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Novel Assessment of Drill Cuttings in Ionic Liquid

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Abstract
The drill cuttings management process has consistently been reviewed to identify safer treatment methods that reduce environmental impact while improving recovery of residual chemicals to enable the reuse of the oil-free cuttings. Recycling and disposal are key waste management options that are of concern to the oil and gas industry. As significant quantities of drill cuttings are produced during drilling operations, there is an increased need for drill cuttings management solutions. This study investigates the novel use of ionic liquids to separate drilling fluid from cuttings. The findings from the laboratory research showed that the drilling fluid on the cuttings can be separated from the cuttings with the recovery of the extraction solvent for reuse in the recovery process. This approach emphasises the potential of ionic liquids in an integrated waste management approach to enhance material recovery.

Keywords: Drill cuttings, Ionic liquid, oil and gas, sustainable development, waste management.

Introduction
Drilling fluids are used during oil and gas well drilling to lubricate and cool the drill bits and aid the transportation of the drill cuttings, which are rock

debris, to the surface for treatment and
disposal. (Bendi et al., 2024). Drilling
fluid increases the high performance and success in drilling complex wells and is essential in well construction (Deville, 2022). Though oil and gas play a key role in the global economy, the hazardous wastes generated during the exploration and production process such as drilling fluids and cuttings are complex to manage due to aromatic compounds (Kazamias & Zarpas, 2021). Wastes from oil and gas drilling operations contain physical and chemical components that can be hazardous to the environment (Onwukwe & Nwakaudu, 2012). The toxicity of the substances in the drill cuttings can impair the health of animals and biotic communities and increase the risks of pollution of air, water bodies, and humans (Ahammad et al., 2017). Following the increase in environmental pollution worldwide, the sustainable livelihood approach has become paramount in identifying the factors affecting communities' socioeconomic aspects. Thus, sound scientific analysis is needed to address those aspects that may be negatively impacted (Briggs et al., 2015).

DRILLING WASTE VOLUME

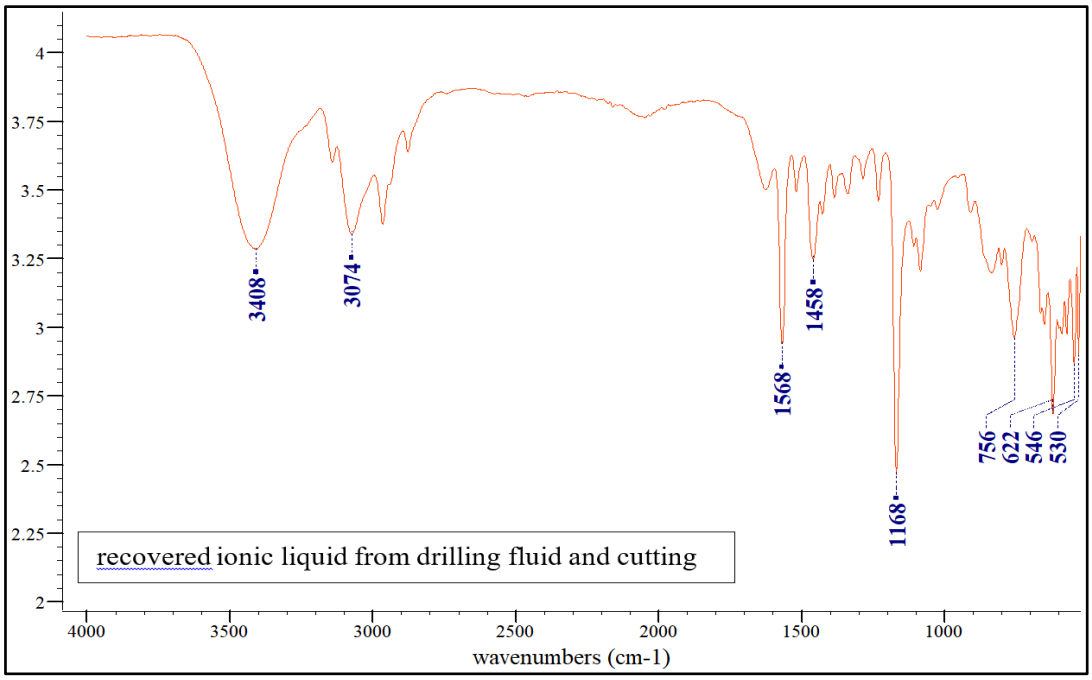
A significant problem facing the oil and gas industry is waste management. With technological advances, waste management concepts provide a proactive treatment of large volumes of waste through the life cycle of oil and gas wells (Onwukwe & Nwakaudu, 2012). Drilling fluid is critical to drilling operations to remove cuttings continuously (Paulauskiene, 2018). The drill cutting volume depends on the type of base fluid used and the size or depth of the well. Further, with the increasing demand for cleaner technologies, drilling waste estimation and management considerations have increased (Dabo, 2023).

