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## **APPLICATION OF PT-84 POLYMER IN HDD MUD – LAB RESEARCH\*\*\*\***

### **1. INTRODUCTION**

Horizontal Directional Drilling is a trenchless method used for instalation of pipelines, air-pressured and gravitational ducts as well as cable instalations. This drilling method is utilized on terrains with roads, rivers and highly urbanized areas, where direct pit under the ground is impossible. HDD technology has more advantages than the traditional methods. Not only do they shorten time necessary for dig-up, but also the pipelines used during instalation can be placed in any desired position under any territorial barrier. HDD does not disturb public transport and does not devastate the environment, what makes it the commonly used technology in the construction industry.

This drilling method consisting of the drilling of a little diameter horizontal hole, in next depends on drilling a hole with usage of drilling rods and a boring head with a steering tile and instrument stalk directed with appropriate approach angle.

HDD drilling process includes three stages (Fig. 1) [1]:

Phase 1. Pilot drilling – creates an entry point that enable proper positioning of a pipeline. With aid of an electronic locator rebore is controlled if it keeps the demanded trajectory. Thanks to steering there is a possibility to avoid such obstacles as: water, electric and sewage systems and foundations. Following this it helps to avoid the danger of damaging previously placed systems and to decrease to minimum the risk of failing with the carried out task.

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Phase 2. Reaming – in order to obtain the desired entry point diameters for casing installation, the reamers with proper diameters are used to widen the entry point. After finishing the accurate pilotage rebores the steering head is replaced with enlarging bit appropriately selected to technical parameters, which is used to enlarge the hole diameter. During the enlarging process a drilling mud is used, which carries out the cuttings and stabilize constantly the drilling hole.

Phase 3. Pullback – the last stage of the horizontal directional drilling operation pulls the installed pipeline under the ground. To the broadened hole with demanded diameter a drilling pipes prepared earlier is inserted. The pipes are placed right after the last enlarging bit with usage of a special head. In case of small diameters there is a possibility of enlarging and inserting the pipe at the same time during the second stage of the drilling process.



**Fig. 1.** Horizontal Directional Drilling. Source: Burkacki-Beta-Boring, Warsaw

Every stage of the process requires the use of the proper drilling fluids to optimize drilling procedure.

An appropriate selection of a drilling mud for the drilling conditions is a base of success in directional drilling. Mud's main task is the cutting's transport from the hole to the surface. Because of very short path of cutting's settling in the annular space the next important job of HDD drilling mud is to maintain cuttings in suspension while stoppage in the circulation. To do so drilling mud with elevated values of yield point and gels are applied [2].

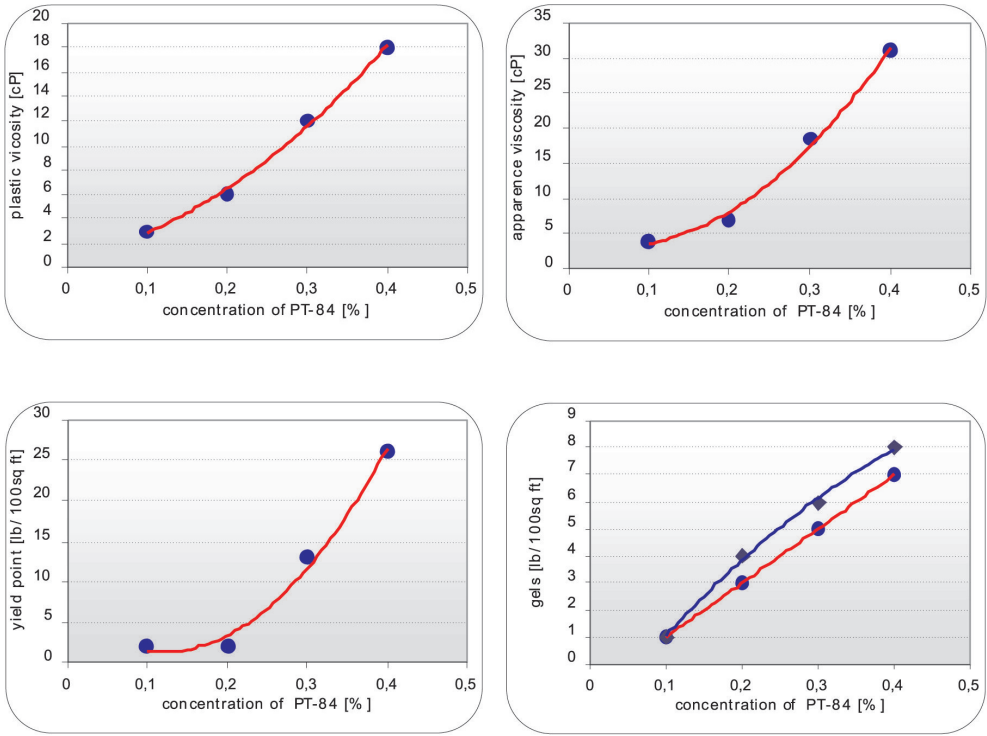
Depending on the hole conditions, sometimes it is necessary to apply a mud with elevated value of plastic viscosity, what positively affects the stability of the hole's wall. In such cases the mud's filtration becomes more and more important and it is crucial to keep in on a low level.

