# FLOWLINES MADE OF SYNTHETIC YARN REINFORCED POLYETHYLENE PIPES

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A number of Russian oilfields are currently entering the last stage of their development, and are showing a high water content in the crude. The number of failures, and the premature replacement of many steel pipes makes the issue of the reliability of steel pipelines more significant than ever. The main reason given for flowline failure is internal corrosion, as a result of formation water coming into contact with the metal surface.

Oilfields are designed with a network of pipelines:

- **flowlines** (Ø89–114 mm) – pipelines for transportation of products from the oil well (oil, water, associated gas) to metering separators, at pressures up to 4.0 MPa.
- **oil and gas gathering mains** (Ø89–720 mm) – pipelines for the transportation of products from the metering separators to the booster compressor station and the initial water separation units, operating at pressures up to 2.5 MPa.
- **pressure oil pipelines** (Ø273–720 mm) – pipelines for processed or partially processed oil from the oil gathering facility and booster compressor station to the central production facility, operating at pressures up to 4 MPa.
- **water flooding pipelines** of oil reservoirs and brine disposal in deep input horizons: low pressure (Ø114–530 mm) – up to 1.6 MPa; high pressure (Ø89–325 mm) – 10–20 MPa.
- **gas pipelines** (Ø273–530 mm) – for transportation of associated gas from oil separation units to gas treatment facilities, or to the consumer, operating at pressures up to 0.8 MPa.

The main corrosion factors of transported agents in the oil flowlines are:

– The pH factor and salinity of oilfield water

– Water-dissolved gas content (including carbon dioxide, oxygen and hydrogen sulphide)

– Micro bacterial corrosion (from sulphate reducing bacteria, hydrocarbon oxidising bacteria and others)

– Solid particles

– Mineral deposits.

Oil and gas companies bear huge losses and unacceptable waste during standbys caused by emergency shutdowns, and the repairs and replacements of worn steel pipelines. They may also suffer losses in transported products, a drop in quality, and environmental pollution. It is obvious that they need pipelines that can operate reliably in the long term [1, 2].

Anaconda™ synthetic yarn reinforced pipes, by Technologiya Kompositov, Perm, are a viable alternative to steel pipes in many instances. These pipes use pipe grade PE and high tension polyester threads, which are resistant to corrosive agents (as described above) which are transported via flowlines, and are also present in the soil.

PE pipes are resistant to external corrosion, which eliminates any need for electrochemical protection units. The inner surfaces of PE pipes are resistant to corrosion and carbonate deposits. This ensures that the flow capacity remains the same, throughout the operating life of the pipe, which cannot be said of steel pipes [3]. Pipe-grade PE pipes have 2.5 times higher hydroabrasion resistance to solid particles compared to steel pipes [4].

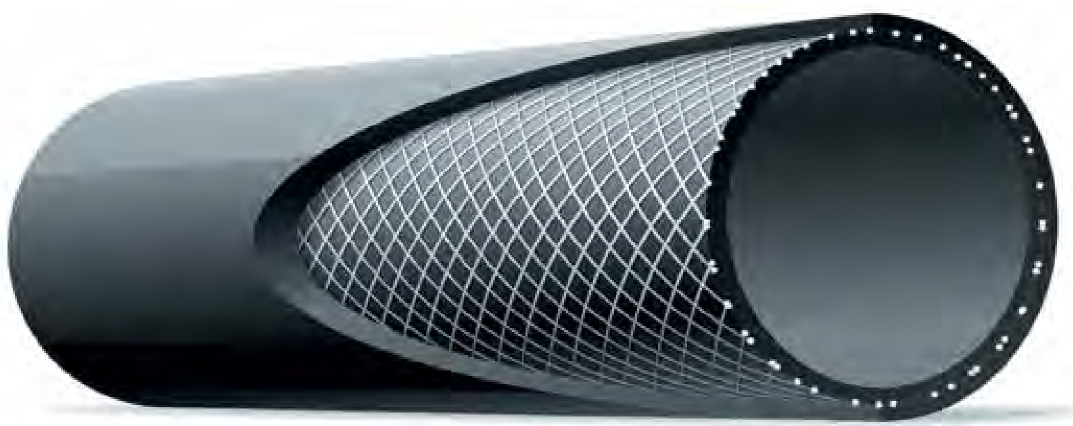
Anaconda™ synthetic yarn reinforced pipes [5] are manufactured with outer diameter of 75, 90, 110, 125, 140 and 160 mm. The pipes are designed for the construction of pipelines with operating pressures up to 4 MPa, and an operating temperature in the pipe wall from –15° to +60°C. The designed operating life of AnacondaTM at oilfields is 25 years.

Anaconda™ pipes are highly flexible and can be wound into coils. 75–125 mm pipes can be supplied in lengths from 350 to 150 m respectively.

Pipelines made of these pipes can withstand ground movement during earthquakes, soil heaving and subsidence, thus increasing their survivability.

Anaconda™ pipes notably expand due to their high coefficient of linear thermal expansion (up to $220 \cdot 10^{-6}$ 1/°C) and low PE creep modulus under pressure and positive temperature drop. In order to keep pipelines made of these pipes at the designated elevation, they are only laid underground; the pipe is then held in place by the ground.

Pic. 1. Synthetic yarn reinforced PE pipe design



Pic. 3. Oil flowline positioning

Pic. 2. Uncoiling of Anaconda™ pipe during construction of oil flowline

Anaconda™ pipes tangential elasticity allows them to withstand water freezing without reducing structural properties after defrosting.

Pipes are connected together by welding. What distinguishes the Anaconda™ pipes here is that welding consists of two standard operations: butt fusion with further bead removal, and welded seam reinforcements using electrofusion connection coupling [6]. Seam axial resistance at butt fusion is lower than the pipe strength, necessitating coupling welding for extra reinforcement.

Anaconda™ pipes bends and risers are completed using elastic bending with a minimal radius not less than the accepted – 25 outer pipe diameters. This, in some cases, can also help avoid knees.

Anaconda™ reinforced PE pipes can replace steel flowlines, oil gathering mains and low pressure water flooding pipelines. From 2005, over 500 km of flowlines have been built using Anaconda™ at oilfields in Russia, Ukraine, Lithuania, Uzbekistan, and Kazakhstan.

Pipes with diameters up to 250 mm are currently undergoing design-engineering development, which will significantly extend the application range of reinforced PE pipes at oilfields.

## References

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