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Sławomir Wysocki*, Stanisław Dubiel*, Daniel Dyndor, Łukasz Boniecki**, Marta Wysocka*****

CLAY MODIFICATIONS WITH BIOPOLYMER PT 300308 FOR HDD MUDS****

1. INTRODUCTION

Horizontal Directional Drilling is a trenchless method used for installation of pipelines, air-pressured and gravitational ducts as well as cable installation. This drilling method is utilized on terrains with roads, highways, railway tracks, canals, rivers, and highly urbanized areas, where direct pit under the ground is impossible. Trenchless technologies such as HDD have more advantages than the traditional methods. Not only do they shorten time necessary for dig-up, but also the pipelines used during drilling can be placed in any desired position under any territorial barrier. In addition, HDD does not disturb public transportation and most importantly, does not devastate the environment, which makes it the commonly used technology in the construction industry.

Horizontal Directional Drillings are used in three different stages of the process (Fig. 1):

1) pilot drilling,
2) reaming,
3) (pipeline) pullback.

The first phase creates an entry point with dimensions that enable proper positioning of a pipeline. Next, in order to obtain the desired entry point diameters for casing installation, the reamers with proper diameters are used to widen the entry point. Finally, the last stage of the horizontal directional drilling operation pulls the installed pipeline under the ground [2]. It is important to note that every stage of the process requires the use of the proper drilling fluids to optimize drilling procedure. Among many useful qualities of a drilling fluid is its

* Wydział Wiertnictwa, Nafty i Gazu AGH, Kraków
** Student, Wydział Wiertnictwa, Nafty i Gazu AGH, Kraków
*** Polimer Technologies, Kraków
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ability to carry cuttings up to the surface, conduct the hydraulic power to the drill stem, stabilize the drilling area/walls, decrease abrasion for the drill pipes, cool down the drill stem and keep cuttings hung in the air when the circulation of drilling fluid is lost in the entry point [3].

