I have highlighted my new comments in light blue.

1. It is still unclear to me how the results presented in this study compare with the results presented in the literature.

Answer: As you know that this publication is short communication, the result presented in this study is all about decrease in the chemical composition of bitumen as a result of irradiation of bitumen with I.R and the period of irradiation was vary to know the effect. The I.R reported in this study is a form of electromagnetic radiation; likewise the gamma and U.V reported in the Literature are also form of electromagnetic radiation.

The effects of UV and gamma radiation on the chemical and physical properties of bitumen have been reported in the literature. It would be nice to know why you have chosen to study the effect of IR irradiation (is this somehow relevant for the processing/refining of bitumen or for its application in asphalt pavement?). How and why the effect of IR radiation would be different from the that of UV and gamma radiation?

Why I chose to Study the effect of I.R Radiation is relevant for its application in asphalt pavement. The effect is of I.R Radiation is not different from that of UV and Gamma. Their effect is tending toward the same direction. The only difference is that the percentage decrease in their chemical and physical properties vary

2. For example, it would be interesting to know if I.R radiation has a different effect on the molecular composition of bitumen than UV radiation.

Answer: I.R Radiation and U.V Radiation are both form of electromagnetic radiation, so, the effect of the two are heading towards the same effect

The effects of UV and gamma radiation on the chemical and physical properties of bitumen are already well known. But it would be interesting to know whether different types of electromagnetic radiations have different effects on bitumen (I would assume so).

Different types of electromagnetic radiation have different effect on bitumen.

3. In addition, the details of the IR radiation procedure are still missing.

Answer: Radiation of Bitumen Samples with I.R

Dry Petri dish (Pyrex) was weighed and 10g of purified natural bitumen was put on it. Thin layer of the natural bitumen was formed on the petri dish. The petri dish containing the purified natural bitumen was subjected to I.R radiations (wavelength) for a period of Seven hours at interval of One, Three and Seven hours respectively. Some of the irradiated sample was withdrawn into petri dish at interval of One, Three and Seven hours to be analyzed. From the withdrawn irradiated sample, 0.6g of it was carefully and accurately weighed into a beaker and 20cm^3 of iso – octane was added to precipitate out the Asphaltene component.
Filtration process of the solution was now carried out by making use of filter paper. From the filtration process, two components were obtained which was residue and filtrate. The residue is asphaltene and filtrate is maltene. The Maltene was collected into a sample bottle while the asphaltene was washed about five times with 20ml iso – octane. By the method employed by Olabemiwo et al (2008) using Column Chromatography, maltene fraction which is the filtrate was separated into saturated hydrocarbons, polycyclic aromatic hydrocarbon and polar compounds

You are not reporting some important details regarding the IR radiation procedure. For example, the intensity and wavelength of the IR radiation are not mentioned in the text, and also information about the thickness of the bitumen sample is missing. These are some of the factors that influence the results you are reporting. The experimental details need to be described in such a way that the reader of the paper can reproduce the experiment, i.e. all relevant experimental parameters need to be known.

Dry Petri dish (Pyrex) was weighed and 10g of purified natural bitumen was put on it. Thin layer of the natural bitumen was formed on the petri dish with thickness of about 0.1cm. The petri dish containing the purified natural bitumen was subjected to I.R radiations(with wavelength of about 3000nm) for a period of Seven hours at interval of One, Three and Seven hours respectively. Some of the irradiated sample was withdrawn into petri dish at interval of One, Three and Seven hours to be analyzed. From the withdrawn irradiated sample, 0.6g of it was carefully and accurately weighed into a beaker and 20cm^3 of iso – octane was added to precipitate out the Asphaltene component.
Filtration process of the solution was now carried out by making use of filter paper. From the filtration process, two components were obtained which was residue and filtrate. The residue is asphaltene and filtrate is maltene. The Maltene was collected into a sample bottle while the asphaltene was washed about five times

with 20ml iso – octane. By the method employed by Olabemiwo et al (2008) using Column Chromatography, maltene fraction which is the filtrate was separated into saturated hydrocarbons, polycyclic aromatic hydrocarbon and polar compounds.