This research show the results of lab tests concerning drilling mud assigned for directional drilling with usage of PT-84 polymer. PT-84 is a mixture of natural polymers and biopolymers worked out by Polymer Technologies Krakow.

## **2. PRELIMINARY RESEARCH**

In the first stage of the research a preliminary tests were led, which had to define the direction of PT-84 activity in mud. To do so a 2,5% suspension of unmodified bentonite

OCMA with addition of PT-84 in different concentration was prepared. After that a measurement of technological parameters according to Polish Branch Standards and American Petroleum Institute has been carried out. The results are presented in the Figure 2.

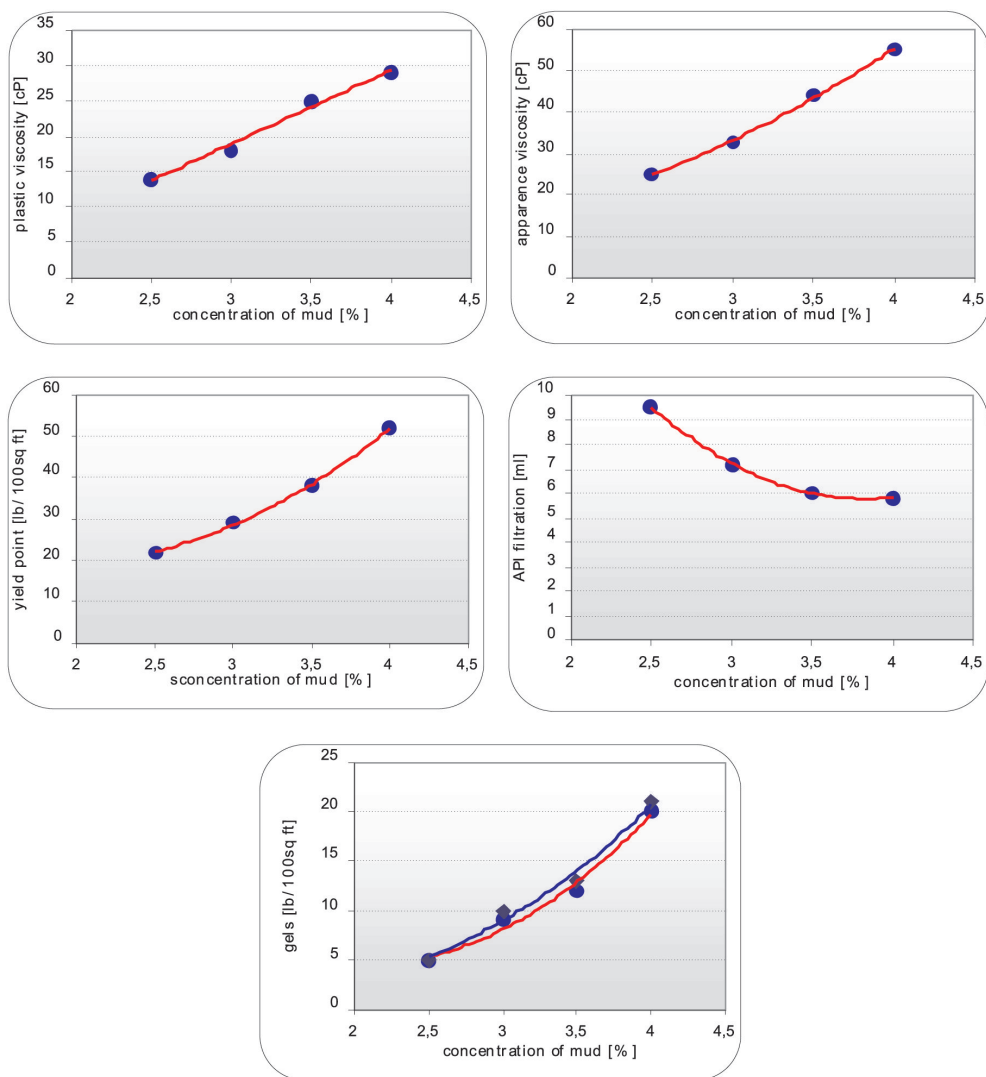


**Fig. 2.** Rheological parameters of composed mud vs. concentration of PT-84

It was observed that increase the concentration of PT-84 causes the increase of rheological parameters and decrease of filtration for bentonite suspension. An addition of 0,4% of PT-84 has been claimed to be the most advantageous.

In the next stage of the research concerning technological parameters of the mud with relationship to its concentration. A mixture of a bentonite with PT-84 was prepared with mass ratio of 12:2. After that a water suspensions of this mixture were prepared in mass concentration from 2,5% till 4% and the rheological parameters and filtration were measured. The results are presented in the Figure 3.

As a result of the carried out research, it was claimed that drilling mud with addition of PT-84 characterizes with good technological parameters. With the rise of worked out drilling mud an advantageous rise of yield point and structural endurance is observed. Also a filtration decrease was noticed.