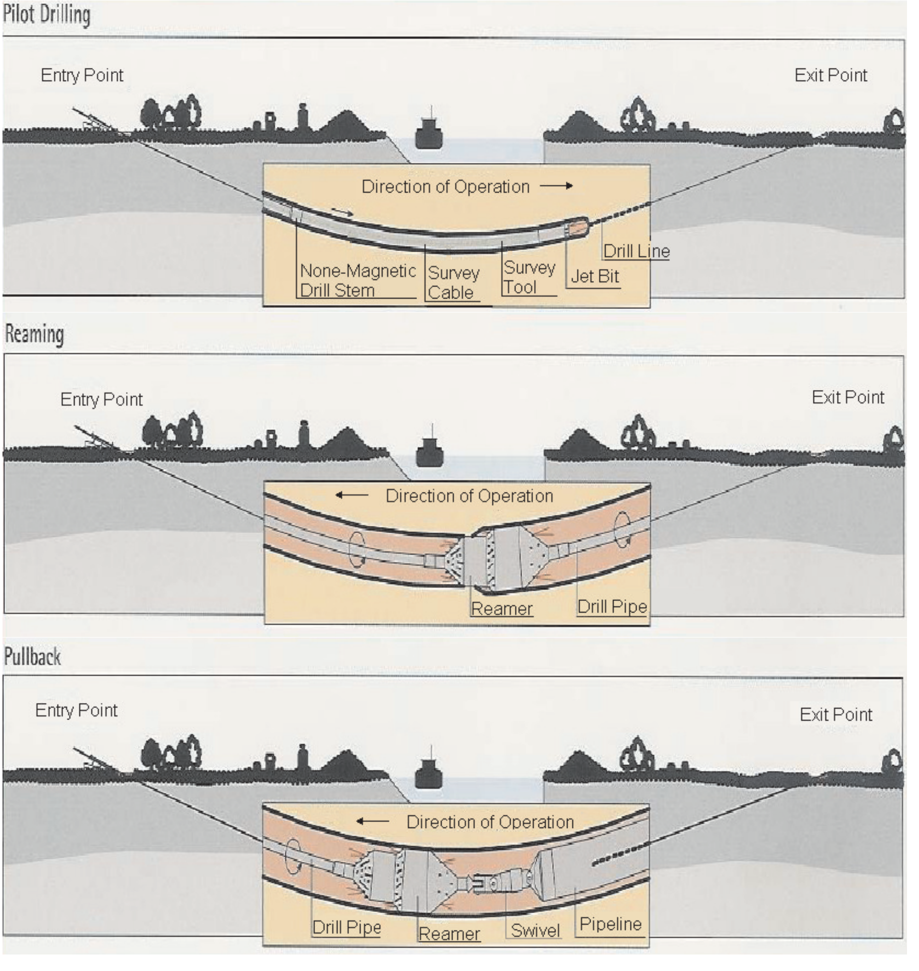

Fig. 1. Stages of HDD technology operations [4]

Drilling fluids that are used for HDD have to possess certain rheological qualities that will facilitate the process. Because of the relatively short distance for cuttings to fall, drilling fluids should have greater floating limit (yield point) and be resistant to structural pressure. Currently used muds are drawn up from bentonite base that is modified with polymers (These modifications are often times made by using the hydrolyzed poliakryloamid). Unfortunately, such prepared muds often require an additional chemical adjustment during drilling, which in turn leads to worsening working conditions and drilling complications.

The increasing demand in drilling technology calls for new solutions and innovations with regard to drilling fluids. Therefore, the Department of Drilling, Oil and Gas at the AGH University of Science and Technology in Krakow, Poland has conducted the research that closely analyses bentonite modification with the use of both synthetic and natural polymers. This study had been carried out to complement the HDD procedure and to look at qualities of new kinds of drilling fluids [1].

This paper presents the laboratory studies that used OCMA bentonite modified with biopolymer PT 300308.

2. EXPERIMENT

The conducted research was to verify the usefulness of biopolymer PT 300308 for bentonite modification validated by the OCMA norms with regard to the HDD technology. PT 300308 is a XC-type polymer modified with sulfonic groups addition. We assumed that drilling fluid should have the following parameters: plastic viscosity of max 15 cp, the relation of floating limit to plastic viscosity as a proportion of YP/PV = 1/1, and the smallest flirtation possible. In addition, we expected the examined drilling fluid to obtain desired technological parameters after 15 minutes of stirring all the components and the parameters to be maintained over time. The research was done on OCMA bentonite to which we added dry biopolymer PT 300308 in proportion 1:10 with respect to bentonite mass and then, we prepared water solution with three different concentrations: 2%, 3% and 4%. After having poured the mixture of bentonite and polymer to water, we stirred the solution for 15 minutes and examined the obtained fluid. The examinations were again carried out after 2 hours of mud sitting in temperature conditioned room. In order to measure the drilling fluid's parameters, we used the Fann viscosity-meter and followed the measurement recommendations from the American Petroleum Institute and OCMA. See Figure 2 for results.

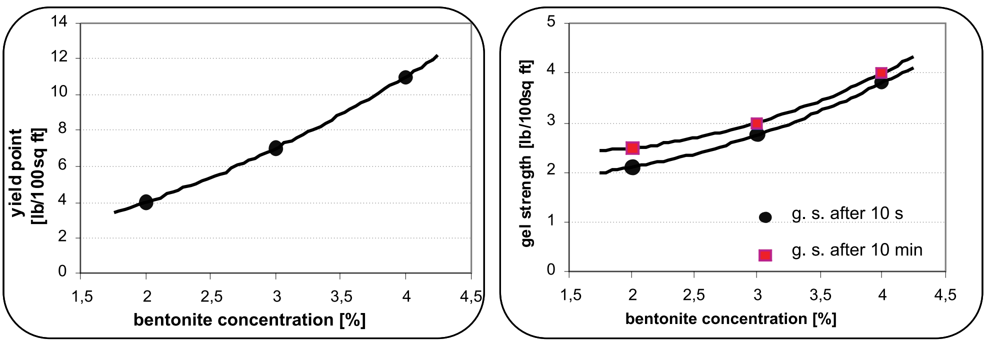

Fig. 2. Correlation between bentonite concentration, and technological parameters after 15 minutes of stirring

The conducted experiment showed that as concentration of bentonite modified with polymers increases, rheological parameters become greater as well. The most advantageous quality of such drilling fluid is the fact that it reaches desired technological parameters after 15 minutes of stirring, which substantially shorten time needed for its preparation.

