Also below the results of comparing the algorithm with multiple model runs, it should be noted that the proposed algorithm is comparable in efficiency in terms of accumulated oil (Figure 3), but requires significantly less computational resources and time (Table 2).

Table 2

Recourse comparison

Parameter	MVC	Algorithm
t calculations	7.5 h	20 sec
t preparing	2-5 h	2 min
N calculations	300	1
Memory	68 GB	227 MB
Drillnes	±	+

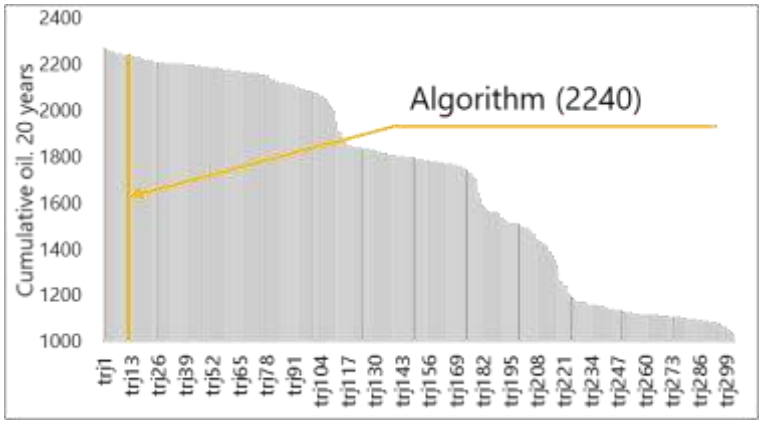

Fig. 3. Cumulative oil

From the analysis of the above results, it can be summed up the method proposed is quiye efficient. The algorithm significantly reduces routine work of an engineer and determines the optimal well trajectory due to mathematical analysis. The algorithm is also more resource-efficient. Further plans for the development of the project include modifications of the approach to be able to determine the trajectory of not only horizontal wells, but also fish bone wells. Also, a large number of tests are needed and improvements to the user interface. Since the algorithm is suitable for operational solutions, it shall be implemented in the process of geo-stirring and geo-watching, as well as in conjunction with multiple model runs to significantly reduce the number of realizations.

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APPLICATION OF AN ECO-FRIENDLY GREEN ADDITIVE FOR DRILLING FLUIDS

Shadfar Davoodi[1], Mohammed Al-Shargabi[1], Minaev K.M[1].
Scientific advisor associate professor Minaev K.M.
National Research Tomsk Polytechnic University, Tomsk, Russia

Several studies have found that the chemical and conventional additives used to reduce fluid loss can have both immediate and long-term negative effects on the surrounding environment, habitats, and ecosystems. Because of these drawbacks, the selection of additives for drilling fluid formulation has grown more challenging from both an environmental and economic standpoint. The preservation of the ecology and ecosystems has taken precedence over hydrocarbon development. As a result, the use of natural, biodegradable, non-toxic, and environmentally friendly green materials has emerged as an acceptable alternative for reducing the negative effects of drilling fluids on onshore and sensitive offshore habitats. The initial application of natural, local, eco-friendly ingredients in drilling fluids was to prevent lost circulation [1,2]. Some examples of lost circulation materials (LCMs) that have been suggested or used in drilling fluids are date tree trunk fibers, coconut coir, rice fractions, and cocoa bean shells. The successful uses of these natural LCMs in the drilling industry have heightened interest in using similar low-cost green waste materials for other reasons, such as managing fluid loss behavior, suppressing shale swelling, and changing fluid rheology. Some research has been conducted on the corrosion prevention efficacy of environmentally friendly green waste for metallic surfaces in tough acidic and saline conditions [3]. The impacts of dried saffron purple petals (SPP) powder on the rheological, and fluid loss characteristics of bentonite-based drilling fluids were investigated in this paper. The SPP powder are shown in Fig 1 [3].

