Application of PCIU for protection of emergency pipelines against corrosion

N N Saveleva, A R Salyakhova, K E Koretskiy, P E Koretskiy

Tyumen Industrial University, 38, Volodarsky St., Tyumen, 625000, Russia

E-mail: nnsavelieva@yandex.ru, angelinasalihova@mail.ru, everlast86rus@bk.ru, loullli@bk.ru

Abstract. The field pipelines at the Samotlor field are the main means of oil and gas transportation. Corrosion causes premature wear of pipes and piping equipment and can cause breakdowns. To prevent emergencies, it is necessary to carry out repair and technical work timely, using chemical dosing units. To protect the field pipelines at the Samotlor field, stationary reagent dosing units are used. All of them are installed at well pads, closer to automated group metering units. They have a number of significant disadvantages: difficulty in installing; difficulty of the repair work; impossibility to remotely control the process of pumping a chemical reagent in real time; long idle time; outdated security system. A modern solution to the listed above problems for the oil and gas industry is the use of portable chemical injection units (PCIU). A PCIU is a state-of-the-art trailer-based system, and it can also be installed permanently on a well pad. The advantage of this installation is its high mobility, ease of installing, minimal installation and maintenance costs, the ability to automate.

1. Introduction
Currently, pipelines are the main type of oil and gas transportation in Russia. Corrosion leads to premature wear-out of pipes and pipeline equipment, can cause accidents, thereby causing spills of oil products, harming nature, and increasing transportation costs [1]. To prevent emergency situations, it is necessary to carry out repair and maintenance works in a timely manner using chemical dosing skids (CDS).

The purpose of this study is to compare portable CDS with stationary CDS currently operating at Samotlor field. We will also determine the economic benefits of using portable dosing skids.

The Samotlor oil and gas field was discovered in 1965 and brought into development in 1969. It is located in the Nizhnevartovsky district of the Khanty-Mansi Autonomous Okrug of the Tyumen region, 750 km North-East of Tyumen, near Nizhnevartovsk.

The area of the Samotlor license site, which is being developed by Samotlorneftegaz, is 2463.2 sq. km. The field has 8902 producing and 3901 injection wells equipped with the latest high-tech equipment. The length of oil pipelines is 2490 km, water pipelines – 2422 km, and other pipelines – 445 km. An extensive network of hard-surface roads with a total length of 1,923 km has been laid throughout the field. Figure 1 shows an overview map of the Samotlor field with a pipelines’ layout scheme.
2. Problem statement
The current issue is corrosion control, which affects most pipelines and pipe network equipment. Due to its effects, corrosion complicates the process of transporting fluid along the pipeline, after which there are emergencies, including breaks that completely stop work for an extended period of time.

We propose to use stationary chemical dosing skids to protect the field pipelines of the Samotlor field. All of them are installed on multiple-well platforms, closer to automated group measure units (AGMU). Further, the injection line should be connected from the chemical dosing skids (CDS) to the point of the main collector in order to protect the linear part of the oil collection.
The total number of CDS in the emergency areas of the Samotlor field is 97 and is shown in figure 2. 30 units of them are fine dimensional blocks and their capacity is 400 l, the remaining 67 units are block objects installed according to the project for the arrangement of the multiple-well platform and their capacity is from 2.5 to 6 m³.

The diagram in figure 3 shows that more than 25% of the total number of all CDS at the Samotlor field is occupied by fine dimensional blocks, which were installed after the implementation of the project for the arrangement of the multiple-well platform, in order to protect emergency pipeline sections at the oilfield.

In addition to the fact that the existing CDS are stationary, they also have a number of significant disadvantages:
1. Installation complexity (many services are involved in order to complete all installation and dismantling cycles);
2. The complexity of repair work, including coordination of hot works, takes a lot of time;
3. For example, to remove a container from a chemical reagent unit, it is necessary to use the following components:
   3.1. Agree on the order for hot works
   3.2. Apply for a power outage
   3.3. Pump out the remaining chemical reagent from the container with the involvement of special equipment from the customer.
   3.4. Dismantling the installation with the involvement of the welding course from the customer
   3.5. Loading of the chemical reagents unit with the involvement of special equipment from the customer.
   3.6. Removal of the installation to the workshop territory
   3.7. And so, to repair one container, you will have to use the following special equipment: crane, trawl, fire brigade, vacuum booster, steam truck, welding course.
4. Inability to remotely control the process of chemical reagent injection in the real time;
5. After scheduled work, stationary CDS are preserved, which leads to non-productive delay;
6. Security system that does not meet modern requirements.