4. This paper presents data only on one bitumen sample, so the results are very limited and cannot be generalized.

Answer: The present data was only on one bitumen sample. It was only period of irradiation that was varied and the result was now compared with the control result.

It should be stated in the conclusions that the effects of IR radiation may be different for different types of bitumen, and further studies are necessary to draw any general conclusions.

In Conclusion

The Gas Chromatogram result for Aromatic fraction of bitumen irradiated with infrared radiation respectively shows that the total number of polycyclic hydrocarbons decreases as the time of irradiation is increases. This reduces the quality of bitumen used for construction purposes or any other purposes. Therefore, bitumen to be used for construction or any other purposes should not be exposed for radiation. Olabemiwo et al(2010) reported the same thing that exposure of Agbabu natural bitumen to sunlight caused a decrease in its total aliphatic hydrocarbons. Distribution of individual aliphatic hydrocarbon was also found to vary with extent of irradiation of the bitumen with sunlight. The polycyclic hydrocarbon profile of the bitumen was also found to depend on the period of exposure of sunlight volatilization, cracking. The changes in the composition of the bitumen will, no doubt, reduce its strength. A reduction in strength will definitely increase the rate of ageing of the bitumen (6).Hence, Gas chromatography analysis shown that bitumen consists of Sixteen Polycyclic hydrocarbon and these are responsible for the quality of bitumen. Once the composition of bitumen is change, the quality reduces and a reduction in quality of bitumen will increase the rate of ageing of bitumen. Therefore, the effects of I.R Radiation may be different for different types of bitumen, and further studies are necessary to draw any general Conclusion.

5. The conclusion that IR radiation reduces the quality of bitumen is quite trivial; I could have predicted this without any measurements.

Answer : You could not have done that without experimental procedure. The Conclusion was drawn based on what was reported in my presentation. So, the conclusion that I.R radiation reduces the quality of bitumen is not trivial

I think that any type of radiation has a detrimental effect on the quality of bitumen, this is what I meant.

You claimed above that the effects of IR radiation are similar to those of UV and gamma radiations. However, I would assume that the molecular composition of bitumen would change in different ways when it is irradiated at different wavelengths. Otherwise, the results would be the same as in the previous studies where UV and gamma radiations have been used.

What I meant was that the effect of IR Radiation is different from that of U.V and Gamma radiations.

6. Moreover, it is unclear to me how the molecular composition of bitumen and its quality are related; how do you know that decrease in the total number of polycyclic hydrocarbons reduces bitumen quality?

Answer: The molecular composition of bitumen and its quality are related. If the molecular composition of bitumen is tampered with, automatically, the quality will be tampered with. Moreover, decrease in the total number Polycyclic hydrocarbon was as a result of changes in the composition of the bitumen .Once the composition of bitumen is change, the quality reduce and a reduction in quality of bitumen will increase the rate of ageing of bitumen

It is obvious that changes in the molecular composition of bitumen will result in changes in its quality. However, my question is how you know that decrease in the total number of polycyclic hydrocarbons has a negative effect on bitumen quality rather than a positive effect? If IR radiation increased the total number of polycyclic hydrocarbons in some other bitumen, would this improve its quality. I know that the polycyclic hydrocarbon content of bitumen may influence its elasticity (see https://doi.org/10.1007/s00397-014-0792-0), but I do not know how this is related to bitumen quality.

Irradiation of bitumen with I.R has a positive effect also. The positive effect is that, it can be useful as a means of remediating a land polluted with bitumen spill. The negative effect of I.R Radiation with bitumen make the composition of Polycyclic hydrocarbon to reduce which will eventually lead to aging of bitumen when is being used for asphalt pavement. My presentation reveals decrease in the total number of polycyclic hydrocarbon not increase and that is what I am reporting.