MATERIALS AND METHODS

0.2g of treated drill cuttings and 0.1g of synthetic oil-based fluid were mixed thoroughly in 2g of 1-propyl-3-methylimidazolium bromide (propylMIMBr ionic liquid) in a test tube. During the experiment, the mixture was observed to separate into a three-phase mixture: the top layer of oil, the ionic liquid layer, and the solid cutting bottom layer. The top layer was separated through decanting, while filtration was used to separate the ionic liquid from the drill cuttings. The drill cuttings were washed with water to remove the traces of ionic liquid. The recovered oil and the ionic liquid were characterised using Fourier-transform infrared (FTIR).

RESULT

The results showed that synthetic drilling oil can be recovered from drill cuttings with only residual traces of oil on them. The recovered ionic liquid from the drilling fluid, cuttings, and ionic liquid simulated mix in **Figure 1** showed minimal changes in the recovered ionic liquid. Meanwhile, the recovered drill cuttings from the drilling fluid, cuttings, and ionic liquid mixture in **Figure 2** showed that the propylMIMBr ionic liquid could extract a significant amount of oil from the cuttings.



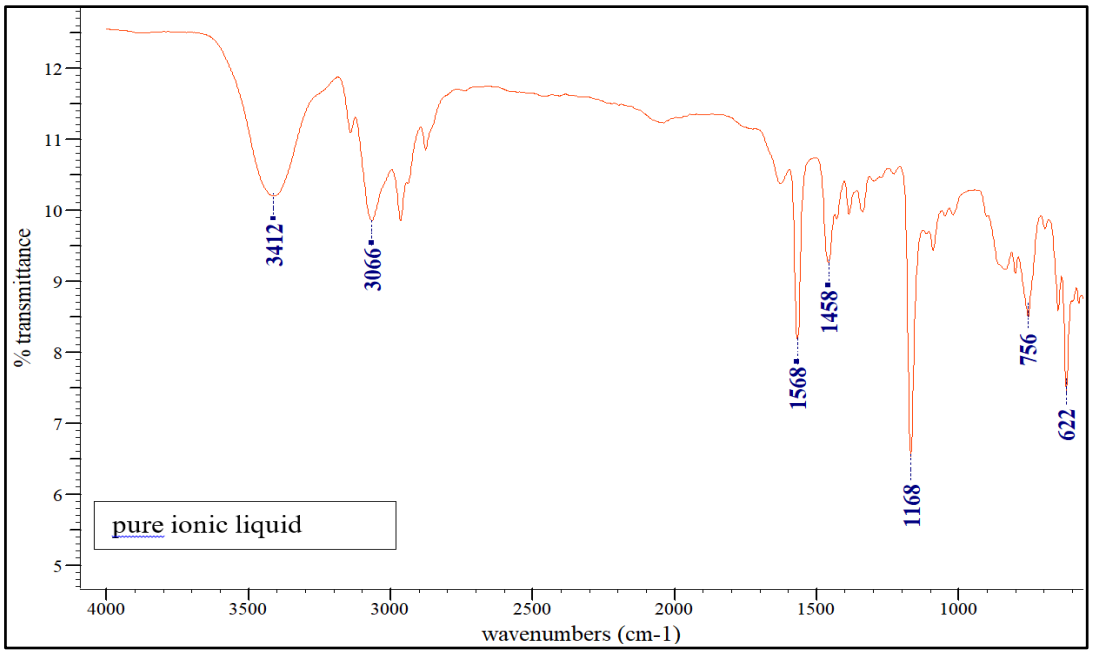
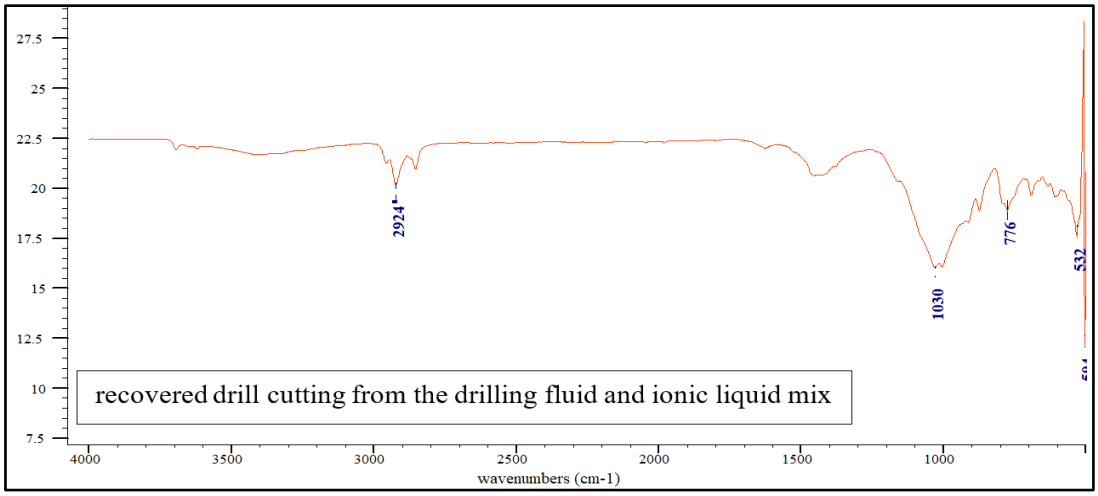


Figure 1: Recovered ionic liquid from drilling fluid, cuttings and ionic liquid simulated mix



