarns are available of 63, 75, 90, 110, 125, 140, and 160 mm outer diameters; moreover 63-125 mm diameter pipes can be delivered in 400 to 150 m reels respectively. The pipes are designed for construction of underground



Figure 1
Unreeing of Anaconda™ pipe reel during pipeline construction

pipelines of 4.0 MPa working pressure at pipe wall temperatures ranging from -15°C to +60°C. The designed service life of Anaconda™ pipes at oilfields is 25 years.

Permanent connections to couple reinforced polyethylene pipes to steel pipelines are vital elements of pipelines. Tekhnologiya Kompozitov has mastered full-scale production of permanent connections of all standard sizes of Anaconda™ pipe. The permanent connection is coupled to polyethylene and steel pipelines by welding.

Anaconda™ pipes and permanent connections to them are certified for compliance with TU2248-001-55038886-01 and TU2248-006-55038886-08 specifications.

Ukrainian TsPV PROMBEZPEKA issued a permit for use of reinforced polyethylene pipes in oil-gathering systems in Ukraine.

The Federal Service for Environmental, Technological, and Nuclear Supervision issued permits for use of pipes and permanent connections designed for up to 4.0 MPa in oil and gas industry and for up to 1.2 MPa in gas distribution systems.

The Federal Service for Consumer Rights Protection and Human Welfare allowed using Anaconda™ pipes in cold water supply systems.

As of today, over 300 km of pipelines have been constructed of Anaconda™ pipes.

APPLICATION

▪ Oil-gathering lines

Flow lines and oil-gathering mains serve to transport oil and gas and water mixtures, the corrosiveness of which is due to potential corrosiveness of their constituents. Presence of aggressive agents (hydrogen sulfide, oxygen, carbon dioxide gas, and mineral salts) leads to corrosion of steel pipelines in case when water content exceeds 70%. The bottom part of steel pipelines is damaged by corrosion spots especially in the lower parts of the lines where strata water settles. The use of Anaconda™ pipes is efficient right in the conditions of increased well stream watering. Polyethylene and polyester are chemically resistant enough to almost all substances contained in well streams and the inner surface remains smooth throughout the entire service life.

Well streams normally contain solid particles leading to hydroabrasive wear which is 2.5 ... 4 times higher in steel pipes than that in polyethylene pipes.

Solid methane hydrocarbons and paraffin oils occur almost in all oils. Their content may vary from traces to 20-28%. Paraffin accumulations in pipelines lead to decrease of throughput capacity and to increase of flow resistance. To cope with accumulations in reinforced polyethylene pipes, mechanical, chemical, and thermal methods are applied.

Chemical cleaning of flow lines from asphaltene-resin and paraffin accumulations is done by means of chemical agents, to which PE80 polyethylene is chemically resistant, for instance by means solvents, such as FLEK-R-021, FLEK-R-017.

It is acceptable to use hot water mixed with cleansing agents or to use hot oil of temperature not exceeding 80°C to washout and remove oil-mud and paraffin accumulations.

In August 2005, in Oil and Gas Production Division -2 of NK Rosneft - Stavropolneftegaz OJSC at Pushkarskoye oilfield, one of the first oil flow lines, 1 km long, was constructed of pipes manufactured by Tekhnologiya Kompozitov. The oil pipeline is in operation under pressure of 2.5 MPa, the well flow rate is 35m³/day, well stream temperature is +60°C, volumetric water cut is 90%, gas to oil ratio is 60m³/ton.

In August 2007, by request of the customer, at oil flow line of Oil and Gas Production Division No.1 of Ufimskoye Oil and Gas Production Department of Bashneft JSOC, two samples of Anaconda™ pipe were installed welded as bypass lines. The working pressure in the oil pipeline is 2.0 MPa; hydrogen sulfide content is significant: 1973.4 mg/l.

In October 2010, one of the samples was tested; bursting pressure remained within normal range.

As of today, more than 250 km of oil flow lines and oil-gathering mains have been constructed of Anaconda™ pipes at more than 30 refineries, for instance:

LUKOIL - Kaliningradmorneft OOO, LUKOIL-Perm OOO, LUKOIL-Nizhnevolzhskneft OOO, UKRNAFTA OAO, and lots of companies in the Republic of Tatarstan.

▪ **Oil reservoir water flooding pipelines**

As a result of oil treatment at oilfields, the two main products are produced: commercial oil and associated gas. Along with that, the ballast is separated from the well product, i.e. strongly mineralized stratum water (brine), which is supplied from the oil treatment tanks by power pumps to the cluster pump station in order to be injected to the bed later on.

