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# THE REFLECTIVITY COEFFICIENT OF CONCRETE SURFACES WITHIN URBAN ENVIRONMENT IN LAFIA METROPOLIS

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**ABSTRACT**: *The natural surface in the urban area around homes are being changed to concrete land surface for two reasons – to check erosion and water logging and for beautification of the areas. These changes most especially along court yards and frontages of buildings have serious effect on the micro climate regimes of the environment. The study is aimed at studying the reflectivity of concrete surface within urban environment in Lafia. The albedo was measured using solar albedometer for one year (Jan – Dec 2019) and the result show marked diurnal and seasonal variation in the magnitude of albedo over the concrete surface. The result shows a decrease in albedo within time from morning till late afternoon. Thereafter it begins to increase. This pattern was observed for all the season. The study concluded that the low reflectivity of the character concrete surface contributes immensely to the thermal character of the urban environment. Appropriate recommendations with regard to the above process were made.*

**KEYWORDS**: Urban, Radiation, Reflectivity Albedo, Land Surface, Nigeria

## INTRODUCTION

In the humid tropical environment, surfaces are gradually being change from the natural grass and the bare ground to hard concrete, especially in the urban environment.

This is an attempt to avoid the muddy surface experienced in these areas as a result of moderate rainfalls and to check erosion within these areas. The growth of urban centres (urbanization) increases the area being covered by the hard concrete.

Courtyard and frontages of building within the urban centres are covered with concrete for two main reasons – checking erosion and water logging on one hand and beautification of the environment on the other hand. This has great effect on the micro – climate characteristics of the area which is affected by radiation flukes of the surfaces.

The study is carried out to ascertain the reflectivity coefficient of concrete surfaces around selected homes within Lafia metropolis.

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This was achieved by examining the albedo magnitude over the concrete surfaces and relating it to energy regime and the micro – climate characteristics of the environment.

**Study Area**

Lafia was selected as the study area. It is an important administrative capital of Nasarawa State and a good commercial nerve centre in the North – Central State. Lafia town is located on Latitude 08º 32' north, and Longitude 08º 30' east. It has a land area of 2,797km$^2$ with a population of 330,712 (NPC, 2006). Lafia enjoys sub – humid tropical climate with an average temperature of between 26º and 30º mean rainfall in Lafia is 1120 and 1500mm (Akwa, (eds), 2007). The wet season commences around mid – April to October. However, there are slight modification probably due to climate change. Other studies have been carried out in large urban centres of Lagos, Ibadan (Oyo, 2018, Adebayo, 2016) Lafia is generally low. It forms part of the high plains of North – Central State (Ekom, L. T. 2014) about 600m above mean sea level. However, there are few pockets of highlands above 1000m around Eggon hills especially around Alogani, Aboshon and Wowyen.

**Materials and Methods**

The reflectivity coefficient was measured over the concrete surface for twelve calendar months within Lafia town. These measurements were taken weekly within a specified day of the week and five consecutive readings were made at 700hr, 1000hr, 1300hr, and 1800hr. using solar albedometer. The reflectivity of any surface depends on the solar insolation, the colour of the surface, the natural texture. The degree of reflection of the surface is determine by the heat retention capacity of the surface or material (Ayoade, 2010). For example, black coloured surfaces have high heat retention capacity than any other colour.

## RESULTS AND DISCUSSION

The summary of the data collected is shown in table 1 below.

**Table 1: Average Albedo Over Concrete Surface (%)**

| Time/Hour | Monthly Average | Dry Season Average | Wet Season Average |
|---|---|---|---|
| 0700hr | 10.5 | 12.20 | 10.68 |
| 1000hr | 9.62 | 13.20 | 10.68 |
| 1300hr | 8.43 | 12.68 | 7.91 |
| 1600hr | 8.11 | 10.60 | 7.48 |
| 1800hr | 10.2 | 11.80 | 10.32 |
| Mean | 9.30 | 12.1 | 9.41 |

*Source: Field Survey, 2019*

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The analysis of the result shows the average albedo for the concrete surface is low. This low value of albedo is attributed to the rough nature, and dry dark colour of concrete surface.

