Corrosion protection in Slovak Gas Industry in a review of last 10 years

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Abstract

Corrosion protection in the Slovakia changed dramatically during the last 10 years. Sophisticated data analysers completed simple multimeter equipment, short-term university education for CP technicians was added to basic technical skills gained by practice, but also more office work on a personal computer was added to simple measurements in the field. Although installation of impressed current systems for distribution pipelines in villages and towns was not common practice, introduction of CP systems for pipelines in urban areas started up during the 90´s.
The paper describes changes and technical development in corrosion protection in the gas industry in Slovakia during the last decade.

Introduction

Slovenský plynárenský priemysel (SPP) is a gas company with a tradition and history. The first and former Gas Work was established in Bratislava on 19-th of March in 1856, since the time when the streets where illuminated by city gas lights. Afterwards, during some decades, another several city gas works arose all over the country. This year SPP celebrates the 150´s anniversary of its foundation.
Conversion from city gas to natural gas started in the beginning of the 50´s of the 20-th century. The first “long distance” distribution pipeline had been operated since 1951.
The first empirical trial field application of cathodic protection on operated pipeline in Slovakia is also almost 50 year old. Based on those experiences, the first technical procedures how to design and operate CP were described.

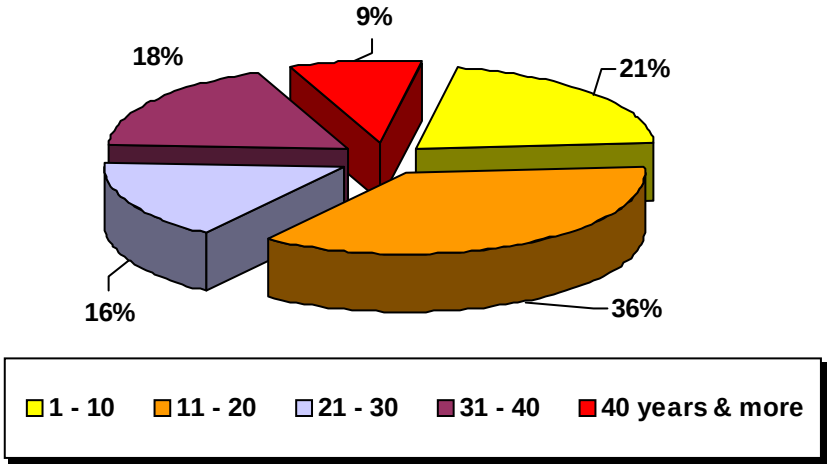
Since those times the pipeline system in Slovakia reaches up to 2 270 km of transportation pipelines and 30 566 km of distribution pipelines. Taking in account, that approximately 40 % of distribution network is made of polyethylene pipes, SPP operates almost 21 000 km of steel pipelines in total. Safe pipeline operation and reliable gas supply is conditioned by application of preventive measures, supported by checks and diagnostics systems combined with effective repair and maintenance system. Applying CP on steel pipelines is a typical preventive and highly effective tool to reach the goal.

Some facts about SPP from the beginning of the 90´s

Tranzit division is the substantial European transporter of Russian natural gas to EU countries (25% of European natural gas consumption represents Russian origin). After division of former Czechoslovakia in the end of 1992, new management has taken command and care of Slovak part of the pipeline corridor that complies from 4 to 5 pipes of 1100 to 1400 mm in diameter. Pipelines were gradually built since 1971 to 1999. Different time of construction was related with the different types of pipe coatings and technology of their application. Data analysis achieved by systematic pigging system indicated corrosion problems primarily characteristic for pipes, that where machinery coated by cold tapes in-situ above the trench in the 70´s. Rising

number of serious coating damages forced CP technicians to seek for adequate systematic solution that will allow replace insufficient coating sections. Division adopted the decision to repair it by liquid polyurethanes that are predominantly applied by airless hot spray. Final result is a compact and homogeneous coating with high adhesion to steel surface.
A shift from corrective to predictive maintenance system was the one of the aims, why intensive measurements of transit pipes were introduced since 1998. This energy corridor is specific due to its complexity, because besides of transit lines, another parallel product lines, such as oil, water, distribution gas pipelines, as well as cables and overhead power lines are situated in rather narrow string of ground that crosses the country.
Another important step to enhance a reliability of transit system was introduction of cathodic protection of pipelines in area of compressor stations.

Application of cathodic protection on pipelines in **Distribution** division was determined by former national standards that were valid for construction of steel pipelines. Referring to the standards, pipelines were divided according to operation pressure. While for pipelines with pressure over 0,4 MPa was obligated to install CP system at the same time with construction of pipeline, impress current systems for distribution pipelines in towns and villages (pressure below 0,4 MPa) were considered redundant. But as the DC stray current corrosion problems were known, unidirectional drainage bonds between pipelines in towns and tram rails were installed since 1978. We would found with no effect impress current systems on distribution pipelines in villages and towns before 1994, when we dated the first attempt to turn things around. Several pilot projects were run to install impress current systems in different conditions of urban environment, to fill in a gap of such CP experiences. Different approaches, with or without installation of isolation joins on customer branches, were also tested. Hence economical comparison of CP introduction versus reconstruction steel/PE pipe was favourable for CP, it was not easy to change an old traditional thinking. For such reasons impress currents systems on distribution pipelines in villages and towns were introduced on approx. 2500 km during 10 years.
Taking in account the age structure of distribution steel pipelines with operation pressure below 0,4 MPa (see Picture 1), there is obvious that CP is the only economic tool how to slow down an ageing of pipelines.

