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Effect of Sandstone on Concrete Procedure With Plastic Synthetic Aggregate

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***Abstract*—**In this research work, the effect of sandstone (SS) on concrete produced with plastic synthetic aggregate (PSA) was investigated. A mix proportion of 1:1.6:3.6 with water cement ratio of 0.50 were used. The percentage replacement of coarse aggregate (CA) with plastic synthetic aggregate and plastic synthetic aggregate/sandstone used were 0%, 5%, 10%, 20%, 30% and 40%. Concrete cubes of 150mmxl50mmxl50mm of CA/PSA and CA/PSA/SS were cast and cured at 3.7,28,60 and 90 days respectively. At the ends of each hydration period, the concrete cubes were crushed and their .compressive strength was determined. The result of compressive strength of 5-40% replacement of coarse aggregate with plastic synthetic aggregate ranges from 8.07-36.7lN/mm2 as against 24.55- 41.21N/mm2 for the control test. The result of the compressive strength of 5-40% replacement of coarse aggregate with plastic synthetic aggregate and sandstone ranges from 5.05-31.75N/mm2 as against 24.58- 41.21N/mm2 for the control test. The workability for 5-40% replacement of coarse aggregate with plastic synthetic aggregate ranges from 15-68mm as against 8mm for the control test (0% replacement).

***Keywords*—** plastic synthetic aggregate, coarse aggregate, sandstone, compressive strength, workability

I. INTRODUCTION

Lightweight concrete can be produced by partially replacing the normal weight coarse aggregate particles with plastic synthetic aggregate and sandstone. In the previous research [I], the effect of plastic synthetic aggregate in the production of lightweight concrete was studied. In that research, plastic synthetic aggregate was used to replace 0-40% of coarse aggregate by weight. In the research presented here, second material sandstone was used together with plastic synthetic aggregate. The plastic synthetic aggregate is commercial available with suitable chemical coating, which is necessary to achieve a uniform dispersion in the fresh concrete mixture and to avoid segregation during mixing and handling of concrete. The plastic synthetic aggregate has negligible water absorption due to the closed cellular structure. [2] Reported that the standard workability tests are not suitable for the plastic synthetic aggregate concrete since they are sensitive to the weight of concrete. [3] Made similar observation when working with some materials together with plastic aggregate. The use of plastic synthetic aggregate in concrete manufacture may provide a satisfactory solution to the problem posed by concrete production [4]. The use of plastic synthetic aggregate should not impair concrete durability. Traditional assessment methods must therefore be adopted to evaluate this material [5].This study contributes to the development of a methodology for assessing concrete manufactured from plastic synthetic aggregate. The methodology is based on the study of concrete containing these materials. The durability and the environmental impact of concrete are closely connected to its transport properties which control the kinetic of the penetration of water and aggressive agents into concrete [6]. The movement of chemical species within the material and the leaching of certain chemicals are also closely linked to concrete diffusivity [7].

Finally, the strength characteristics of concrete containing increasing level and plastic synthetic aggregate and plastic, synthetic aggregate/sandstone were studied to identify the influence of these materials on concrete produced with them.

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II. MATERIALS AND METHOD

Concrete mixture with six levels of PSA and PSA/SS replacement ranging from 5- 40% and control mixtures with no PSA were investigated to determine their effect on compressive strength. The mixtures were labeled MO, M5, M10, M20, M30 and M40 with the different plastic synthetic aggregate (PSA) replacement percentages represented by the final digits in the label. Crushed plastic synthetic aggregate angular in shape with a non toxic chemical coating and having a mean diameter of 2.5mm were used in the concrete mixtures. The sandstone which was also used was obtained from Ezumoha in Isiala Mbano L.G.A of Imo State. The sandstone is reddish in colour and angular in shape. The fine aggregate used was a clean river sand free from deleterious substances with specific gravity of 2.62 and bulk density o l,533kg/m3. The coarse aggregate was obtained from a local supplier with a maximum size of 20mm, specific gravity of 2.65 and bulk density of l, 467km/m3. Both aggregate conforms to [8] and [9] respectively for coarse and fine aggregates.

The cement used was ordinary Portland cement (Dangote) which conforms to [10]. Test to determine compressive strength, workability and density were carried out in this study. For the compressive strength test, PSA and PSA/SS were used to replace 0-40% of coarse aggregate by weight. For the

compressive strength test 150mm(6in) cube specimen were used. A total of 180 specimens were cast and cured in water at room temperature in the laboratory for 3,7,28,60 and 90 days. At the end of each hydration period, three specimen for each mixture were tested for compressive strength and the average recorded. For the workability, a standard slump come measuring 300mmx200mmx 100mm was used. The compaction was also in three layers as carried out in compressive strength, i.e. 1/3, 2/3, 3/3 using tamping rod [11, 12].