The rheological parameters of composed fluid were studied again after 2 hours of conditioning it in temperature of 25°C. The results are shown in Figure 3.

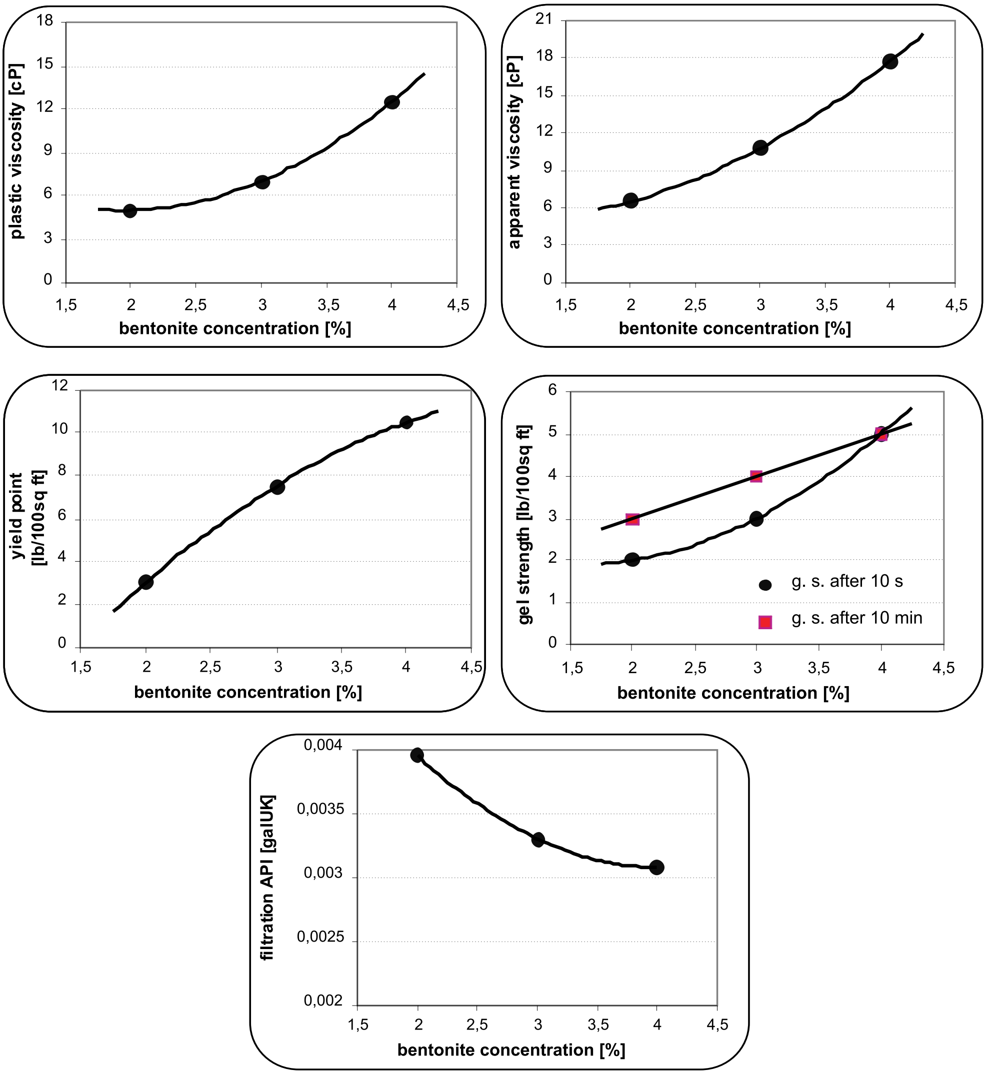

Fig. 3. Correlation between bentonite concentration, and technological parameters after 2 hours of water loss

