International Journal of Engineering Research-Online
A Peer Reviewed International Journal
Articles are freely available online:http://www.ijoer.in
Vol.1.Issue.1:2013

RESEARCH ARTICLE

STUDY OF PHYSICAL PROPERTIES OF CRUSHER PRODUCTS FROM CHANDIKHOLE AREA OF ODISHA AND THEIR SUITABILITY IN LIGHT OF CIVIL ENGINEERING USE

LOHANI T.K[1*] AND JENA S.K[2]

[1]Professor & HOD, Civil Engineering, Orissa Engineering College, Bhubaneswar, India

[2]Associate Professor, Civil Engineering, Orissa Engineering College, Bhubaneswar, India

Article Received: 29/05/2013 | Revised from: 02/06/2013 | Accepted on: 30/06/2013

LOHANI T.K
Author for Correspondence:
E-mail: tkl_66@yahoo.com

ABSTRACT

Big size stones are transferred to primary crusher through vibrating feeder from hopper for first crushing, then the crushed materials are transferred to impact crusher through belt conveyor for secondary crushing. The materials crushed are transferred to the vibrating screen, and separated to different sizes. Those aggregate with suitable size are transferred to the final product pile and those with unsuitable size will be transferred to the impact crusher for re-crushing. These forms a closed circuit manifold cycles. The sizes of final products will be graded and separated according to customers' requirements. As Chandikhol of Odisha is a place rich in crushing units, crusher products are collected from different crushers whose origin varies from query to query and finally different engineering properties are studied in the laboratory to find their suitability for construction and highway materials.

Keywords: Crusher plant, compressive strength, impact value, water absorption, Chandikhole

INTRODUCTION

The production of aggregates for construction is the largestof the extractive industries in Odisha. Natural aggregatesform the main component, by volume, in the manufacture of concretebut the part played by aggregates in the durability and performanceaspects of concrete is still relatively little understood (Fookes, 1990). The quarries from which the samples are collected to determine and compare few engineering properties lie in the district of Jajpur of Odisha. The study area is a potential zone in Odisha due to its geographical location surrounded by innumerable industries of large to medium scale. It is also the junction of Express Highway running from Duburi to Paradeep and NH-5 plying from Kolkata to Chennai. This enhances the importance of this place by which requirement of crusher products is too high. In total six nos. of quarries are studied thoroughly taking different aspects like physiography, geology, morphology as well as origin (Fig. 1). Fresh stones from different quarries are brought to different crushing plants mushroomed along several Kms. stretch.

This crushing plant are used to crush granite and other hard rock aggregates etc. It's specially designed vibrating feeder to feed jaw crusher whose capacity can be up to 45-80 tph. Secondary crushing equipment is impact crusher has a capacity of 50-80 tph. This crushing and screening plant is designed considering the raw materials' real situation and the specific requirement. It's really suitable for small quarry crushing plant. Impact crusher is widely applied in transportation, construction and other industries. The impact crusher features reasonable structure, high prod+uctivity, easy operation and maintenance and safe performance. Impact crusher crushes materials with impact force. When materials enter, crushed due to the high-speed impact of the blow bar and are thrown to the impact plates on the rotor for secondary crush. Then materials will be shot back to the blow bar again for the third crush. Process repeats until the materials are crushed to the required size and discharged from the lower part of the machine. Size and shape of the finished product can be changed by adjusting the gap between the impact rack and rotor support. Impact crusher employs self-weigh security device strength, Impact value and water absorption ratio are calculated in different phases to find their suitability for various uses. In today's construction technology, aggregates having huge and different rates of grain sizes are being used in concrete that is the most common used building material. Aggregates play an essential role in mechanical and durability properties of concrete against aggressive environmental media during service life(Ozturk et.al, 2012). Construction is the backbone of global infrastructure. Aggregates contribute major part of construction (such as P.C.C, R.C.C, Pile foundation etc.) besides road construction. Among all the stone quarries available that exist in Odisha, Chandikhole contributes the major part. The reason behind it is that maximum stone

in its back frame. When other objects enter the impact cavity, they will be forced out of the machine by the impact rack in the front and back of the machine. Compressive