III. Results and Dicussion

Fig 1 and fig 2 shows the result of compression strength obtained when plastic synthetic aggregate was used to replace coarse aggregate at a replacement level of 0%, 5%, 10%, 20%, 30% and 40% respectively. The result of the compressive strength of 5 - 40% replacement of coarse aggregate with plastic synthetic aggregate ranges from 8.07-36.7lN/mm2 as against 24.58-41.21N/mm2 for the control test. Fig 3 and 5 shows the result of the compressive strength obtained when both plastic synthetic aggregate and sandstone were used at the same percentage replacement level of coarse aggregate. The result of the compressive strength of 5-40% replacement of coarse aggregate with plastic synthetic aggregate and sandstone ranges from 5.05 - 31.75N/mm2 as against 24.58-41-21N/mm2 for the control test. The result of this study showed that sandstone decreases the early strength of the plastic synthetic aggregate concrete (5-40% replacement) and that the early age gain of strength due to high process of hydration when plastic synthetic aggregate alone was incorporated has been reduced by replacing half of plastic synthetic aggregate with sandstone. [13] Made the same observation when worked with plastic synthetic aggregate and other materials. Table 12 shows the result of workability of concrete produced when plastic synthetic aggregate was used to replace 0-40% of coarse aggregate. The result of workability for 5-40% replacement of coarse aggregate ranges from 12-61mm as against 8mm for the control test, fig 4 and 6 shows the result of workability for 5-40% replacement of coarse aggregate with plastic synthetic

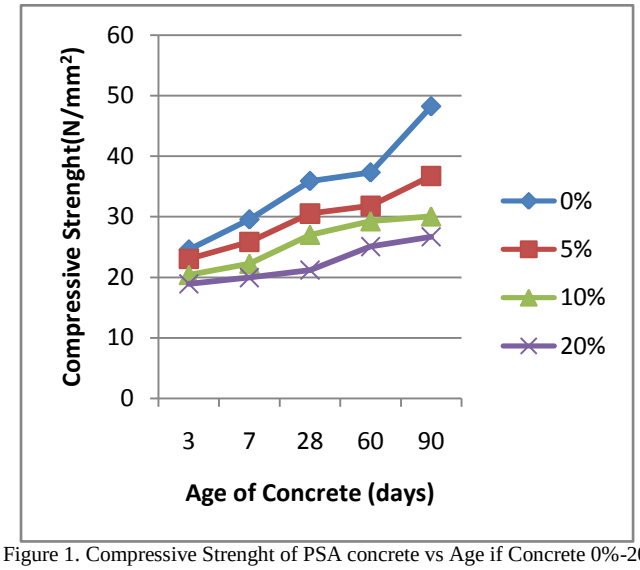

Figure 1. Compressive Strenght of PSA concrete vs Age if Concrete 0%-20%

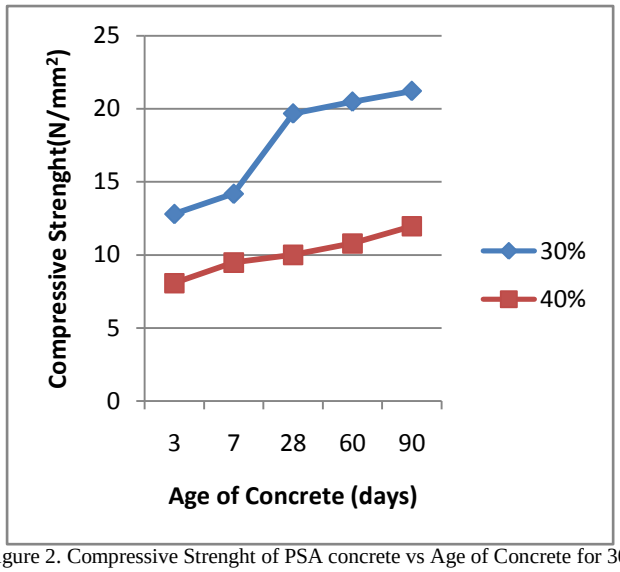

Figure 2. Compressive Strenght of PSA concrete vs Age of Concrete for 30%-40%

aggregate and sandstone which ranges from 15-68mm as against 8mm for the control test. The result as shown in fig 6 shows that the workability of concrete produced when both plastic synthetic aggregate and sandstone were used to replace coarse aggregate is greater than the workability concrete produced when plastic synthetic aggregate alone was used to replace coarse aggregate in concrete matrix. The higher the workability of concrete, the lower the strength, the result of workability of the concrete produced justified the result of the compressive strength obtained.