After the stratum water mixes up with fresh (washing) water, with discharges from various units of equipments and pumps, with atmospheric precipitations, it contains considerable amount of dissolved oxygen, so the speed of steel pipeline corrosion is significant.

The range of efficient application of Anaconda™ pipe in oil reservoir water flooding systems includes process water lines leading from the oil treatment unit to the cluster pump station; the pressure in the process water lines is 1.6...2.5 MPa.

In total over 20 km of oil reservoir water flooding system water lines were constructed, mainly in the facilities of UralOil OOO, Ukrnafta OAO in Chernigovneftegaz Oil and Gas Production Division etc.

▪ **Utility and drinking water lines**

Utility and drinking water lines are designed to supply water to rotational camps, fire-extinguishing systems, area and planting watering etc.

Fresh water from rivers and blowing wells, used as utility and drinking water, contains a considerable amount of dissolved oxygen which causes corrosion in walls of steel pipes.

Moreover, salts are accumulated on the inner surface of steel water lines and that reduces the clear opening and increases flow resistance when the water passes through.

The inner surface of polyethylene pipes is not prone to corrosion or carbonate accumulation as opposed to steel pipe, the throughput capacity of which can decrease by 10...48% in five years of operation depending on the hardness of water.

In total over 40 km of utility and drinking water lines were constructed; the biggest line among them is 22 km long water line branch of 4.0 MPa working pressure leading from the main line of drinking water supply to the control and distribution station of Oporny town in Mangyshlaksкая oblast in Kazakhstan.

In addition, it is important to mention water lines in Raspadskaya ZAO in Kemerovskaya oblast, LUKOIL-PERM OOO (Sukhanovskoye oilfield), etc.

A relatively new application of Anaconda™ pipes is construction of high-pressure (up to 4 MPa) water lines for artificial snow-making of biathlon runs and pistes. As of today, the water lines are constructed for the Federal Training Center of Olympians in Chusovoy town, Gubakha Ski Center in Permsky Kray, Zarechye Village Ski Center in Tulsкая oblast, Aist Ski Center in Nizhny Tagil etc.

GAS DISTRIBUTION PIPELINES

Anaconda™ pipes are used as well in construction of distribution pipelines to transport natural gas. At present over 30 km of high-pressure (1.2 MPa) gas pipelines connecting villages have been constructed: in Kirovskaya oblast – in Omutninsky, Zuyevsky, and Kirovo-Chepetsky districts; in Ulyanovskaya oblast – in Mainsky and Cherdaklinsky districts. In future Anaconda™ pipes can be used in 2.5 MPa working pressure gas pipelines.

- **Construction and Operation**

Polyethylene pipes are coupled by welding.



Fig. 2 Laying a stalk of Anaconda™ pipes into a trench

The welding consists of two steps: the pipes are butt-welded with a heated device and the flash is removed, then the welded joint is reinforced by means of an electrofusion sleeve.

A significant experience has been gained in the construction of oilfield pipelines of Anaconda™ pipes; various procedures have been developed to unreel, weld, and lay the pipes.

The pipes are unreeled from reels by means of a special device, i.e. the unreeler. The unreeling speed is up to 1 km/hour depending on the requirements. The pipes should be unreeled if the pipe wall temperature is not below 5°C.

The pipeline is bent by bending provided that the radius of the elastic bending is not less than acceptable (25 outer diameters of the Anaconda™ pipe). That makes it possible to do without branches. Stalks of Anaconda™ pipes of up to 125 mm in diameter can be laid manually.

In one shift a team consisting of 4 workers can weld 8...10 butt-welded joints and manually lay 1...2 km of stalks into a trench.

The cost of Anaconda™ pipeline construction is ≈40% lower than that of steel pipes.

Polyester yarns as well as polyethylene are prone to creep. This is seen particularly in the process of pipeline hydraulic testing. In case of high test pressure load, the pressure decreases in pipelines constructed of Anaconda™ pipes. So, during testing, the pressure should be sustained in pipelines until its full stabilization.

In the process of operation, no maintenance of the pipelines is needed practically as they are not affected by corrosion. In case of transporting problem mediums, removable test samples are installed as bypass lines to control the condition of the pipeline; such samples are periodically removed and tested in the laboratory.

CONCLUSION

Pipes manufactured by Tekhnologiya Kompozitov can be efficiently used in construction of oil-gathering pipelines, low-pressure water lines of oil reservoir water flooding systems, and in gas distribution networks. High performance index of Anaconda™ pipes application is due to the following:

- high operational performance of the pipes;

- ease and high speed of pipeline construction;
- relatively low cost of pipes and assembly;
- long service life of the pipelines;
- low maintenance costs