The early morning (0700hrs) value of the coefficient of reflectivity was highest value with an average of 10.5%. The next highest value was 10.2%, the average albedo at 1800hrs. The outcome could be the angle of incidence of radiation upon the surface at these times and the fact that in the morning most of the surface are wet as a result of early morning dew. The angle of incidence on the wet morning surface is directly proportional to the reflectivity of the radiation and it increases as the angle of incidence increases. The late morning (1000hrs) monthly average value was about 9.26% while that of afternoon monthly average was about 8.11%. The diurnal pattern of the reflectivity coefficient suggest that the Zenith angle of the sun is an important factor in the magnitude of reflectivity. The month trend shows, that for the early morning periods (0700hr), the albedo exhibits higher value in the raining and dry season with lowers values in the transition month June and July had higher albedo that October and November. The highest value for this morning period were recorded in the dry season month of February and March. This is a result of increased insolation due to reduced cloudiness during the dry season. The highest value for the late morning was also recorded in February and March with 13% and 12.8% respectively. While the lowest was recorded in September with value of about 8.2% (fig.2).

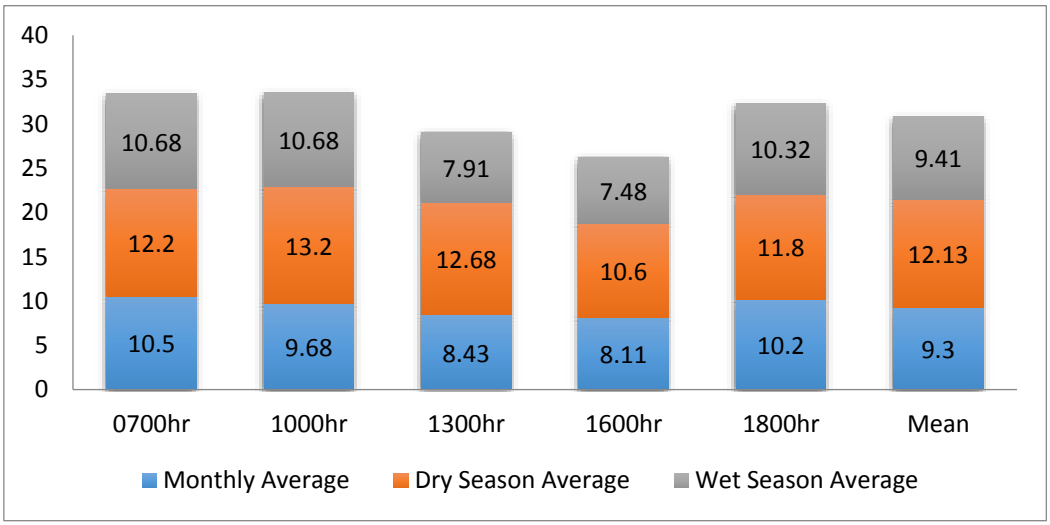


**Fig. 1: Average Albedo over concrete surface**

*Source: Field survey, 2019*

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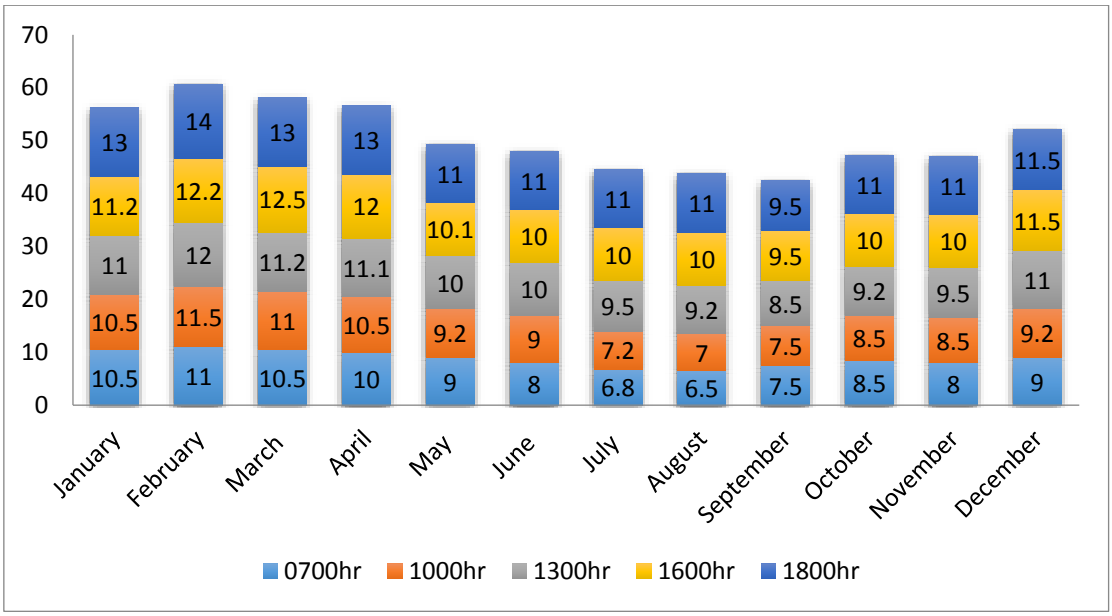


**Fig. 2: Monthly albedo over concrete surface**

*Source: Field survey, 2019.*

In the afternoon the highest value of 11.08% was recorded in February followed by 11.00% in March. The lowest was observed in July with a value of 7.0%. From July, the albedo increased steadily till February. Therefore, it also began to decrease steadily. The lowest value was recorded in August in the late afternoon, thereafter, the value began to increase steadily reaching the peak of February with albedo of 11.60%.

In the evening the lowest value was 9.8% obtained from August and September. The following months had higher albedo values and steadily the peak was recorded in February. The albedo values obtained was on the high retentive capacity of the concrete surface.

