International Journal of Technical Research and Applications e-ISSN: 2320-8163,
www.ijtra.com Volume 4, Issue 3 (May-June, 2016), PP. 18-22

A STUDY ON VARIATION IN QUALITY OF FINE AGGREGATE IN UPSTREAM AND DOWNSTREAM AT KRISHNA RIVER AT VIJAYAWADA

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Abstract— **Ambitious plan of establishment of state capital of Andhra Pradesh- Amravati, the vision of all the prominent leaders of the state and industrialists to make the state developed as fast as possible in all aspects is excepted to have a huge requirement of construction materials. In this region the requirement of fine aggregate is met from river Krishna and Godavari rivers only. With the increase in demand for fine aggregate in the region of coastal Andhra Pradesh and Hyderabad region, the fine aggregate from the Krishna river bed is being excavated in an unscientific manner and supplied. Samples from various sand reaches from the upstream and downstream of Krishna river at Vijayawada were collected and analyzed for various parameters and compared the results with specifications of IS 383-1970. Deviations were observed both in zone 2 and zone 3 when compared to IS specifications in size fractions .As the deposition of the sand is a natural process of geological action of river, it is bound to have variations in the size fractions, as there is no method of systematic mining and stock piling adopted in this region. In order to over come these variations in size fractions and to assure the construction industry with consistent quality of fine aggregate a proposal of removing excess size fractions from the fine aggregate of sand reaches of Vijayawada region and blending the short falls with artificial sand is made and schematic diagram of the same is presented.**

Index terms- **artificial sand, fine aggregate ,mining ,stock piling, zones.**

I. INTRODUCTION

Ambitious plan of establishment of state capital of Andhra Pradesh- Amravati, the vision of all the prominent leaders of the state and industrialists to make the state developed as fast as possible in all aspects is excepted to have a huge requirement of construction materials. In this region the requirement of fine aggregate is met from river Krishna and Godavari rivers only. With the increase in demand for fine aggregate in the region of coastal Andhra Pradesh and Hyderabad region, the fine aggregate from the Krishna river bed is being excavated in an unscientific manner and supplied sand is a commonly occurring granular material composed of finely divided rock and mineral particles. It is defined by size, being finer than gravel and coarser than silt. The composition of sand varies, depending on the local rock sources and conditions, but the most common constituent of sand in inland continental settings and non-tropical coastal settings is silica (silicon dioxide, or SiO_2), usually in the form of quartz. The second most common type of sand is calcium carbonate. As per IS code sand is divided into 3 categories:

- Natural Sand –It is the Fine aggregate resulting from the natural disintegration of rock deposited by streams or glacial agencies.
- Crushed Stone Sand – The Fine aggregate produced by crushing hard stone.
- 1.3 Crushed Gravel Sand – Fine aggregate produced by crushing natural gravel.

A. Common constituent of sand

- The most common constituent of sand is silica (silicon dioxide, or SiO2), usually in the form of quartz.

- Sand is classified as:
- Fine Sand (0.075 to 0.425 mm)
- Medium sand (0.425 to 2 mm)
- Coarse Sand (2.0 to4.75 mm)

B. Sand Mining

Sand mining is a practice that is used to extract sand, mainly through an open pit. However, sand is also mined from beaches, inland dunes and dredged from ocean beds and river beds. Sand dredged from the mouths of rivers can also used to replace eroded coastline, Another reason for sand mining is for the extraction of minerals such as rutile, ilmenite and zircon, which contain the industrially useful elements titanium and zirconium. These minerals typically occur combined with ordinary sand, which is dug up, the valuable minerals being separated in water by virtue of their different densities, and the remaining ordinary sand re-deposited.

In the area under study sand mining in upstream of Vijayawada is by dredging and down stream the mining is

from the dry sand beds. sand mining in dry sand beds is done by manual labour or using excavators and in water submerged areas It is exploited by deploying dredging equipments. The dredged materials is brought to the banks using boats. The mined material is being either stocked or loaded directly in to the trucks. In dry areas the excavated sand is directly loaded in to the trucks. No scientific stock piling is being adopted to minimize the variations in the quality.