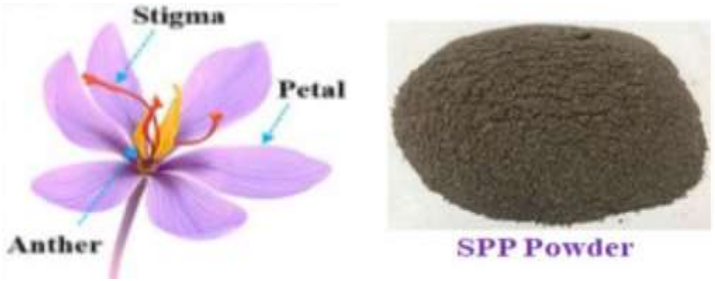

Fig. 1. SPP powder.

Fresh SPPs were collected in Iran's Khorasan Razavi region. 50 g of SPPs were rinsed with freshwater, dried, and milled to make the SPP powder. Mojallali Co. provided NaCl (98%) and acetone (96%) for this study (Iran). Analytical bentonite was purchased from (KTA Co., Tehran, Iran). For all electrochemical studies, mild steel (ST12, Foolad Mobarake Co., Iran) plates with dimensions of 10 cm 5 cm 0.2 cm were employed as working electrodes. Table 1 shows the formulation of fluid samples.

Table

Fluid samples formulation

Content	Fluid sample			
	Base fluid	1 wt % SPP	2 wt % SPP	3 wt % SPP
Freshwater (cc)	500	500	500	500
Soda ash	0.03	0.03	0.03	0.03
Caustic soda	0.05	0.05	0.05	0.05
NaCl (wt %)	3.5	3.5	3.5	3.5
Bentonite (wt %)	10	10	10	10
SPP powder (wt %)	-	1	2	3

In this study, dried saffron purple petals powder (SPP) was used as an ecofriendly green addition in a bentonite-based drilling fluid (EDX-mapping images of the SPP powder is shown in Fig.2), and the impacts of SPP on the rheological characteristics, and filtration behavior of drilling fluids were studied. Rotary viscometry and RMS findings revealed a significant improvement in the rheological characteristics of the SPP-filled muds, with the consistency index and yield stress increasing by 94.4 percent and 233.4 percent, respectively, in the presence of 3 wt percent SPP powder. Therefore, the rheological properties of mud samples containing the SPP powder should be different from base mud. The shear viscosity and shear stress curves for the prepared mud samples as a function of shear rate are shown in Fig. 6. The obtained results from the RMS test indicate a pseudo-plastic behavior for all the mud samples. Of note, increasing the SPP content enhances the shear viscosity, which in turn, increases shear stress. As a result of the excellent rheological and filtration performance of drilling fluids containing SPP powder, SPP was introduced as a powerful viscosifier agent for drilling fluid applications. Filtration behavior of drilling fluids in the presence of SPP powder revealed a significant decrease, with the integration of 1–3 wt percent SPP powder resulting in a 23–45 percent reduction in filtrate volume when compared to the base mud (see Fig. 3, 4 and 5). The SPP powder demonstrated its efficacy as an eco-friendly rheological modifier and fluid loss controller in rotary viscometry, RMS, and filtering tests. To observe whether the presence of the SPP powder could affect the microstructure of the mud cakes, the morphology of the mud cakes de- posited from the base mud and the mud with the content of 3 wt% SPP powder was investigated using FE-SEM analysis.

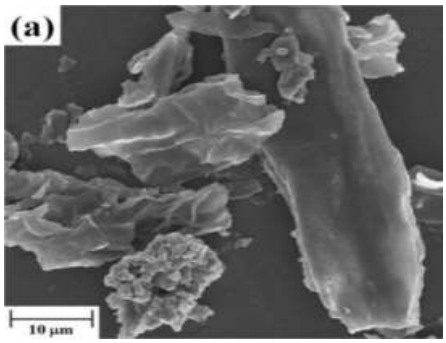

Fig. 2. EDX-mapping images of SP

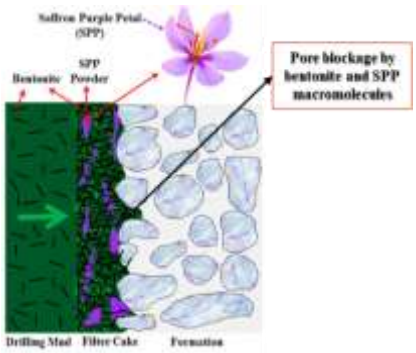

Fig. 3. The creation of a mud cake in the presence of SPP powder is depicted schematically.