quarries are situated in Chandikhole of Jajpur district. The two major ports of Odisha namely Dhamara (Bhadrak district) and Paradeep are too close to Chandikhole which increase the demand of crusher products of this region. As far as quality of the products are concerned, Chandikhole quarries are much ahead of the others in the state of Odisha. Tests have been carried out according to IS Standard on non-standard and standard size aggregates to study the influence of aggregate size on mechanical properties. Dolerites, granite, limestone aggregates of different sizes have been tested. No basic relations have been found between elongation index and flakiness index, and the different aggregate sizes (Turk &Dearman, 1988).

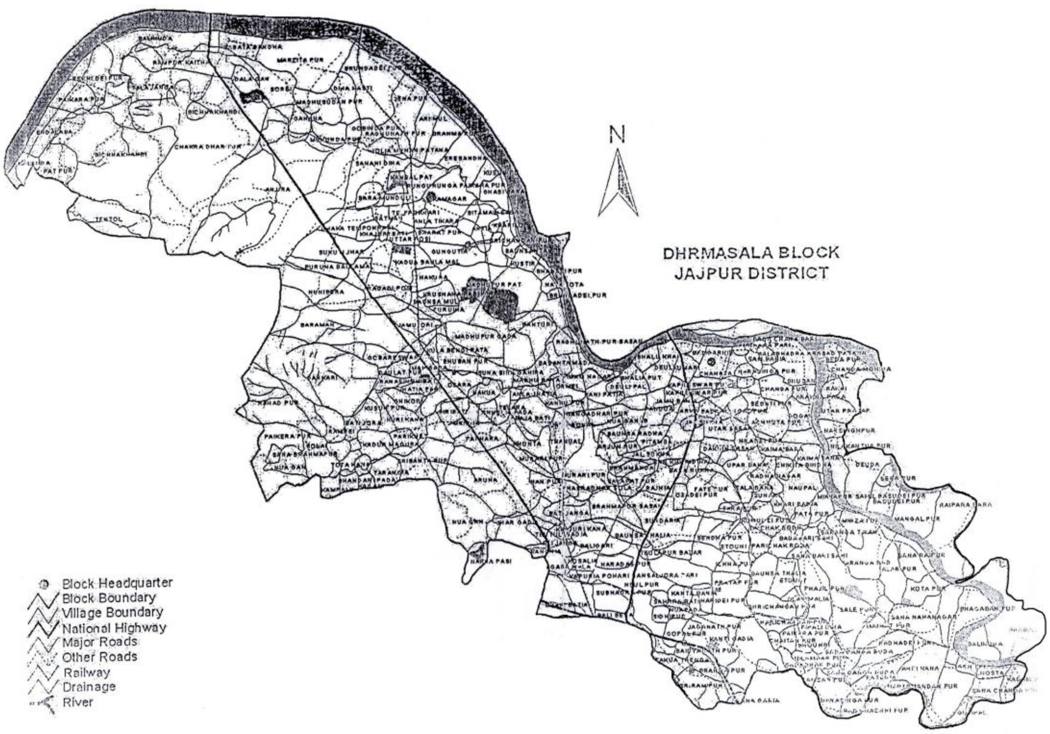

Fig. 1 Map of the study area under Dharmasala block of Jajpur district in Odisha

METHODOLOGY

Determination of Compressive strength of Concrete Cubes

Compressive strength of concrete cubes made up of different types of coarse aggregates. 1.3 kg of cement, 2.6 kg of sand and 5.2 kg of coarse aggregates were added and mixed thoroughly in a basin. 780g of water was added to it and again mixed well.The concrete was poured in the cube mould of 15 cm X 15 cm X 15 cm and tempered properly to avoid any void.The cube moulds were then placed on vibration machine for thorough compaction.After 24 hours these moulds were removed and test specimens are put in water for curing.Same procedere was followed for different types of coarse aggregates.After 7 days the cubes were taken out and were tested by compression testing machine. Shape of the aggregate and surface texture is vital characteristics in the view of mechanical bonding effect and bond strength in concrete design (Masad, 2002).The purpose of this test is to determine the compressive strength of 3/4 inch and 1/2 inch structural lightweight aggregate for use as it applies to geotechnical applications. The test is designed to determine the actual particle strength of the structural lightweight aggregate. The test is not an indication of the allowable bearing pressure that can be achieved using the aggregate, since such a determination has many variables, which cannot be addressed by this test. Basically, the force supplied by a concrete compression machine is a definite value. For normal concrete strength application, say below 50MPa, the stress produced by a 150mmx150mmx150mm cube is sufficient for the machine to crush the concrete sample. However, if the designed concrete strength is 100MPa, under the same force (about 2,000kN) supplied by the machine, the stress under a 150mmx150mmx150mm cube is not sufficient to crush the concrete cube. Therefore, 100mmx100mmx100mm concrete cubes are used instead to increase the applied stress to crush the concrete cubes. 1.3 kg of cement, 2.6 kg of sand and 5.2 kg of coarse aggregate of one type was taken in a mixing basin and the aggregates were mixed well.780g of water was added to it and mixed well.The aggregates passing through 12.5mm and retained on 10mm IS Sieve are oven-dried at a temperature of 100^{0}C to110^{0}C for 3hr to 4hr.The cylinder of the apparatus is filled in 3 layers, each layer tamped with 25 strokes of a tamping rod.

Determination of impact value of different type of coarse aggregates