C. OBJECTIVES

- To study the quality of the sand available from upstream and downstream regions of Krishna river .
- To look into the possibility of supplying of fine aggregate with consistent quality by blending natural and artificial aggregate.
- To study the variation in size fractions of fine aggregate on continuous basis in a particular quarry.

D. SIGNIFICANCE

It was experienced in the recent past in the regions of Andhra Pradesh and Telangana states of India the construction activity declined due to acute shortage of fine aggregate. Due to this severe shortage any quality of the material available was put in to construction activities. As the mining and stock piling of the sand is not scientific in this region, there are several environmental restrictions regarding depth of mining, there is a need to examine the quality of natural fine aggregate available and come out with alternatives to ensure fine aggregate material to the construction industry with consistent quality. In some area it is being dredged and supplied directly with considerable amount of moisture to far of places resulting in paying fright for excess moisture in fine aggregate.

II. DESCRIPTION OF STUDY AREA

The area under study falls in bifurcated Andhra Pradesh in 30 km upstream and 30 km downstream of Vijayawada in Krishna river.

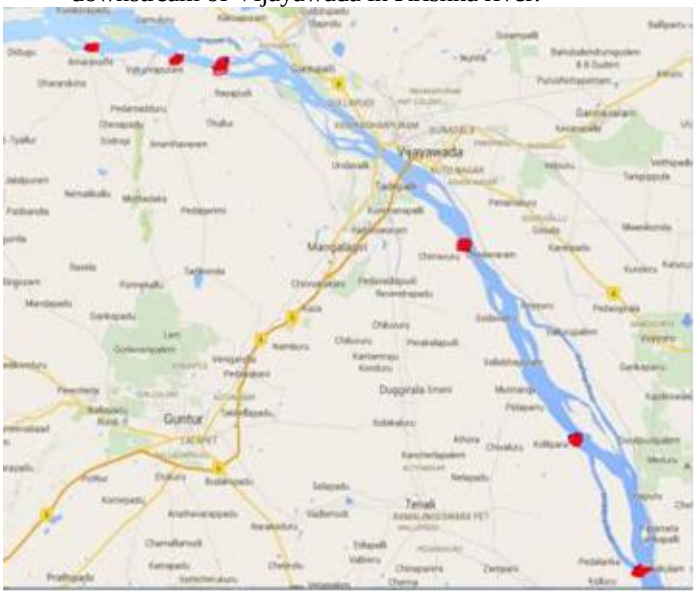

Fig-1: location of sand reaches in upstream and downstream of Krishna river at Vijayawada

Table-1:The locations of sand mining in Krishna river in area under study are given below:

Location	Latitude	longitude
Amaravathi	16.58N	80.36E
Harichandrapuram	16.57N	80.43E
Tulluru	16.56N	80.46E
Chirravuru	16.45N	80.66E
Kollipara	16.29N	80.77E
Kolluru	16.19N	80.81E

Upstream: AMARAVATI,HARICHANDRAPURAM, THULLUR.

Downstream:
CHIRRAVVURU, KOLLIPARA, KOLLURU.

A. COLLECTION OF SAMPLE

These are six locations from which three samples are collected for three continues days from each location. we also have collected fifteen samples from THULLUR sand reach for fifteen continues days. Each sample was collected approximately 2kilograms and these samples are labelled indicating location, date of collection, running mine or not in running.

These samples are represented for testing purpose.