The shapeless particles of the SPP powder have a micro-sized dimension with a broad particle size dispersion, as shown in Fig. 2a. The primary elements in the chemical structure of SPP, according to the EDX and elemental mapping studies, are O (35.5 wt percent) and C. (60.8 wt percent).

The elemental mapping of inorganic and organic components for the foundation mud and mud cake with 3 wt percent SPP powder is shown in Fig. 3. The basic mud comprises Mg, O, Si, and Al elements derived from the crystalline clay minerals' smectite groups, as seen in Fig. 3a.

The elemental mapping and FE-SEM findings verified the presence of SPP fiber structures in the filtrate cake, establishing a physical network structure and filling cake cavities, fissures, and irregularities in the mud filtrate cake.

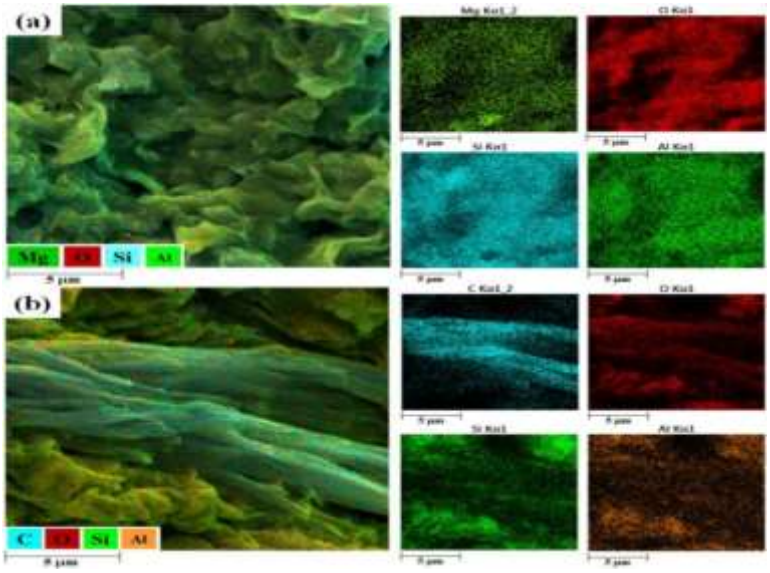

Fig. 4. Elemental mapping photos for the basic mud (a) and the mud with 3 wt% SPP powder, as well as the filtrate cakes (b).

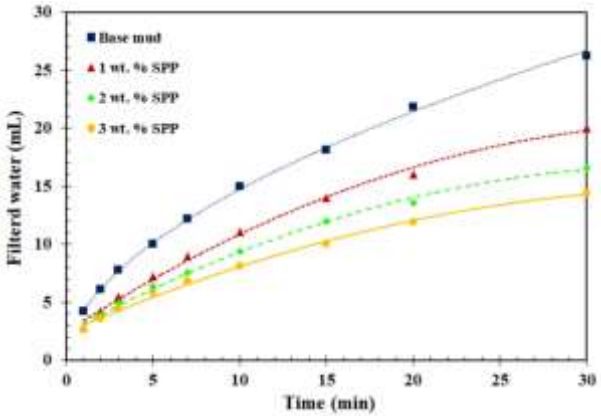

Fig. 5. Filtration results for prepared base mud and muds containing 1, 2, and 3 wt% SPP powder

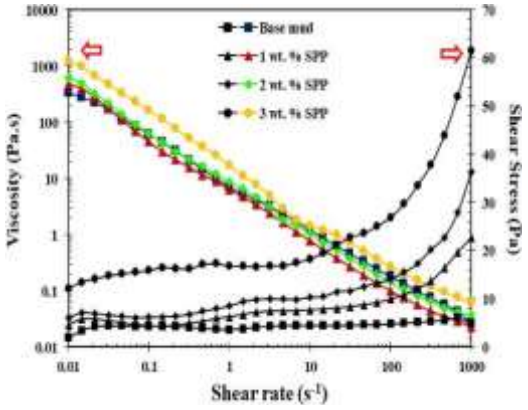

Fig. 6. Shear viscosity (colored) and shear stress (black) curves for the prepared mud samples containing 1, 2, and 3 wt % SPP powder as a function of shear rate.

