Qualitative Analysis of Selected Hydrocarbon Produced in Kansas Using FTIR: An Oil-Oil Correlation Study

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Abstract

Hydrocarbons have been produced in Kansas since the 1860s, however, the properties and characteristics of the produced oil are still poorly understood.

An oil-oil correlation analysis has been conducted on twelve hydrocarbon samples from three subbasins and from five producing intervals within the State of Kansas. Fourier Transform Infrared Radiation (FTIR) was used to characterize the organic functional groups present within the samples and Thin Layer Chromatography (TLC) was used to assess the hydrocarbon fractions in the samples. The FTIR spectrum of all the samples exhibit similar peaks implying similar functionally groups were present in all the samples. The TLC analysis showed all the samples were composed of two fractions with a mean retention factor of 0.82 ± 0.02 for the aliphatic fractions. This is interpreted to illustrate similarity in the aliphatic fractions found in all the samples.

Introduction

Hydrocarbon is being produced in more than 90% of the counties in Kansas (Fig. 1; KGS 2023). Hydrocarbon constitutes a broad class of organic compounds composed of carbon and hydrogen atoms. This study aims to employ FTIR techniques to evaluate the composition and attributes of hydrocarbons produced from different intervals and subbasins in Kansas.

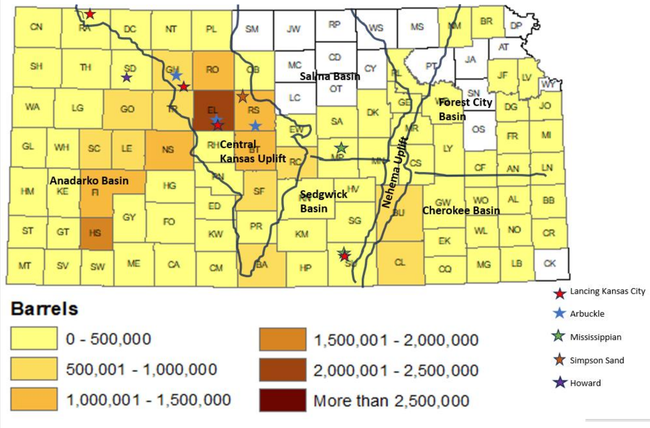
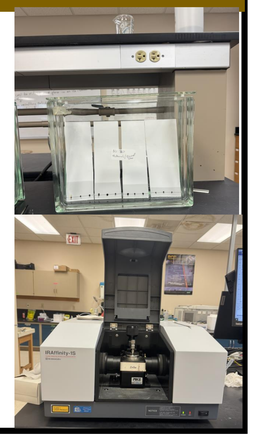


Figure 1: Oil production map of Kansas for 2022 showing locations of samples and subbasins (Modified from KGS, 2023)

Methods

- **Thin Layer Chromatography (TLC)**
  - A drop of oil sample was added to the TLC plate.
  - Solvent Prepared
    - 20 ml azeotropic mixtures
      - 80 % Methanol & 20 % Petroleum Ether
  - Hydrocarbon components separation
    - Spotted TLC plate placed in TLC Chamber and covered.
      - Components separated based on elution on TLC plate
        - Constituents identified under UV light
- **Fourier Transform Infrared Spectroscopy Analysis**
  - 1 mm of oil samples placed in instrument
  - 40 scans per samples at a frequency range of 400-4000cm^{-1}
  - Samples transmittance measured.



Results and Discussion

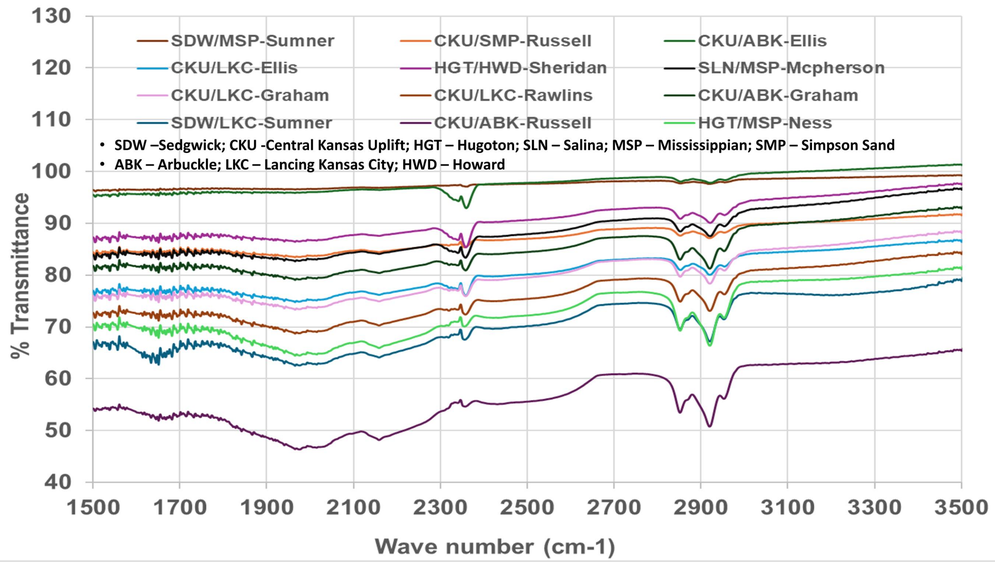


Figure 2: FTIR spectrum of analyzed hydrocarbon samples illustrating similarities in peaks representing functional groups present within the samples

Samples showed very strong similarities in their peak patterns with the exception of CKU/ABK-Russell sample. This could be due to variation in its composition resulting in low transmittance. Predominant peaks within frequency range 2850-2970 cm^{-1} are alkanes (Skoog et al., 2017).

Results and Discussion

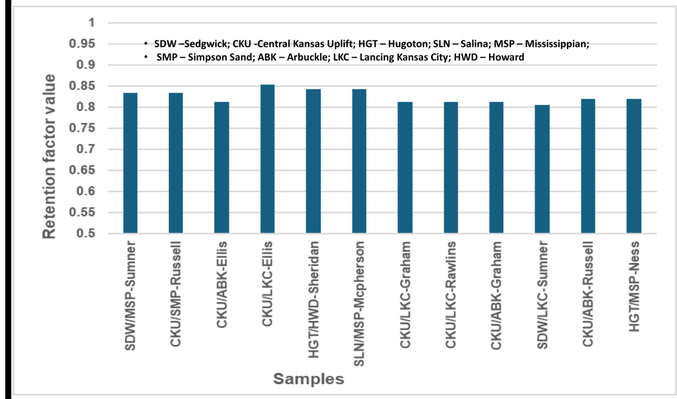


Figure 3: Plot of the retention factors of samples

The retention factor (R_f)for the aliphatic fraction of all samples ranges from 0.80-0.85 with a mean of 0.82 and a standard deviation of 0.02. The low standard deviation implies similarities in the aliphatic fractions found within the samples even though they are from different producing intervals and subbasins.

Conclusions

- The FTIR spectrum of the samples showed similar peak patterns, which may suggest similarities among the hydrocarbon samples.
- The mean retention factor of the aliphatic fractions was determined to be 0.82 with a standard deviation of 0.02 demonstrating low variation in the properties of the samples.

References & Acknowledgments

- Kansas Geological Survey, 2023. County Oil Production Map. https://www.kgs.ku.edu/PRS/petro/interactive.html
- Skoog, D.A., Holler, F.J., Crouch, S.R. (2007). Principle of Instrumental Analysis, sixth edition, pp 455-480.
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