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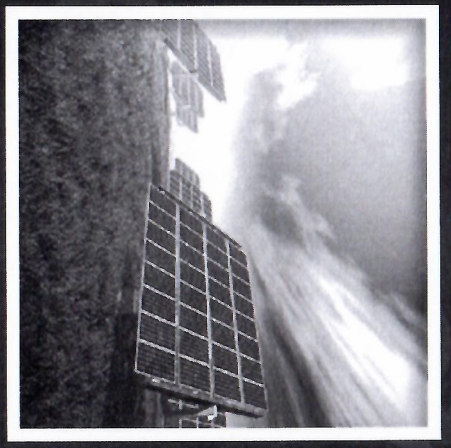

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TECHNICAL DIAGNOSTICS OF THE CONDITIONS OF DRILL PIPES AND OIL AND GAS TRANSPORT PIPELINES

ABSTRACT
Columns of welded pipes in the oil and gas wells and pipelines for their transportation to consumers fall into high responsible structures prone to corrosion and cracks. Therefore it is important to know the remaining strength of the pipes in the case of occurrence of any of the mentioned types of damage. Steels intended for the production of protective pipes for oil and gas drills are specified by the API 5CT standard.
Premature failure or damaging of parts and components of welded pipes columns in wells, as well as pipelines for the transport of oil and gas is generally caused by the simultaneous influence of a large number of technological, metallurgical, structural and exploitation factors. Therefore convenient structural solutions, which provide the mechanical safety of parts and the integrity of structures, can be realized only through total comprehension of their behavior in various operation regimes.
The paper elaborates the importance of technical diagnostics for monitoring and analysis of protective pipes conditions in the wells and pipelines during the oil and gas transportations. Also, an analysis of the causes of failure of the pipes and pipelines is conducted and the importance of forming of database is considered.
Keywords: drill pipes, transport pipeline, damage, technical diagnostics, database

1. INTRODUCTION

Columns of welded pipes in the oil and gas wells and pipelines for their transportation to consumers fall into high responsible structures prone to corrosion and cracks. Therefore it is important to know the remaining strength of the pipes in the case of occurrence of any of the mentioned types of damage. Steels intended for the production of protective pipes for oil and gas drills are specified by the API 5CT standard [1].

Based on the precise testing of the type and the size of the fault and calculation of welded joint work capacity, it is possible to decide on its use or possible repairing, i.e. disposal.

Steel pipes in oil and gas industry are constantly exposed to corrosion, supported by pressures and temperatures that prevail inside the well. Corrosion can lead to reduction of mechanical properties of the steel, which under unfavorable conditions can cause the initial crack and fracture, figures 1 and 2. Fracture of casing wells can be caused and accelerated by various mechanisms of corrosion [2].

Figure 1. *Common corrosion of pipes*

Figure 2. *Fracture of the pipes*

2. TECHNICAL DIAGNOSTICS

During the exploitation of casing of wells and transport pipelines, the useful properties of the assembly and its integral parts are gradually lost. Likewise, degradation of material properties and/or deformation of the elements can be accelerated due to exploitation and assembly errors, and therefore periodic or constant diagnostic measurement and periodical testing are necessary so that processes that can create conditions for system failure can be systematically controlled.

Properly conducted technical diagnostics protects parts of the casing pipes in wells and transport pipelines from the immediate hazard, provides safe work to employees, rational techno-economic exploitation, maintenance and environmental protection.

Programs for testing the casing pipes mainly predict the following [1]:

- testing with test plate iron coupons, installed in the pipeline for the monitoring of intensity of corrosion deposits,
- testing of hydrogen content using analyzer,
- determination of the CO2 and H2S content, determination of the iron content (if the content of iron is below 0.02%, FeS^2 that causes the corrosion does not originate)
- determination of the Benfield solution content (content Fe< 0,02%, V< 0,7% and H2S),
- determination of the inhibitor content in the condenser (means for protecting surfaces of the pipes),
- ultrasonic testing (UT) of pipe walls thickness,
- testing of corrosion damage of the inner surface of the pipe using calibrator,
- using test probes for the measurement of corrosion,
- ultrasonic testing of the conditions of the inner surface of the gas pipeline in operation

Programs for testing the pipelines for transportation of oil and gas primarily include [1]:

