

The Extraction Process of Diesel from the Drill Cuttings Samples by Using a Mixture of Toluene –GPR and Petroleum Ether-AR Solvents

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Abstract The capability to remove diesel and synthetic diesel from the drill cuttings before disposal can significantly reduce the long-term environmental effects of disposal. Drilling technology has up dated to reach the environmental regulations and thus the drill cuttings extracted becomes less harmful to the environment. This paper summarizes research efforts into development of a technique that uses a mixture of Toluene –GPR and Petroleum Ether-AR solvents to extract fuels from drill cuttings at 600 rpm for stirring and constant temperature of 40°C. The laboratory data indicates that a high quality fuel extracted from the drill cuttings has no adverse effects on the environmental. In addition, ASTM distillations of Rashid and Ampatico samples show that the recoveries are 98% and 97% by volume respectively. Moreover, the oil content in the final drill cuttings extracted is no more than 0.3 % by volume and the high quality fuel product can be used again.

Keywords Synthetic diesel; drill cuttings; oil-based muds

Introduction

The environment impact of oil and gas well drilling is a major issue facing today's petroleum industry. Therefore, one of the most difficult environmental problems to resolve at the well site is the disposal of waste mud and cuttings because they are often physically unstable and unsuitable for landfill [1,2].

When oil –based mud is used, the drilled formation solids (cuttings) are regarded as controlled hazardous-waste. As such, they can be disposed of in the three ways: decontamination treatment followed by discharge into the sea, injection of the cuttings into the well, or transfer to a controlled hazardous-waste landfill [3]. The lowest environmental effect for solids disposal, especially for offshore operation, is decontamination treatment followed by discharge. However, conventional decontamination technology exhibits limited efficiency in extracting oil from the cuttings. In the industry these cuttings have been treated as a waste product [4]. Drilling technology has adapted to current environmental regulations, and new oil-based drilling fluids have become considerably less harmful to the environment. According to the requirements of the Egyptian environmental law No. (4) of 1944, these studies characterize the nature and sensitivities of the environments and consider the impact of the various development [5]. In addition, a balance between the needs of economy and the needs of environment has been considered. Finally, this means that the cuttings must be collected from the operation area and transported to onshore cuttings cleaning site where they can be treated.

Invert Emulsion Mud

The invert emulsion mud is known as non-aqueous fluids (NAF) or oil- based muds (OBM). These fluids are usually preferred over aqueous (water-based) drilling fluids because they improve drilling performance,



particularly with regard to drilling rate, hole stability, thermal stability and lubricity. Recent advances in water-based fluids have gone a long way to close this performance gap, but in many cases, invert emulsion fluids are still the preferred option [5-6]. The disposal of drilled cuttings associated with invert emulsion fluid can represent a potential environmental concern, especially in offshore operations where drilled cuttings have been traditionally disposed of into the sea. Other factors, including the tightening of environmental regulations, shipment of cuttings to shore, and generation of invert emulsion fluid cuttings in land operations can also add to environmental concerns regarding the disposal of cuttings on land [7-8].

The first invert emulsion fluids were created with diesel oils, primarily because of the low cost and widespread availability of diesel. In many parts of the world, diesel fluids are still successfully used. However, in the early 1980s, many operators became concerned about the occupational health risks associated with diesel-based fluids and consequently requested fluids based on oils with a lower aromatic content and flash point. As a result, mineral oils became a common invert emulsion base fluid, even though a higher degree of refining made them more expensive than diesel [9-10]. In many areas, operators have changed to mineral oils, especially for land-based and zero-discharge offshore activities.

Separation Methods

It is the advanced method, where the contaminated cuttings are heated in a heating flask at a constant temperature 40 °C with 600 rpm of the mixer as shown in Figure 1. Moreover, the solvent extraction process contains the volume percent in mixing of Toluene-GPR with a boiling point about 100 °C and Petroleum ether-AR with a boiling range 60-80 °C as shown in Figure 1. Continuously, this mixture is separated in the filtration process by using a pressed filter sheet to produce the solids and diesel/solvent mixture at a room temperature. Finally, the distillation process is used to separate all fraction cuts of diesel and all the solvent recovery as shown in Figure 2 [11]. In focusing, the remaining solids contain no more than 0.3 % by volume of diesel/oil contents. In addition, the extracted diesel has a high quality for reusing again. The full block diagram of the separation processes is shown in Figure 3.