III. METHODOLOGY

The methodology adopted in the present investigations is given below:

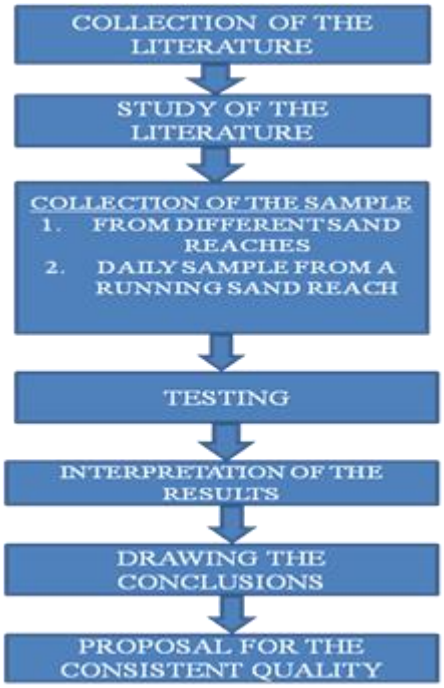

Fig-2: flow chart of methodology

5 kg Samples of fine aggregate were collected from different sand reaches in an around Vijayawada up to a stretch of 30 kilometers both in upstream and downstream side of Krishna river.Samples were represented for 15 days continuously from Thulluru sand reach. The represented samples were subjected to coning, quartering testing of various parameters of fine aggregate in accordance with IS 2386 (part 1 and part 8)-1963 test procedure. Moisture present in the sample is tested by drying them in an oven till there is no further weight loss. The results obtained were compared with IS 383-1970 specification for coarse and fine aggregates from natural sources for concrete. A proposal of removing excess size fractions from the fine aggregate of sand reaches of Vijayawada region and blending the short falls with artificial sand is made and schematic diagram of the same is presented.

IV. RESULTS AND DISCUSSIONS

Table -2 : Consolidated sieve analysis results of upstream and downstream.

TABEL 2

CONSOLIDATED SIEVE ANALYSIS OF UPSTREAM AND DOWNSTREAM SAND REACHES

	PERCENT PASSED								
seive size(mm)	amaravathi	harichandrapuram	tulluru	average of upstream	kollipara	charavuru	kollaru	average of downstream	total average
10									
4.75	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
2.36	100.0	100.0	100.0	100.0	99.3	99.3	100.0	99.5	99.8
1.18	97.5	97.8	99.3	98.2	98.5	98.0	99.7	98.7	98.5
0.6	77.9	84.9	81.7	81.5	94.8	92.9	95.9	94.5	88.0
0.3	63.0	70.9	51.5	61.8	84.1	74.7	68.0	75.6	68.7
0.15	34.5	40.2	13.5	29.4	19.2	20.7	7.4	15.8	22.6
0.15	7.1	11.2	2.0	6.8	4.2	7.1	2.3	4.5	5.6

Table- 3: Results of specific gravity, fineness modulus, moisture content.

Location	Specific gravity	Fineness modulus	Moisture content (%)
Amaravathi	2.33	3.66	12
Harichandrapuram	2.08	4.6	16.25
Thulluru	2.64	4.8	14.10
Chiravuru	2.11	4.57	7.0
Kolluru	2.18	4.8	4.26
Kollipara	2.18	4.76	5.37

Table -4: Comparison of sieve analysis results with zone II limits.

TABLE 4

COMPARISION OF SIEVE ANALYSIS RESULTS WITH IS 383 - 1970.

	PERCENT PASSED									Zone II	
seive size(mm)	amaravathi	harichand	tulluru	average of upstream	kollipara	charavuru	kollaru	average of downstream	total average	low range%	high range %
10	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100	100
4.75	100.0	100.0	100.0	100.0	99.3	99.3	100.0	99.5	99.8	90	100
2.36	97.5	97.8	99.3	98.2	98.5	98.0	99.7	98.7	98.5	75	100
1.18	77.9	84.9	81.7	81.5	94.8	92.9	95.9	94.5	88.0	55	90
0.6	63.0	70.9	51.5	61.8	84.1	74.7	68.0	75.6	68.7	35	59
0.3	34.5	40.2	13.5	29.4	19.2	20.7	7.4	15.8	22.6	8	30
0.15	7.1	11.2	2.0	6.8	4.2	7.1	2.3	4.5	5.6	0	10

Table -5: Comparison of sieve analysis results with zone III limits.