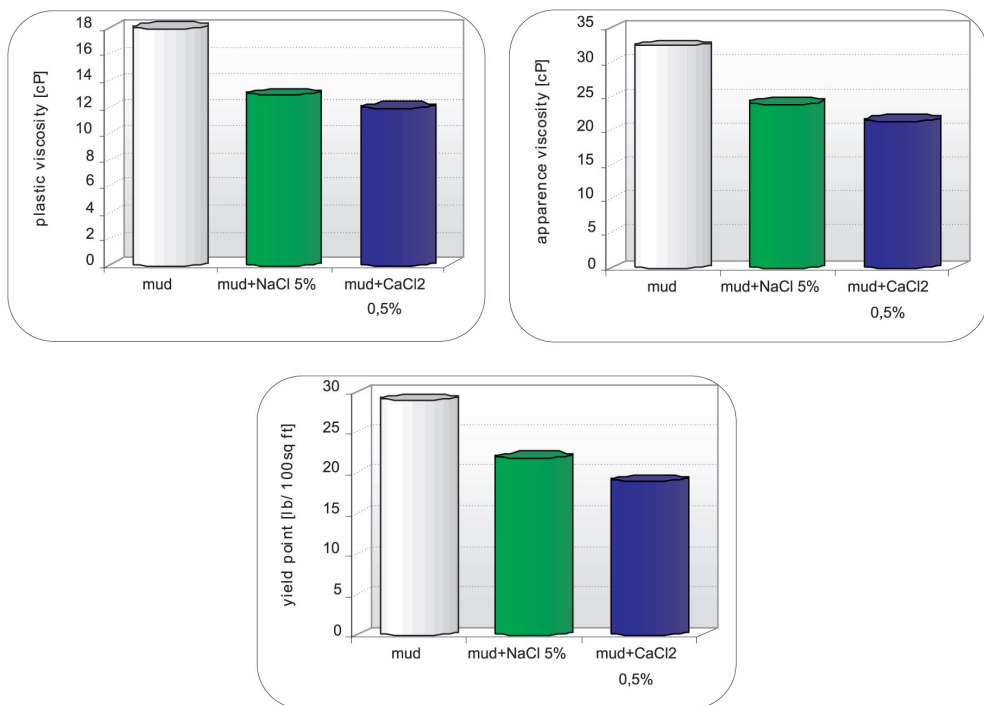


**Fig. 3.** Technological parameters of composed mud vs. concentration of mud

### 3. SALT CONTAMINATION

In order to check the PT-84 resistance to salt contamination tests of rheological parameters of 3% drilling mud with addition of 5% NaCl and 0,5% CaCl<sub>2</sub> have been carried out. The results are shown in the Figure 4.

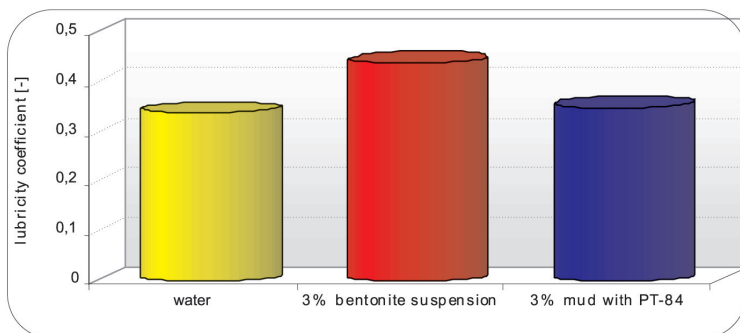
As a result of carried out research it was observed that technological parameters of mud with addition of PT-84 treated with monovalent and bivalent ions are influenced only a little and stay on a satisfying level.



**Fig. 4.** Salt resistance of 3% composed mud with PT-84

#### 4. LUBRICITY

In case of horizontal drilling it is especially important to provide a mud with appropriate lubricity to have the drilling pipes do not give in to excessive consumption and to prevent from pipe stuck. In order to check the bentonite suspensions with addition of PT-84 lubricity a test with usage of Lubricity Tester has been carried out. The obtained results in comparison with drilling mud applied in industry are shown in the Figure 5.



**Rys. 5.** Lubricity coefficient of 3% mud composed with PT-84

As a result of the test it was claimed that lubricity coefficient of composed mud does not exceed the value of 0,35. Moreover – it may be decreased with application of lubricating agents.

## **5. COMPOSITION**

It should be noticed, that the recipe of the tested mud consist of only two compounds: bentonite OCMA and polymer PT-84. It causes a low costs and easy preparation of the mud. It also allows an easy regulation of technological parameters.

## **6. CONCLUSIONS**

Basing on the carried out research it can be claimed that:

- addition of PT-84 for bentonite suspension cause the increase of rheological parameters' values,
- with the increase of concentration of the mud an advantageous increase of yield point value and structural endurance value is observed. Also a decrease of filtration is noticed,
- because of a little amount of components, there is a possibility of easy technological parameter's regulation.

## **REFERENCES**

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- [3] American Petroleum Institute Specification 13B-1 (RP 13B-1, Field Testing Water-Based Drilling Fluids) 3rd Edition; 2003
- [4] Polish Branch Standard BN-90/1785-1, 1990