ISSN: 0975-8585

Research Journal of Pharmaceutical, Biological and Chemical Sciences

Testing A New Method Of Intensive Measurements To Determine The State Of Anti-Corrosion Coating Of Main Pipelines Western Siberia.

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ABSTRACT

Integrity of anti-corrosion coating of the main pipeline is a prerequisite for system survival of the entire oil and gas transmission system. Currently, most of the main pipelines of Western Siberia are being operated for 25-35 and more years, and therefore relevance of the problem of controlling their state of isolation is not doubted. Enterprises operating gas and oil pipeline network of great extent, no doubt are interested in qualitative monitoring and adequate interpretation of the results. This paper represents some diagnostic testing results of insulation coating state of main pipelines by a two-electrode intensive measurements method, on the basis of which, recommendations on optimization of this type of work in the conditions of Western Siberia are presented.
Keywords: two-electrode method, corrosion, main pipelines, cathodic protection, “Modata”.

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INTRODUCTION

Only the direct losses from corrosion in the world are so huge that the society has to spend dozens and even hundreds of billions dollars annually to fight it. Total direct corrosion losses in the United States (in Russia, the statistics, unfortunately, is not conducted) is about 70 billion dollars per year, i.e. more than 4% of the gross domestic product. And that's not taking into account the problems arising from the accident which occurred because of corrosive destruction in different constructions [1].

Since it is not possible to stop the corrosion process completely, one of the most important environmental and economic issues, the most relevant for the fuel and energy complex of the country in general and Western Siberia in particular, is slowing down the metal corrosive destruction rate to an acceptable level.

Practically for cessation on outer surface of a pipelines of corrosion process either it is necessary to create a flow on a pipeline of electric current or maximally increase resistance of external circuit of current of corrosion couple. First method is implemented by imposing on pipeline of external current, second – by applying on outer surface of the pipeline of insulation coating. Use of first method is called active protection, second one – passive. Therefore, insulation coatings of pipelines fulfill the role of passive protection, and cathodic polarization – active.

Cathodic polarization of pipeline is carried out by an external source of constant current – special units (in other words stations) of cathodic protection (CPS) or by connecting sacrificial anodes (protectors), and for providing sufficient efficiency must be conducted on the full length (protection in length) and incessantly (protection in time). As for active, as well as passive corrosion protection of underground pipelines must meet certain requirements, given in appropriate State Standards and regulatory and technical documents.

Protection from corrosion of underground pipelines is implemented as the complex, as specified: use of insulation coating (basic type) and cathodic polarization (subsidiary type) for protection primarily locations of bare pipe (surface of pipe in locations of pores, crack and other defects in insulation coatings) by supporting necessary value of protection potential.

Process of corrosion protection of steel underground pipelines presents complex multi-factor process, to provide the sufficient efficiency of which should be regularly controlled, taken in account and regulated different parameters. Control of condition (quality) of insulation coatings and efficiency of cathodic protection on underground pipelines is reached by executing appropriate electrometric surveys (measurements).

Currently, there are two basic ways to protect underground metal constructions from corrosion - the so-called active (electrochemical) and passive (using insulation coatings) protection that are used on most of the pipelines in the complex.

Operating principle of the passive protection is based on reducing corrosive environment access to the metal surface, which implies that the less insulation coating is damaged, the better its operating efficiency is.

The essence of the method reduces to measurements in pitches of 5-10 meters enable and disable potentials and potentials of their gradients (Uen; Udis; dUen; dUdis) for fixed operating modes of cathode protection systems (CPS) that affect the security the surveyed pipeline section, and further algebraic manipulation with the results of these measurements [2].

Proper application field of this method is the pipelines with insulation, built meeting the requirements [3], which allows localizing individual through faults amid the high-quality insulation coating and evaluating the pipeline safety in these defects.

This scheme is recommended for use the majority of manufacturers of diagnostic equipment, as well as regulatory documents of organizations, operating pipelines [4-5].

However, this scheme does not fully consider the peculiarities of pipeline transportation system work under conditions of Russia. In particular - the presence of 1 to 20 parallel pipelines in one pipeline right-of-way with the studied pipeline, as well as challenging geographical and climatic conditions in the places of diagnostic operations.