TABLE 5

COMPARISION OF SIEVE ANALYSIS RESULTS WITH IS 383 - 1970.

	PERCENT PASSED									Zone III	
seive size(mm)	amaravati	harichand	tulluru	average of upstream	kollipara	charavuru	kollaru	average of downstream	total average	low range%	high range%
10	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100	100
4.75	100.0	100.0	100.0	100.0	99.3	99.3	100.0	99.5	99.8	90	100
2.36	97.5	97.8	99.3	98.2	98.5	98.0	99.7	98.7	98.5	85	100
1.18	77.9	84.9	81.7	81.5	94.8	92.9	95.9	94.5	88.0	75	100
0.6	63.0	70.9	51.5	61.8	84.1	74.7	68.0	75.6	68.7	60	79
0.3	34.5	40.2	13.5	29.4	19.2	20.7	7.4	15.8	22.6	12	40
0.15	7.1	11.2	2.0	6.8	4.2	7.1	2.3	4.5	5.6	0	10

Table -6: Comparison of THULLURU sample sieve analysis results of 15 days with zone II limits.

TABLE 6

COMPARISION OF TULLURU SANDREACH SAMPLE SIEVE ANALYSIS FOR 15 DAYS RESULTS WITH IS 383 - 1970.

	PERCENT PASSED															Zone II	
seive size(mm)	day 1	day 2	day 3	day 4	day 5	day 6	day 7	day 8	day 9	day 10	day 11	day 12	day 13	day 14	day 15	low range%	high range %
10	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
4.75	98	100	100	100	100	100	100	98	100	100	100	99	100	100	98	90	100
2.36	88	100	96	98	94	97	99	88	96	91	93	96	97	98	91	75	100
1.18	74	84	82	91	85	78	89	69	71	68	80	85	81	89	86	55	90
0.6	48	52	58	71	43	41	78	41	46	39	42	41	46	78	38	35	59
0.3	20	18	17	30	18	21	38	12	19	11	19	16	15	36	12	8	30
0.15	6	3	3	9	4	6	8	2	3	1	8	6	3	8	2	0	10

Table-7: Comparison of THULLURU sample sieve analysis results of 15 days with zone III limits.

TABLE 7

COMPARISION OF TULLURU SANDREACH SAMPLE SIEVE ANALYSIS FOR 15 DAYS RESULTS WITH IS 383 - 1970.

	PERCENT PASSED															Zone III	
seive size(mm)	day 1	day 2	day 3	day 4	day 5	day 6	day 7	day 8	day 9	day 10	day 11	day 12	day 13	day 14	day 15	low range%	high range%
10	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
4.75	98	100	100	100	100	100	100	98	100	100	100	99	100	100	98	90	100
2.36	88	100	96	98	94	97	99	88	96	91	93	96	97	98	91	85	100
1.18	74	84	82	91	85	78	89	69	71	68	80	85	81	89	86	75	100
0.6	48	52	58	71	43	41	78	41	46	39	42	41	46	78	38	60	79
0.3	20	18	17	30	18	21	38	12	19	11	19	16	15	36	12	12	40
0.15	6	3	3	9	4	6	8	2	3	1	8	6	3	8	2	0	10

