Neutron backscattering technique as alternative method for quality assurance and standardization of petroleum products

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Introduction

- Petroleum is defined as a naturally occurring mixture of hydrocarbons, usually in a liquid state, which may also include compounds of sulfur, nitrogen, oxygen, metals, and other elements (ASTM, 2005).
- Its elemental composition, has relatively constant carbon content.

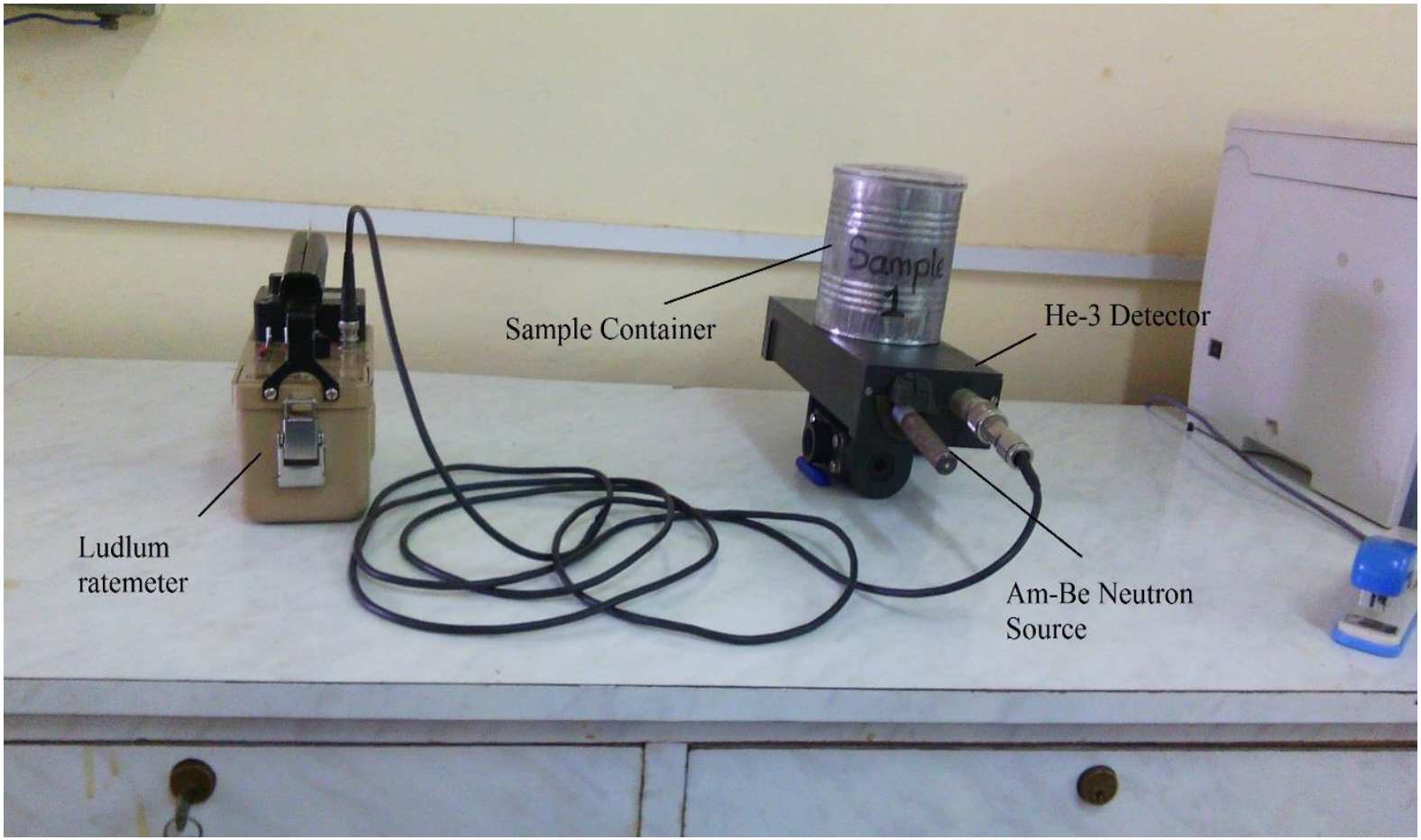
Introduction.

- Hence its variation is due to hydrogen and other heteroatom content.
- Petroleum with high hydrogen content usually has low sulfur content.
- Therefore, the percentage of hydrogen content can be used to determine the crude brand

INTRODUCTION.

- Presently there no generalized method for determining quality and standard of petroleum products in Tema Oil refinery in Ghana.
- They still employ the chemical method which is destructive, product specific, requires more than one method and demand high temperatures (Quality control Department, TOR)
- Therefore an alternative method, which is fast, non-destructive, does not require heating and is more general comes in handy.