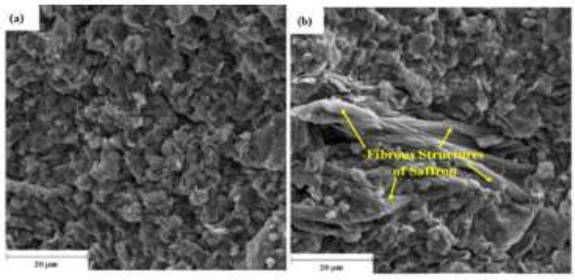

Fig. 7. FE-SEM micrograpf of dried mud cakes (3 wt% of SPP)

Looking more closely at Fig. 7a and b, it can be seen the deposited fibrous SPP acted as a plaster covering the cake voids, leading to a de- crease in the permeability of mud cake, and subsequently, the dramatic improvement in the filtration behavior.

The presence of 3wt % of the SSP in the fluid significantly improved the fluid's yield stress and consistency index by 223.3% and 94.4%, respectively compared to those of the base mud. The filtration performance and cake formation results confirmed a 45% enhancement in the permeation barrier behavior of the fluid containing 3wt % SPP powder. Furthermore, having SPP as an organic green additive would leave no damaging effects on the surrounding environment and ecosystem.

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INVESTIGATION OF THE STRESS-STRAIN STATE OF THE PROCESS PIPING OF THE COMPRESSOR STATION UNDER THE DYNAMIC LOADS

Schreder A.S.

Scientific advisors associate professor Rudachenko A.V., associate professor Bolsunovskaya L.M.

National Research Tomsk Polytechnic University, Tomsk, Russia

During the operation of the compressor station on the technological piping of the gas compressor unit (hereinafter GCU), in addition to the static load from the pressure of the transported gas, there is a dynamic vibration load transmitted from the gas compressor unit [1].

In this work, the pipeline fittings of the gas compressor unit, modeled in the software, were analyzed for static and dynamic loads. The mean square value of the vibration velocity and changes in the elevations of the pipeline over time at characteristic points were also experimentally determined. Also, a dynamic analysis of pipeline fittings was carried out when setting the operating pressure in the frequency range from 0 to 2000 Hz, as a result of which the most dangerous point of the GPA pipeline fittings and ways to reduce this load were determined, taking into account damping properties.

During the operation of the gas compressor unit, dynamic loads occur, presented in the form of vibration, which reduces the reliability of pipeline valves. These loads can be expressed in terms of RMS vibration velocity at characteristic points of the GPU. Figure 1 shows the points on the supports where the root mean square velocity was measured.

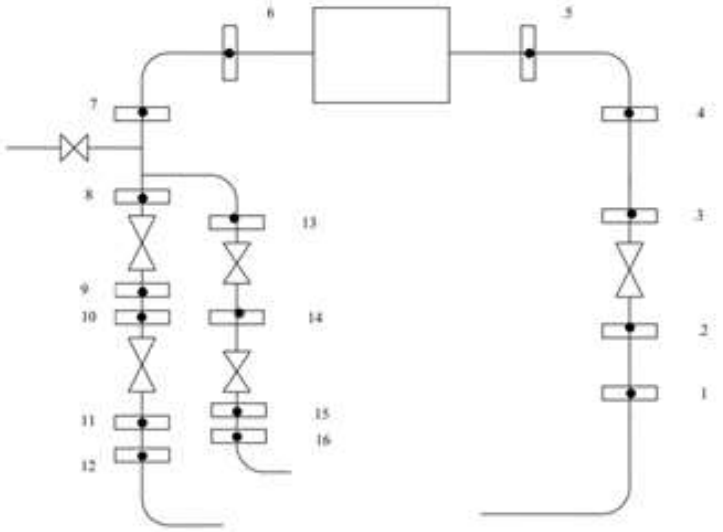

Fig. 1. Scheme of point location for measuring vibration of piping supports

Based on the results obtained empirically, a graph of the RMS vibration velocity at characteristic points was built.