Impact crushers have high material capacities. They break middle and low strength materials according to two breaking principal. For this reason, they can use both primer and secondary steps in applications and they provide more fine material then jaw crushers in primer step. Therefore, they diminish secondary crushers load and they may enable material output in wanted grain thicknesses without any secondary crusher need. Moreover, they offer some advantages as high performance, easy repairing and handling properties and low operation costs (Legg, 1998). On the other hand, vertically shafted crushers are used both secondary and tertiary processes in applications. Since they perform breaking only with crushing, their productions are cubic shaped and qualified. They are usually used in quarries. In hardened concrete, strength, density, permeability, pore amount, shrinkage and creep are substantially affected by these properties of aggregate. Besides, all these properties determine the durability of concrete and one can encounter durability problems due to inappropriate aggregate selection (Galloway, 1994 and Wang, 2010). The test sample consists of aggregates passing 12.5 mm sieve and retained on 10 mm sieve. The aggregates are filled up to about one-third full in the cylindrical measure and tamped 15 times with rounded end of the tamping rod. The measure is now filled with the aggregates to over flow, tamped 15 times. The surplus aggregates are struck off using the tamping rod as straight edge. The net weight of the aggregates in the measure is determined. The impact machine is placed with its bottom plate flat on the floor so that the hammer guide columns are vertical. The cup is fixed firmly in position on the base of the machine and the whole of the test sample from the cylindrical measure is transferred to the cup and compacted by tamping with 15 strokes. The hammer is raised until its lower face is 38 cm above the upper surface of the aggregates in the cup, and allowed to fall freely on the aggregates. The test sample is subjected to a total of 15 such blows, each being delivered at an interval of not less than one second. The crushed aggregate is then removed from the cup and the whole of it sieved on the 2.36 mm sieve until no further significant amount passes. The fraction passing the sieve is weighed accurate to 0.1 g. The fraction retained on the sieve is also weighed and if the total weight of the fractions passing and retained on the sieve is added, it should not be less than the original weight of the specimen by more than one gram. If the total weight is less than the original by over one gram, the result should be discarded and a fresh test made. The above test is repeated on fresh aggregate sample.

Water Absorption Test of coarse aggregates

2 kg of sample was thoroughly washed to remove finer particles and dust.2000 g of each sample was taken in a perforated wire basket. The basket was placed in a water tank containing water of temperature between 22 and 32^{o}C. After a period of at least 24 hours the sample was taken out and was placed on dry soft absorption cloth. The sample was allowed to dry in an open environment for about 5 minutes. The sample was then weighed on a weighing machine and the weight was taken as W grams.