METHODOLOGY



Results and Discussion

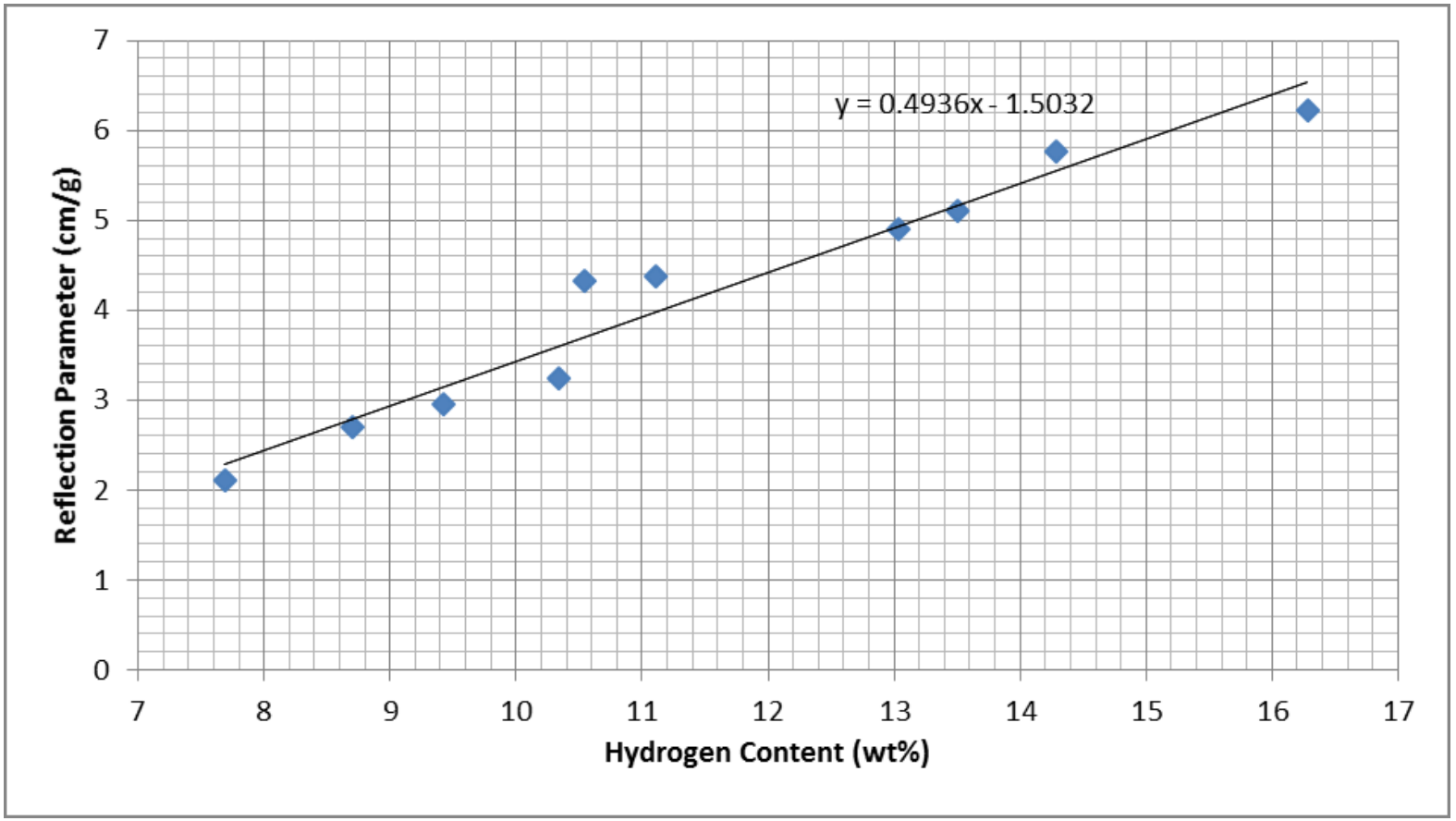
- For a given geometry, calibration line for the determination of hydrogen content can be obtained according to [Akaho, et. al., 2001; Jonah, et. al., 1997], from the equation

$$\mu_0 = \mu_g + m_g H(wt\%) \qquad 1$$

Methodology

- Petroleum products were taken from Tema Oil Refinery
- Jubilee field crude oil from Ghana
- Forcados and Bonny light crude oil from Nigeria.
- The background intensity (I_0) was obtained after the container was cleaned with highly volatile Naphtha. The sample intensity (I) was then determined for count time of 10s.

Results and Discussion.



Results and Discussion.

μ_g is also obtained from

$$\mu_g = \frac{1}{\rho}\frac{I - I_0}{I_0}\left(cm^3/g\right) \qquad 2$$

Where

$(I-I_0)/I_0$ is relative excess neutron count

I_0 is thermal neutron count of empty container

I is thermal neutron count of the container with sample

ρ (cm^3/g) is physical density of the petroleum product

Results and Discussion.

Sample	ρ (g/cm^3)	H(wt%)$_h$	H(wt%)$_v$
Light Naptha	0.725	14.94	15.07
Heavy Naptha	0.770	13.39	14.08
Aviation Turbine	0.823	13.42	13.57
Kerosene	0.825	13.46	13.65
Gasoline	0.867	13.16	13.18
Residual fuel Oil	0.925	11.31	11.17
Forcados Crude Oil	0.877	12.89	12.74
Jubilee Crude Oil	0.861	13.39	13.27
Bonny light Crude Oil	0.857	13.48	13.34

Results and Discussion.

- The trend of the results confirm that the total hydrogen content is not dependent on geometrical arrangement

- It was also noticed that, the trend of results are comparable to values obtained with those reported in literature using different methodologies such as the API gravity.

Results and Discussion.

- For the Crude oil samples, the hydrogen content was high in Nigeria bonny light crude oil and Ghana Jubilee crude oil samples whiles a low percentage was recorded in Forcados crude oil sample.

- This confirms the API classification of bonny light and Jubilee crude oils as 'Light / Sweet Crude Oil' and therefore can be recommended as of high economic value and best crude oil for refining.

Conclusion

- Based on the results of this investigation, it was generally observed that, an increase in the thermal neutron counts indicates high hydrogen count or concentration in a given sample
- This method goes to confirm that, products with high hydrogen contents have less densities and more volatile (combustive), therefore, this method can be used to check adulteration of petroleum products in the Ghanaian market.

THANK YOU FOR YOUR ATTENTION