Also, a large number of CDS at the Samotlor field have been operating for more than 10 years, so they are under increased safety control. Due to the short service life, these units will soon need to be replaced.

Based on this, there are doubts about the rationality of using stationary CDS both from a logistical and economic point of view.

Therefore, oil and gas enterprises are faced with the issue of developing innovative dosing units that can minimize all the costs, related to existing chemical dosing units.

3. Problem solution
A modern solution to these problems for the oil and gas industry is the use of portable chemical injection unit (PCIU). PCIU is the latest trailer-based system and can also be installed stationary on the multiple well platform.

The unit is equipped with electric metering pump units in the amount of 3 pieces. This unit can operate from the main electrical networks or independently from the Geko power station with a voltage of 380 V, the power consumption of which is no more than 4 kW.

The unit also has antistatic plastic containers in the amount of 3 pieces. The volume of one container is 3000l, the total volume is 9000l. Containers are intended for storing any chemical reagents, including methanol. If necessary, the PCIU unit can simultaneously pump three different chemical reagents. The IBRC installation can supply the reagent simultaneously to three wells, or supply the reagent to the well, pipeline, and AGMU.

The following are 3D models of PCIU (Figure 4,5,6).
Figure 4. Unit in assembly. General view of PCIU

Figure 5. Unit in assembly. Top view.
The portable block includes:
- electric metering pump unit
- electric metering glandless pump unit
- electric gear oil pump unit
- 3-plunger electric pump unit
- additional capacity for 3000 liters
- control cabinet;
- pipe manifold and isolation valve;
- pressure, temperature, liquid flow rate and liquid level monitoring devices;
- remote control of metering pumps to increase or decrease chemical supply;
- control position;
- fire-fighting board;
- ventilation;
- interior lighting;
- exterior lighting;
- energy-saving block compartment heaters;
- terminal boxes, switches;
- electrical and control cable;
- unauthorized access alarm with output to the dispatcher
- real-time video surveillance gives the customer the ability to monitor the timely and safe performance of service organizations.

and also, there is no need to coordinate hot works

4. Discussion of results

Advantages of this installation:
- Easy to install. (Maximum 2 specialists involved);
- Repair works are carried out immediately on site (including removal of containers in case of their failure);
- Monitoring and controlling PCIU remotely in the real time;
Due to the portability of this unit, the need for conservation is eliminated;
High security against unauthorized access;
Full-service life more than 10 years;
Minimal installation and maintenance costs.

It should also be noted that all work on the production process automation can be carried out using the considered equipment [3].

Economic efficiency:
The economic efficiency of these installations is great. Due to PCIU, it is possible to significantly reduce the cost and time for its maintenance and repair without involving special equipment from the customer [4].

For the year, at the Samotlor field, the cost of servicing all CDS is 17 million rubles. Approximately for a month the cost is 1 million 400 thousand rubles. As mentioned earlier, most of the installations at the field have been in service for more than 5 years, which in turn requires even more repair costs or complete replacement of old CDS with new ones.

With a similar cost of stationary and portable CDS, it is more profitable to install portable installations. As costs can be reduced due to the portability of PCIU, longer service life and ease of installation, repair, and maintenance. For example, 2 specialists are enough when dismantling this unit (replacing the container with a chemical reagent).

5. Conclusion
Performance of the oil and gas pipeline is one of the most important aspects of the oil and gas industry [5]. The correct tool is needed to solve this problem. The portable chemical injection unit from LLC "YugraChemService" will be a worthy replacement for the stationary chemical dosing skids available at the Samotlor field. PCIU will reduce the economic costs and time spent on repairs and maintenance, thereby increasing the productivity of the production process.

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