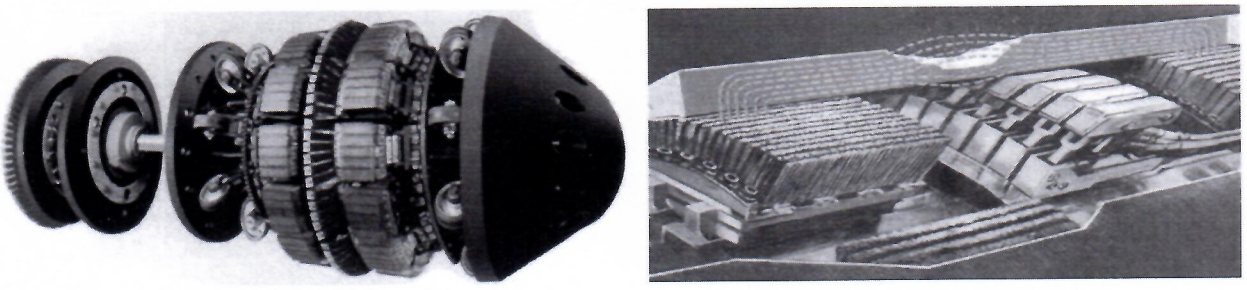
- testing of the immediate condition of the inner surface of the gas pipeline in operation using magnetic particle method (MT), 'intelligent pigging',
- testing of the conditions of the inner surface of the gas pipeline in operation with magnetic tester MFL (magnetic flux extends longitudinally with respect to the axis of the pipeline),
- testing of the inner surface of the gas pipeline in operation with magnetic tester MFT (magnetic flux spreads transversally with respect to the axis of the pipeline),
- testing of the inner surface of the gas pipeline in operation with combined magnetic tester (two magnetic fluxes on one tester),
- ultrasonic testing of pipe wall thickness,
- ultrasonic testing of the inner surface condition of the gas pipeline in operation.

Basic MFL tester, figure 3, is consisted of three parts: drive- provides power supply that powers electromagnet and complex device electronic, sensor- carries convertors that scan 360° of the pipe circumference and are placed between the poles of the magnet, computer part with instruments were the registration of test data is performed.

An example of reporting of MFL testing with a tester where properties, places and positions on the steel pipes for two faults are defined, is presented on figure 4.

3. FAILURES IN EXPLOITATION OF WELDED PIPES AND PIPELINES

Casing welded pipes in oil and gas well are constantly exposed to corrosion, high temperatures and high pressures. Corrosion (pitting corrosion, intercrystalline stress corrosion, hydrogen embrittlement corrosion) can lead to significant reduction of mechanical properties of steel and/or welded joints which may under unfavorable conditions in