The examination carried out after 2 hours of mud creation showed that the drilling fluid had desired technological parameters. We also demonstrated that an increase in concentration of betonite modified with biopolymer causes an increase in rheological parameters and a decrease in filtration. Good quality HDD fluids are characterized by the fact that their technological parameters do not change over time or change in an insignificant way. In order to verify stability of technological parameters in composed fluid, we compared obtained results for both measurement points; after 15 minutes and 2 hours. The results can be found in Figures 4 and 5.

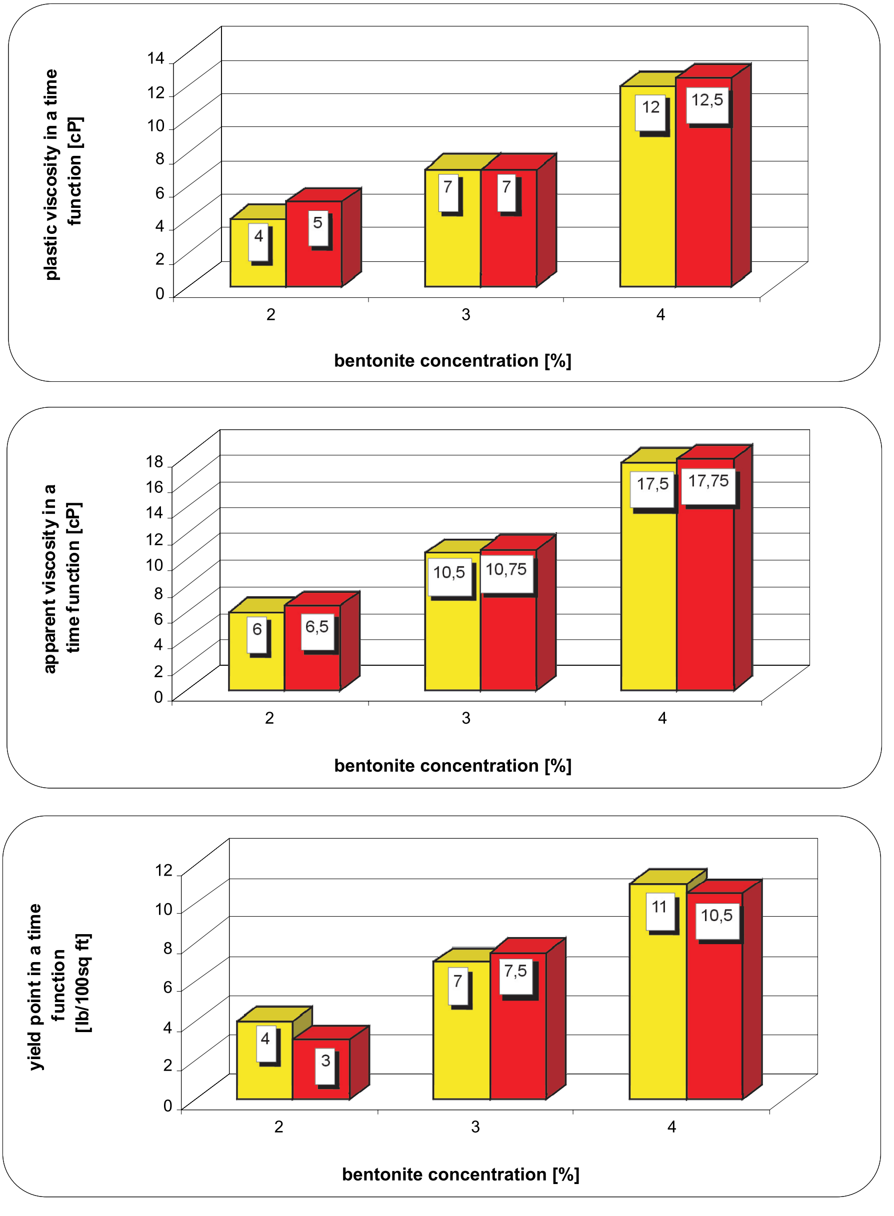

Fig. 4. Examination of technological parameters with respect to bentonite's concentration in time function