Water absorption = [(W - 2000)/2000] x 100%

Determination of Abrasion Value

18mm aggregates were taken and sieved in 20mm sieve and passed in 12.5mm sieve and out of the retained sample in 12.5mm sieve 2.5kg was collected. Similarly 12mm aggregates was sieved in 12.5mm sieve and passed in 10mm sieve and out of the sample retained in 10mm sieve 2.5 kg was collected. The aggregate was placed in the Los Angeles Machine along with 11 nos. abrasive charge. The cover of the machine was fixed and rotated for 15 minutes. The machine is balanced and driven such that there is uniform peripheral speed. The machine was stopped after the desired number of revolutions and material is discharged to a tray. The entire stone dust was sieved on 1.70 mm IS sieve. The retained sample is then weighed.

RESULTS AND DISCUSSION

Compressive strength

Calculations

Size of the cube =15cm x15cm x 15cm

Area of the specimen (calculated from the mean size of the specimen) =225cm^2

Characteristic compressive strength (fck) at 7 days

Compressive strength = (Load in N/ Area in mm$^{2)}$ =..............N/mm^2

Observation

Table 1 Results of Compressive Strength of concrete cubes (M_{25})

Sl. No.	Quarry Location	Compressive strength in 7 days (in N/mm^2)	Compressive strength in 28 days (in N/mm^2)
1	Baghua	20.04	23.08
2	Bajabati	20.48	23.53
3	Chadakamara	20.31	23.32
4	Dankari	18.22	21.53
5	Jabera	16.26	20.24
6	Rahadpur	15.51	19.93

Concrete is a versatile engineering material consisting of cementing substance, aggregates, water and often controlled amount of entrained air. It is initially a plastic, workable mixture which can be moulded into a wide variety of shapes when wet. The strength is developed from the hydration due to the reaction between cement and water (Agbo et.al, 2013) which may be one of the other parameter to calculate the strength of concrete.

Impact Value

Calculation

The aggregate impact value is expressed as the percentage of the fines formed in terms of the total weight of the sample. Let the original weight of the oven dry sample be W_1gm and the weight of fraction passing 2.36mm IS sieve be W_2 gm. Aggregate impact value =100 W_1/W_2 Percent. This is recorded correct to the first decimal place.

Observation

Table 2 Results of Impact Value of different aggregates

Sl. No.	Quarry Location	W (in gm)	$W_{retaining}$ (in gm)	Passing ($W-W_{retaining}$) (in gm)	% of Abrasion
1	Baghua	5000	4910	90	1.80%
2	Bajabati	5000	4820	180	3.60%
3	Chadakamara	5000	4890	110	2.20%
4	Dankari	5000	4950	50	1%
5	Jabera	5000	4820	180	3.60%
6	Rahadpur	5000	4840	160	3.20%

Water Absorption

Calculation

The water absorption test is a simple calculation by soaking the samples in water at room temperature for a fixed period. Before soaking the weight of the sample is taken and similarly after soaking the weight of the same sample is recorded. The difference in weight is the percentage of water absorption by the sample.

Observation

Table 3 Results of Water Absorption Test for Aggregates

Sl. No.	Quarry Location	Weight of the sample taken (in gm)	Weight W (in gm)	Water absorption value (in %)
1	Baghua	2000	2020	1
2	Bajabati	2000	2050	2.5
3	Chadakamara	2000	2050	2.5
4	Dankari	2000	2070	3.5
5	Jabera	2000	2060	3
6	Rahadpur	2000	2060	3

Abrasion Test

Calculation

% of Abrasion = (Passing / 5000) * 100

Where Passing = 5000 – Retained in 1.70mm sieve

= $W - W_{retaining}$

Observation

Table 4 Results of abrasion tests on the specimens

Sl. No.	Quarry Location	W (in gm)	$W_{retaining}$ (in gm)	Passing ($W-W_{retaining}$) (in gm)	% of Abrasion
1	Baghua	5000	4910	90	1.80%
2	Dankari	5000	4950	50	1%
3	Bajabati	5000	4820	180	3.60%
4	Chadakamara	5000	4890	110	2.20%
5	Jabera	5000	4820	180	3.60%
6	Rahadpur	5000	4840	160	3.20%