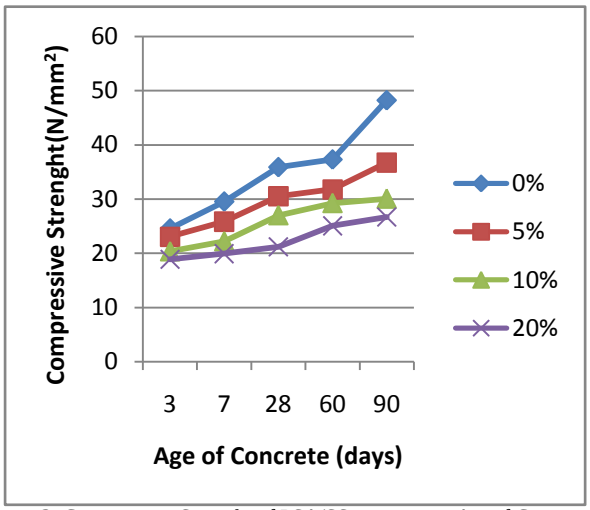

Figure 3. Compressive Strenght of PSA/SS concrete vs Age if Concrete 0%-20%

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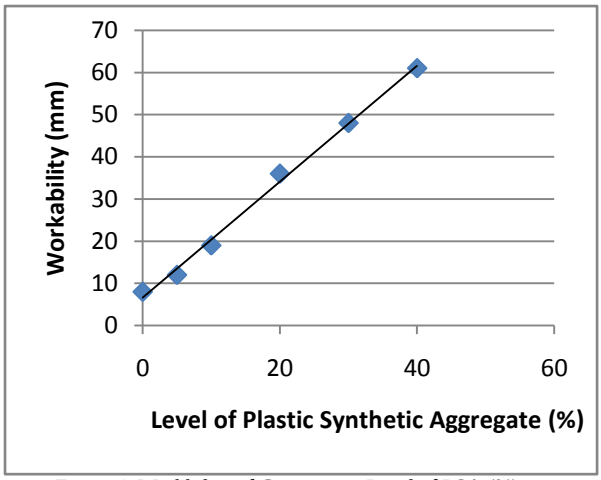

Figure 4. Workbility of Concrete vs Level of PSA (%)

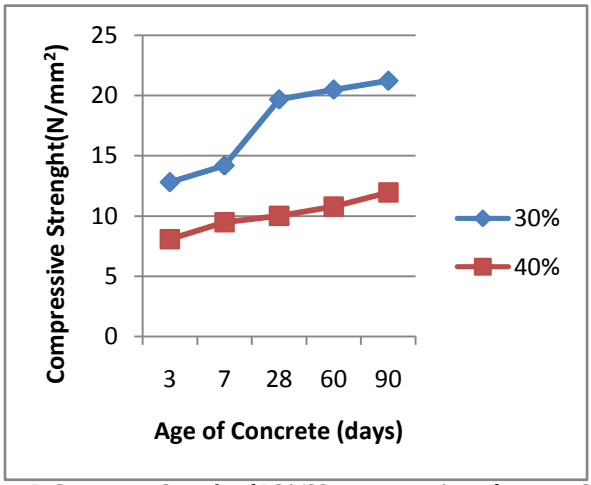

Figure 5. Compresive Strenght of PSA/SS concrete vs Ages if concrete 30%-40%

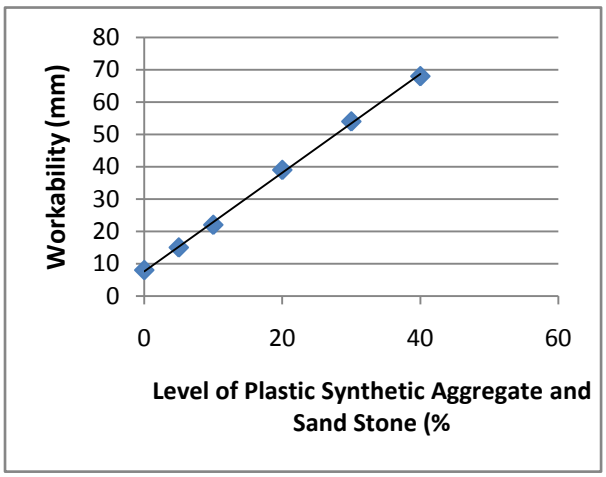

Figure 6. Workability of Concreate vs Level of PSA/SS (%)

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