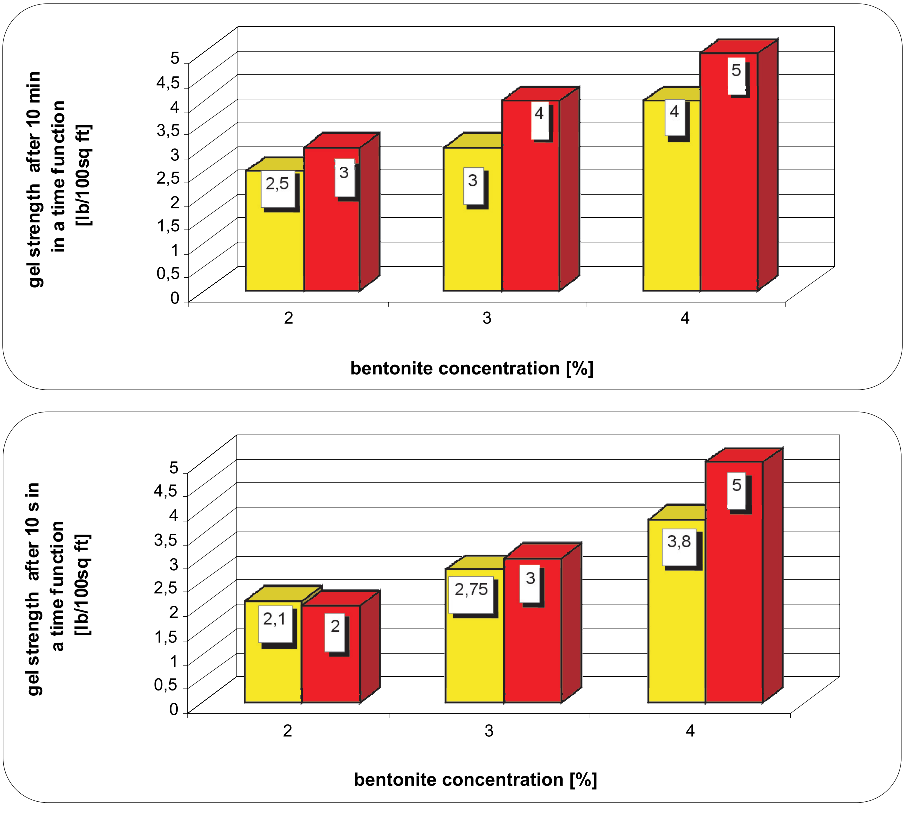

Fig. 5. Examination of gel strength with respect to bentonite's concentration in time function

According to the results in Figures 4 and 5, technological parameters of examined drilling fluid barely altered with time change. The drilling fluid we composed had stable technological parameters, which consequently means better cuttings carrying from the entry point during drilling.

3. CONCLUSION

The conducted study showed that the composed fluid reaches its optimal parameters after 15 minutes of stirring, which plays important role when using HDD technology. The technological parameters of the examined fluid barely changed as time went on, which made us believe that this composed drilling fluid can be used for most industrial HDD. Another important quality is the fact that the examined fluid fulfilled our assumptions with regard to required parameters. It had low plastic viscosity (lower than assumed limit of 15 cP) and the relation of floating limit to plastic viscosity, YP/PV was approximately equal to 1. What is more, thanks to only a few ingredients used for its composition, the drilling fluid was easy to compose and relatively inexpensive. Also, the use of biopolymer made the mud an environmentally-friendly drilling fluid.

Units

1 cP	=	1 mPa s
1 lb/100sq ft	=	0,4788 Pa

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