METHODS OF RESEARCH

As objects of study, were chosen: main pipeline UBKUA (Ust-Balik-Kurgan-Ufa-Almetyevsk) in the area 641-889 km, main pipeline NKK (Nizhnevartovsk-Kurgan-Kuibyshev) in the area 879-1129 km, and main pipeline T-Yu (Tyumen Yurgamysh) in the area 0-251 km located in one pipeline right-of-way. The diagnostic study was carried out during the period of 2013 to 2014 using the measuring complex «Modata» of the German company «WeilekesElektronik», and universal diagnostic measuring instrument "Diakor" of CJSC "KhimServis". During measurements, external reference electrode was placed according to the scheme in Figure 1, i.e. perpendicular to the examinee pipeline at a distance of 5-10 m.

RESULTS

Figure 1 shows one of the schedules of intensive measurement by two-electrode method in the area 1 km, obtained by «Modata» measuring complex.

In locations of probable damages of anticorrosion insulation coating of pipeline (through damages or complete loss of insulation) are indicated values of switch-on potential (UON) and switch-off potential (UOFF) as well as value of “funnels of voltage” in moments of switching off cathodic protection and difference of “funnels of voltage” in moments of switching on and off of cathodic protection.

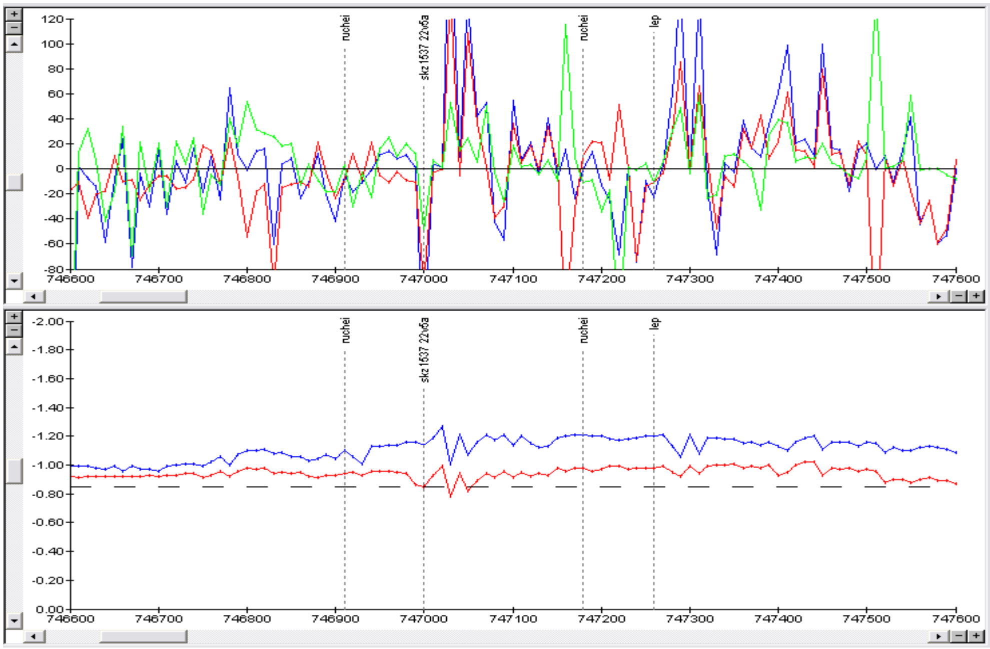

Figure 1: Schedule intensive two-electrode measurement method with 3 pipelines in one pipeline right-of-way with the perpendicular installation of the external reference electrode.

As can be seen, with placement of eternal reference electrode perpendicular to the pipeline, measuring ON and OFF "funnel" gives no clear results, because while spacing the electrodes at a distance of 5-10 m, neighbour pipelines, also having defects in the insulation coating and joint protection, fall in the measuring area. As a result, it seems impossible to interpret measurement results clearly and to indicate defects in corrosion-resistant coating exactly in the inspected pipeline. To clarify the state of the insulation in the given sector, an additional diagnostic examination was carried out using alternating current (Pearson's method). As a result, a defect of insulation was found for 1 meter long and with total area of 4m2, confirmed by check pit sampling. Photo of check pit is shown in Figure 2.

Figure 2: Check pit on the pipeline UBKUA made based on the results of the diagnostic test

Later on, during examination, the modified scheme of measurements was applied in some areas to clarify the data. External electrode (EE) with 5-10 meter step was placed not perpendicular but parallel to the axis of the pipeline. The results of comparison of the data obtained are shown in Table 1.