The low albedo coupled with other factors of the Lafia environment results in a high energy balance situation over concrete resulting in increased ambient air temperature of the environment.

Thus, the surplus energy resulting from the low reflectivity is therefore compounded into sensible heat to increase the ambient temperature as there is hardly any other source of dissipation within the urban environment. This will result in raised air temperature. The consequences of this is human physiological comfort is best imagined as the air temperature will be high.

## RECOMMENDATIONS AND CONCLUSION

The concrete cement surfaces contribute immensely to the alteration of the environment. Excess energy and heat are stored up in the day and released in the night making the ambient our temperature higher than what is required for human comfort. A phenomenon that is called

Urban Heat Island Effect (UHIE). The use of concrete surfaces over a large area should be discouraged in Urban Centres. Instead carpet grasses should be used in such areas. This will increase the rate of infiltration and also check erosion. Alternatively, green belts should be created near areas with concrete surfaces in the form of green cover. This will enhance an effective energy advection system where surplus energy will be transferred out to be used for evapo-transpiration in the adjacent areas. The atmospheric temperatures are expected to be lower than they were over concrete surfaces. In addition, the concrete surfaces should be covered with shed leaves to reduce the rate of absorption of direct insolation. Massive sensitization campaign should be carried out in all radio and F.M stations of the state to enlightened citizen on the adverse effects of concrete surfaces. A monitoring team should be set up by Nasarawa State Urban Development Board (NUDB) to check the excessiveness of concrete surfaces and to bring violators to book to serve as deterrent to anyone that will like to go against such laws. The Nasarawa State House of Assembly should as a matter of urgency come up with laws to protect the comfortability of the urban centres in the states.

In conclusion, unless recommendations mentioned above are strictly adhered to, the issue of concrete surfaces in Urban Centres in Nasarawa State will continued to make the Urban Centres ambient temperatures uncomfortable for human living. Besides the phenomena will also leads to climate change – a dreaded environmental problem facing the world over.

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