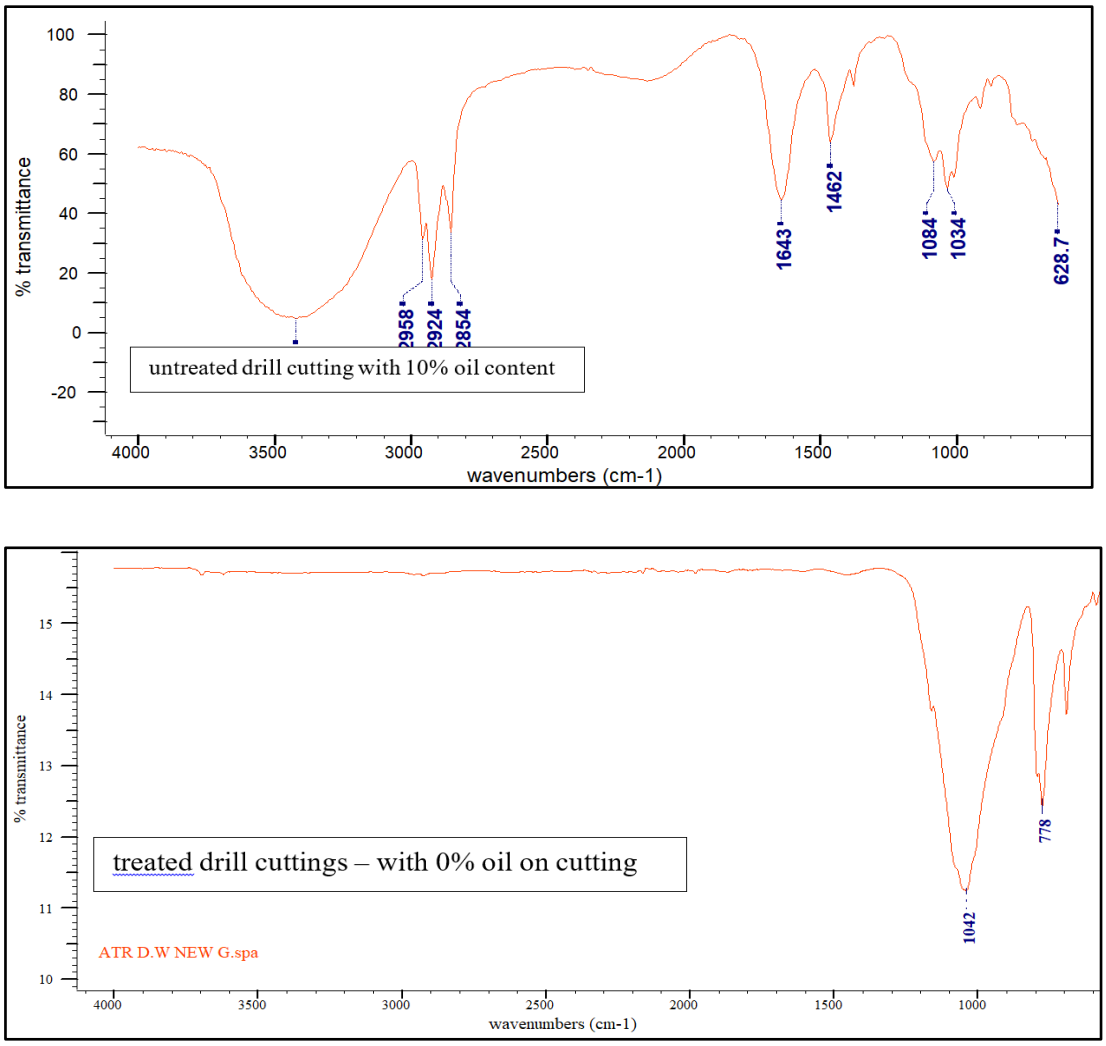


Figure 2: Recovered drill cuttings from drilling fluid, cuttings, and ionic liquid simulated mix

DISCUSSION

It is paramount that waste minimisation processes reduce the impact of the volume of drilling wastes generated. This also depends on the amounts of drilling waste generated so that the required treatment technology can be adapted to minimise disposal options (Dabo, 2023). It is known that the treatment of drill cuttings constitutes a significant expense in drilling waste management. Thus, other improved options that can enable the removal of the oils on the cuttings, which also meet the regulatory requirements, are considerations that will allow the reuse of waste materials from drilling (Davarpanah, 2018 & Sayyadnejad et al., 2008).

Oil and gas operators are open to novel technologies that can help them achieve their material recovery goals and minimise the volume of waste despite other

proven technologies in use (Gaurina-Medimurec et al., 2020). Globally, drilling waste management companies have advanced their treatment efforts in adaptive alternative technologies and reagents to isolate the contaminants in the drill cuttings to solidify the inert material for recycling (Ilinykh et al., 2022). Hence, the use of ionic liquid in isolating the residual drilling fluid from the drill cuttings is an approach that can be explored to help waste managers decide if this is a viable option with the most economical and environmental benefits (Veil et al., 2003).

CONCLUSION

The generation of waste from the drilling waste management process has led to improvements in methodologies for sustainable management of wastes from drilling operations, focusing on reducing localised impacts. As legislative drivers continue to enforce resource recovery and best practices, the chemistry of the drilling fluid and cuttings has attracted the attention of scientists investigating value recovery methods to explore conditions to maximise reuse.

RECOMMENDATION

The management of drill cuttings is of particular interest to the petroleum industry. Crucial to sustainable development goals is recycling of waste to meet other reuse purposes. Hence it is recommended that a range of other ionic liquids especially in the imidazolium group be investigated to determine the most effective in recovering oil on drill cuttings.

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