Results and Discussions

As shown in Table 1, the distillation of Rashid sample has an initial boiling point 140 °C and final boiling point 249 °C with a high quality fuel of gasoline and kerosene that has 100 RON and 95.9 MON. Moreover, the recovery of distillation is 98% and thus the squeezed cuttings has 2% by volume of contaminated fuel. In addition, the cuttings can be used safely without any adverse effects on the environment.



Figure 1: Photographs of a stirring system, solvents and contaminated cuttings



Figure 2: Photographs of ASTM distillation unit with receiving products

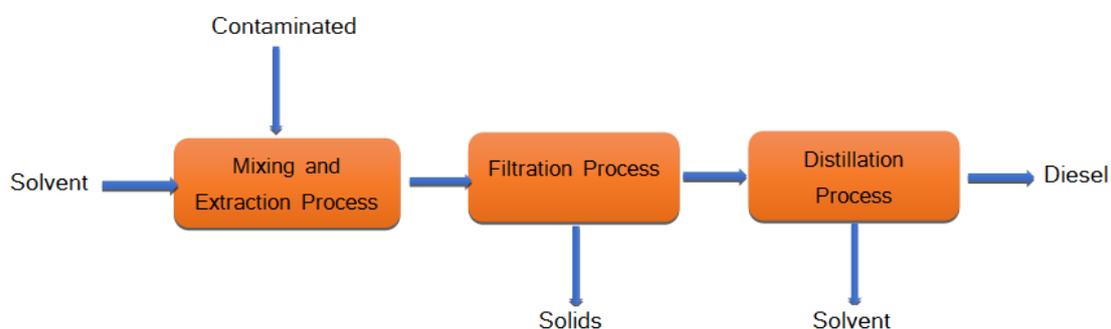


Figure 3: The block diagram of the separation processes

On the other hand, the distillation of Ampatico sample has an initial boiling point 111 °C and final boiling point 338.2 °C with a high quality fuel of gasoline, kerosene and diesel that has 101 RON and 97.2 MON as shown in Figure 4. In addition, the recovery of distillation is 97% and thus the squeezed cuttings has 3% by volume of contaminated fuel. Finally, the cuttings can be used safely again without any side effects on the health.

Table 1: ASTM distillation of extracted high quality diesel samples from Rashid and Ampatico.

Volume %	Distillation of Rashid Sample (°C) ASTM D86-04b	Distillation of Ampatico Sample (°C) ASTM D86-04b
0	140	111
10	148	185.1
30	150	199
40	156	215
50	207	221.5
60	217	227.5
70	221	289.5
80	229	313.3
90	241	330.5
97	-----	338.2
98	249	-----
Research Octane Number (RON)	100 (Gasoline +Kerosene) (High Quality)	101 (Gasoline +Kerosene +Diesel) (High Quality)
Motor Octane Number (MON)	95.9 (Gasoline +Kerosene)	97.2 (Gasoline +Kerosene+ Diesel)



Figure 4: Photographs of the extracted high quality diesel fractions

Conclusions

- a. The results show that the solvent works for recovery of the high quality and quantity fuel from drill cuttings and the analyses represent no significant changes in fuel structure after the extraction process.
- b. ASTM distillation of Rashid sample shows that the recovery is 98% by volume with RON of 100 and MON of 95.9.
- c. ASTM distillation of Ampatico sample shows that the recovery is 97% by volume with RON of 101 and MON of 97.2.
- d. The investigation demonstrates that the drill cuttings extracted can be successfully disposed of using land treatment without adverse environmental effects.
- e. The oil/diesel contents in the final drill cuttings extracted do not exceed 0.3 % by volume and the fuel product is recycled for reuse with the high quality and quantity fuel.
- f. The separation methods are easier, faster, cleaner and more effective without adverse effects on the environment.

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