- Larger font indicates that the values are exceeding the range of the particular zone specifications as per IS 383-1970.
- Smaller font with thick box indicates that the values are deficient in the respective fractions when compared to the IS
- codal specifications
- The results of sieve analysis of AMARAVATI(1),HARICHANDRAPURAM (2), THULLUR(3) , CHIRAVURU(4), KOLLIPARA(5) AND KOLLURU(6) are presented in table 1,2,3,4,5,6 respectively.
- Consolidated Average values of sieve analysis of 6 locations represented are presented in table7.
- Consolidated Average values of sieve analysis of 6 locations are compared with Zone II specifications of IS 383- 1970 presented table 9. Deviations are observed mostly in the seize fractions of 1.18 , 0.6,0.3 mm size fractions.
- Consolidated Average values of sieve analysis of 6 locations are compared with Zone III specifications of IS 383- 1970 presented table 10. The deviations are observed in 0.6 and 0.3 mm size fractions.
- Consolidated Average values of sieve analysis of 15 days of THULLUR sand reach are compared with Zone II specifications of IS 383- 1970 presented table 11. Few deviations are observed in 1.18, 0.6 and 0.3 mm size fractions.
- Consolidated Average values of sieve analysis of 15 days of THULLUR sand reach are compared with Zone III specifications of IS 383-1970 presented table 12. Few deviations are Observed in 1.18mm fraction and significant deviation is observed in 0.6 mm fraction.
- The deviation are observed mostly in the size fractions of 1.18, 0.6 mm KOLLIPARA sample is found to have deviation in 1.18 and 0.6 mm size fraction in all the samples.
- 80% of the day wise samples collected are falling in zone 2 and 20% of the found deviated from zone II.
- 80% of the day wise samples collected are found deviated with respect to zone III.
- The study indicates that the chances of deviations are bound to be present in this region above 20%.
- The fine aggregate of this region is being supplied to Hyderabad region , Nellore, Ongole and in Kurnool in huge quantity.
- Moisture content in the dredged sand is varying from 12% - 16.5% and in the dry sand reaches the ranges are from 4.26%- 7%.

V. CONCLUSIONS

- Deviations are observed mostly in the seize fractions of 1.18 , 0.6,0.3 mm when compared with specifications of zone ii.
- The deviations are observed in 0.6 and 0.3 mm size fractions when compared with specifications of zone iii.
- 80% of the day wise samples collected are falling in zone 2 and 20% of the found deviated from zone II.
- 80% of the day wise samples collected are found deviated with respect to zone III.
- Moisture content in the dredged sand is varying from 12% - 16.5%.
- Customers are paying fright for high moisture present(12%-16.5%) in the dredged sand.

VI. RECOMMENDATIONS

- As the demand for high strength concrete is increasing ,the fine aggregate goes in to the high strength concrete should meet the norms of the zone II strictly . As it is a natures gift we cannot expect to have consistency in the quality of fine aggregate.
- In order to make the natural fine aggregate available with consistent quality it is required to process and supply to the consumers.
- Fine aggregate that is going to the customers is having an average moisture content of 10%,customer are paying for moisture content in the material and for transportation of moisture also.
- The short falls in the size fraction can be met by blending with artificial sand. The surplus fraction can be separated by subjecting the sand to drying, sieving, separating fractions, blending different size fractions as per the requirement.
- The schematic diagram for processing of natural fine aggregate occurring in Vijayawada region in river Krishna is presented in fig

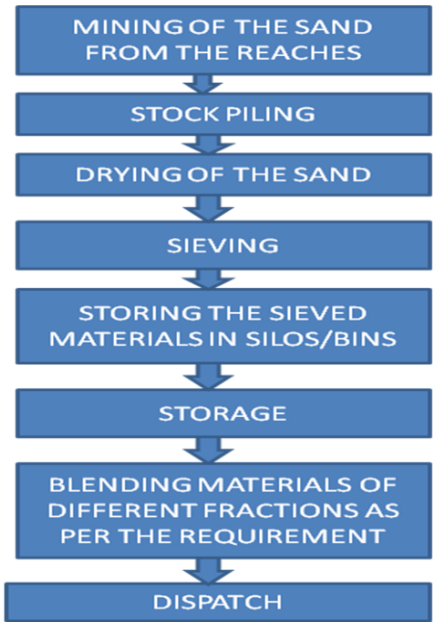

Fig. 3

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