Table 1: Comparison of results of measurements perpendicular and parallel placement of MEA

Quantity of defects	UBKUA			T-Yu		
	Area 641-646 km	Area 740-750 km	Area 882-889 km	Area 7-14 km	Area 150-160 km	Area 224-227 km
MEA. perpendicular	14	22	15	3	22	14
MEA. parallel	14	23	17	5	23	14

Chart of intensive measurement with a parallel installation of the MEA is shown in Figure 3. The graph clearly shows corrosion-resistant coating defects detected during the diagnostic testing.

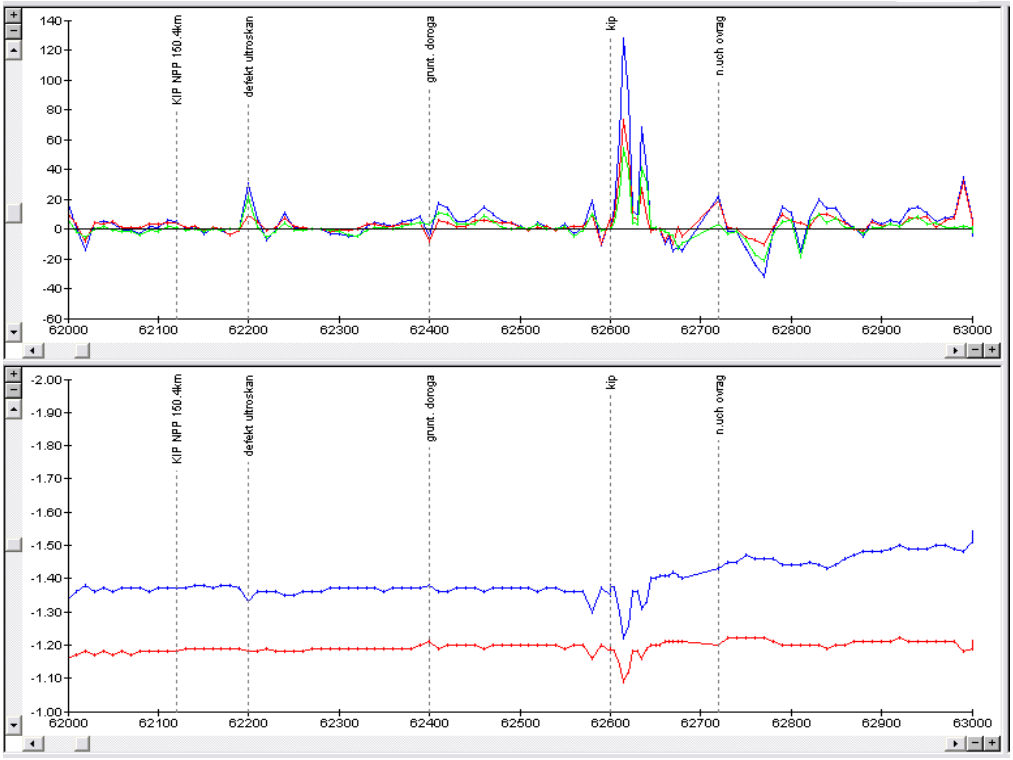

Figure 3: Chart of intensive two-electrode method measurements by three pipelines in one pipeline right-of-way with parallel installation of MEA.

As can be seen from Table 1, at a parallel placement of reference electrodes in areas of the total length of 42 km, it became possible to identify 6 insulation defects additionally. Some of them were confirmed by check pit sampling, such as defect on the pipeline T-Yu with coordinates 153km + 140m. Photo of a check pit is shown in Figure 6.

The only disadvantage of this method, identified empirically, was the worst (as compared with a perpendicular arrangement MEA) accuracy in determining the location of the defect. The mistake was in the range of ± 5 m. However, if a defect is detected, it is sufficient to carry out additional measurements with the removal of the electrode perpendicular, which will increase accuracy up to ± 1 m.

Figure 4: Check pit on the pipeline T-Yu made based on the results of the diagnostic test.

CONCLUSIONS

1. On the basis of the submitted data, it was revealed that a parallel installation of reference electrodes (MEA) during the intensive two-electrode method measurement on pipelines in multiline version, provides a more plausible information about safety and state of researched pipeline insulation coating, and if placing the 2nd electrode in place of the 1st, it gives a 100% inspection of length.

2. An additional and important advantage of using this method is the easier passing of areas with overgrown shrubs (trees), areas with a complex profile, and also to the marshland by a diagnostic team.

3. Based on the results obtained, it is recommended to conduct extensive measuring in combination. This will enhance the quality and significantly improve the speed of the diagnostic works.

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