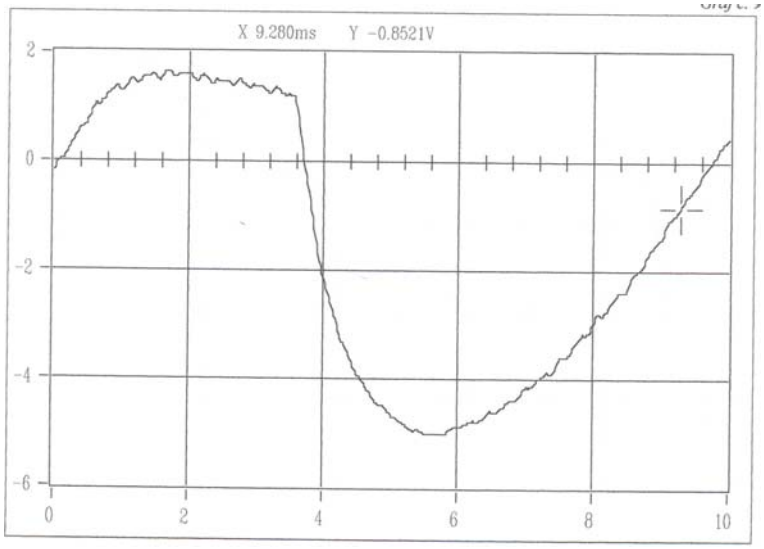


Picture 1 – Age structure of steel pipelines in urban areas

Due to that reasons, SPP has prepared an ambitious plan that could increase a total share of pipelines in urban areas protected by impress current systems up to 50%.

Exchange of technical equipment

Previous times can also be characterised as a time of technical equipment exchange. DC rectifiers of old construction represented a majority of all DC sources for cathodic protection systems. Some of them used a metal (preferably Zinc) reference electrode, that was typical construction for the 70´s. Detailed observations confirmed that the older rectifiers due to its electric construction emitted an output signal with high ripple factor (see Picture 2). Impress current systems were paradoxically the source of anodic current peaks despite of that no real corrosion attack related to this fact was recorded.



Picture 2 – Pipe to soil potential waveform produced by CP rectifier of old construction

Similar situation was noticeable in a development of new drainages, where simple diode unidirectional drainage bonds without current limiter unit were replaced by new ones with different concepts: diode plus halogen bulbs and finally power transistors constructions. Very traditional personal measurement equipment needle multimeter, porous ceramic flower-pot reference electrode were gradually replaced by digital, memory appliances, datalogers and very sophisticated measuring systems.
A huge progress was achieved in field of coating surveys and measurements. Wide scale of various methods were tested and applied in different conditions: AC methods such as Pearson, signal current attenuation method, audio frequency generator measurements as well as DC techniques: CIPS and DCVG.
Complex measurements alias external inspections have been performed in Distribution division since 1996. They allow completely assess the corrosion conditions of buried structure, effectiveness of applied CP and physical conditions of installed CP equipment. Up to now 4110 km has been tested.

Corrosion Protection Centre

Undisputed asset in improvement of conditions for development of cathodic protection was establishing a professional department dealing with specific corrosion problems in 1995 in Košice. Centre provides technical, know-how and educational services for operator and maintenance staff which takes care of CP installations.
Since that time Corrosion Protection Centre has cooperated in several international projects with partners like EON-Ruhrgas, Force Institute and Gas de France. Centre has formed company´s own inspection team to perform systematic over the line pipeline inspections. Services of inspection team were also rendered in Ukraine and Germany.
Several research projects or case studies were also provided by the team, such as AC corrosion study (1, 2), introducing of CP installations at compressor stations in Tranzit division, pilot project of CP installation for distribution pipelines in Prievidza town etc.

Educational process

At the beginning of the 90´s it was succeeded to take some actions that improved company environment for good corrosion protection. Company´s organizational structure was modified to create professional CP maintenance teams for each local company branch.
We initiated talks with Technical University in Košice to prepare and launch a 3 semester course of additional professional education specially orientated on corrosion of buried or immersed metal construction. Content of the course was compiled to bring basic knowledge of corrosion of metals, chemistry, CP methods, operation and maintenance of CP installations, CP measurement techniques etc. Education included theory lectures, lab and field practises as well. During the decade 90 technicians - operators of various product lines (water, oil, gas…) graduated in the course.
To regularly refresh and improve educational degree and technical skills, every three years SPP CP personnel has been taken a four day intensive course tutored by Corrosion Protection Centre. Course gives technical and practical information how to treat the problems in corrosion protection.
A new quality in form of internal education of CP personnel is expected after opening a new training field in SPP training centre in Žilina in summer of 2006. Training field was designed to provide trainings of:

- repairs of pipeline coating faults by bitumen, cold PE tapes, heat-shrinkable sleeves and other repair materials;
- a coating work quality checks such as: coating thickness, peeling test, holiday detection test etc.;
- welding of cable connections to pipeline and how to coat the welding spot.

Besides of it, a small training pipeline network with an extension of 150 m, was built. Network was divided into sections of bitumen and PE coated pipes; includes isolating joints, CP rectifier and anode groundbed, sacrificial anodes, installation of polarized drainage. This arrangement gives an opportunity to teach and practice:

- tracing the position of the pipeline;
- localisation of simulated pipeline coating faults;
- potential, current and voltage measurements in a various modifications;

- procedures how to identify malfunction of impress current system, sacrificial anode or drainage system.

Practical assets of the training field are highly expected due to rising movement of professional CP staff caused by changes of maintenance system in a company.

References

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