a) New MFL tester wall *b) Expansion of magnetic flux through the pipe*

Figure 3. *Device for the inspection of the gas pipeline*

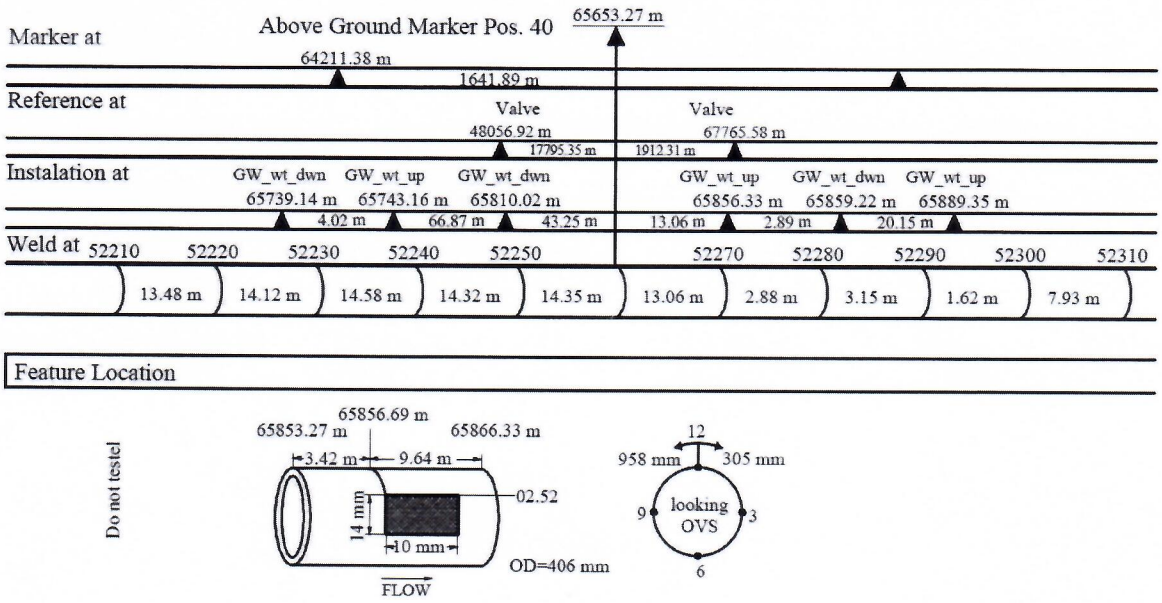


Figure 4. *Site display- chainage, positions on the pipes and the size of the defect*

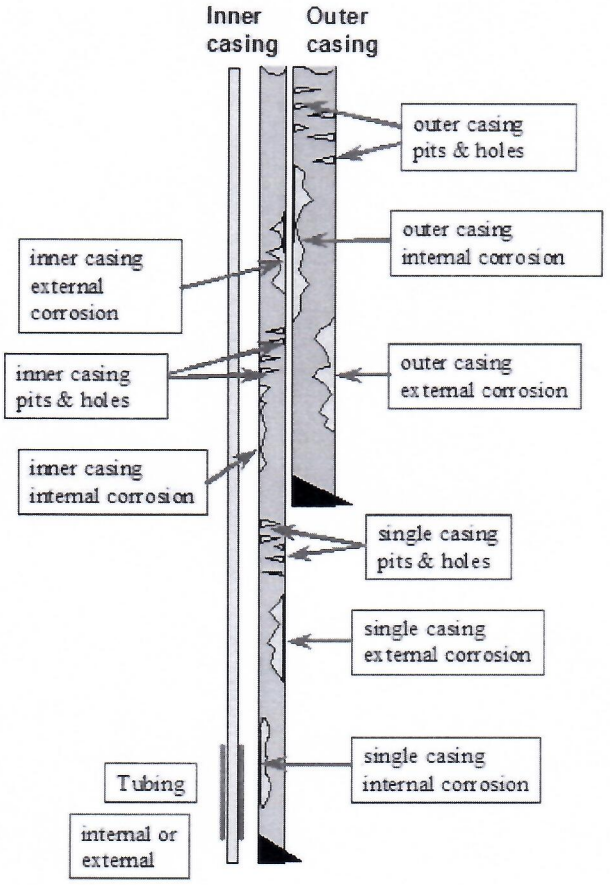


Figure 5. *Corrosion occurrence sites in drill casing pipes*

an introduction to failure/fracture of the pipe even faster if the pipes stresses are higher, figure 5 [3]. Welded pipes for transportation of oil and gas are also exposed to the corrosion, but to a lesser extent.

3. DATA BASE

A reliable assessment of the integrity and suitability for the use of welded pipes/pipelines construction elements in the oil and gas industry can only be made by creating a data base. The associated software packages would enable more efficient data base usage, analysis of certain influencing factors, possibilities of preventing their destruction and searching for variant solutions in all phases of design and development of the structures.

Important information for the improvement of the methods of designing and construction of responsible parts and elements of supporting structures, for the improvement of the properties of existing materials and their processing technologies, as well as the development of new materials represents the analysis of damages and fractures or the parts and elements of supporting structures. Also, the analyses of damages and fractures allow the development of new technical solutions and testing methods during the prototype phase. The analyses of damages and fractures for determination of reasons that cause them, in order to eliminate them, represent the process that requires a systematic approach to the problem.

Data bases of conducted testing and analysis of causes of failure on adequate constructions of welded pipes columns in oil and gas wells and pipelines for their transport to the consumers provide great opportunities for determination of changes of mechanical properties of material and welded joints of construction in the variation of large number of influencing factors, and to reduce undesirable effects to tolerable value, that is, to realize convenient construction solution as a whole.

CONCLUSION

Conducted research provides many possibilities in the analysis of the behavior of pipes and pipelines in oil and gas industry in order to determine the changes of mechanical properties of material and welded joints of pipe constructions in oil and gas wells and pipelines of transport systems, during the variation of a large number of influencing factors, and for obtaining the safer structures or for reducing some undesirable effects to tolerable value, that is, for realization of convenient construction solution for piping of wells and transport pipelines as a whole.

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