Granitic rocks are the major source of crushed fine and coarse aggregates for use in concrete in Chandikhole. The existing quarriesare situated in a variety of granite types. Although some quarriesproduce coarse aggregates with better properties, most are consideredunsuitable for special purposes.Laboratory testing of the various granite types present in theTerritory indicates that fine-rained granites have superiormechanical and physical properties in comparison with othergranite types and hence are potentially suitable for many specialconcrete purposes (Irfan, 1994). It is recommended to use derived equations, representing the best fit between the aggregate properties, with care and for rough estimation only (Harthi & Saada, 1997) to find the best suitable aggregates from the study area.

CONCLUSION

The paper summarizes the main physical and chemical considerationsof aggregate in concrete, especially those leading to crackingand deterioration. It broadly considers the IS specificationof aggregates, which has largely been built up from decadesof local experience, and emphasizes the need in many locationsoverseas for more specific requirements on use of aggregatesin different climatic conditions. From the study of different parameters stones of different quarries give diversified result and hence stringent decision needs to be taken considering major parameters.

It is quite reflective from the results of compressive strength parameters that either for 7 days or 28 days Bajabati crusher stones are qualitative since compressive strength is a major asset of durability and Rahadpur is the poorest (Table 1). As far as aggregate impact value is considered (Table 2), Dankari with a minimum of 1% and Bajabati as well as Jabera share equally with 3.6%. Water absorption (Table 3) is highest in Dankari and lowest in Baghua. If abrasion value is considered then Bajabati and Jabera have equal abrasion value of 3.6% whereas Dankari is minimum with 1% (Table 4). Considering all those four properties together Bajabati quarry may be considered as the best among all those six quarries from where samples were collected.

REFERENCES

[1]. Al Harthi A.A., Abo Saada Y.E. (1997), “Wadi natural aggregates in Western Saudi Arabia for use in concrete” Bulletin of the International Association of Engineering Geology, Vol. 55, pp. 27-37.

[2]. Ali UğurÖztürk*, R. TugrulErdem, CelalKozanoglu (2012), “Investigation of Crushing Type of Concrete Aggregates on Mechanical Properties of Concrete”, International Journal of Materials Engineering, Vol. 2 (2), pp. 6-9.

[3]. Fookes, P.G. (1980), “An introduction to the influence of natural aggregates on the performance and durability of concrete” Quarterly Journal of Engineering Geology, Vol. 123, pp. 207-229.

[4]. Galloway, J. E. Jr. (1994), Grading, shape and surface properties, in significance of tests and properties of concrete and concrete-making materials. ASTM Special Technical Publication No: 169 C, Philadelphia, pp. 401-410.

[5]. Irfan, T.Y. (1994), “Aggregate properties and resources of granitic rocks for use in concrete in Hong Kong” Quarterly Journal of Engineering Geology, Vol. 27, pp. 25-38.

[6]. Legg, F.E. Jr. (1998). Aggregates. 4th ed. Chapter 2, Concrete Construction Handbook, ed. Dobrowolski, J. McGraw-Hill.

[7]. Masad, E. (2002), “Aggregate imaging system (AIMS). The Transportation Research Board, Superpave Mixture/Aggregate Expert Task Group”, August 28-29, Minneapolis, MN.

[8]. Nyiutsa Samson Apebo, Aondowase John Shiwua, Ameh Polycarp Agbo, JosephatChukwugozieEzeokonkwo& Paul TerkumburAdeke, (2013), Effect of Water-Cement Ratio on the Compressive Strength of gravel - crushed over burnt bricks concrete, Civil & Environmental Research, Vol. 3 (4), pp. 74-81.

[9]. Türk, N. and Dearman W.R. (1988), “An investigation into the influence of size on the mechanical properties of aggregates” Bulletin of the International Association of Engineering Geology, Vol. 38, pp. 143-149.

[10]. Wang, H.Y. &Shee, Y.N. (2010), “Performance characteristics of dredged silt and high-performance lightweight aggregate concrete”. Computers and Concrete, Vol. 7 (1).