Alternative for River Sand

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Abstract: The need of finding an alternative for river sand arises due to the over exploitation of river sand and its various harmful consequences. The focus of the current study was on offshore sand, which is clearly one of the most viable alternatives for river sand, with respect to availability, ease of extraction, environmental impact and cost. Offshore sand is already used in Sri Lanka mainly for road filling and it is also used for construction in all over the world. A sea survey was conducted in Kaluthara-Benthota sea area and a resource distribution map was plotted. Samples from Muthurajawela offshore sand stick piles were collected and Cl^- content was checked. Offshore sand saturated with sea water has Cl^- content around 0.3%, where as if the seawater is gravity drained; it reduced to around the acceptable 0.075%. The action of an average rain fall would be enough to reduce the Cl^- contents to below acceptable levels. However, two other alternatives were also studied in a limited way, namely manufactured sand and quarry dust are quarry products. While quarry dust is merely a by product from the production of course aggregate and tends to be flaky in shape, manufacture sand is actually produced such that a more desirable "rounded cubic" shape is obtained.

Keywords: Area map of resources, Effect of rain on sand stock piles, Cl^- content, Offshore sand

1. Introduction

Growing construction industry and natural catastrophes like Tsunami has contributed to sand demand and has increased in an exponential rate. Although sand extraction from river basins have already reached the maximum capacity, sand suppliers are striving to fulfil the demand with some undesirable manners and trying to grab the market opportunities. In a time period where more emphasis is on sustainable development, these illegal and unethical sand extractions from river basins and river banks have already accounted massive damages to the environment. Ma Oya, Deduru Oya, Kalu Ganga and Kelani Ganga have already been affected by sand mining severely.

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During the last half decade there has been a rise in the tendency to mine land based sand from flood plains. Employing mechanized sand mining with dozers, loaders or specially designed equipments have turned the surrounding areas in to total chaotic situation. Government and the respective authorities had to impose new rules and regulations to protect the environment. Now sand has become a scarce resource and prize of a cube of river sand has become unbearable to the average consumer. The situation desperately demands alternatives to river sand to overcome this crisis.

Potential Alternatives for River sand are;

- Dune sand
- Land Base Sand
- Quarry Dust
- Manufactured Sand
- Offshore Sand

Among them offshore sand has a very high priority due the availability, ease of extraction, low environmental impacts and costs. This paper describes resource distribution in South West sea area, and properties of offshore sand, and it's suitability for construction works.

1.1 Offshore sand

Natural Quartzsite deposits underwent weathering, erosion and formed sand. These sand particles transport to sea along rivers while their particle shape get more rounded as well as size get finer. Finally they are deposited around river mouth as a fan shape deposit. As Sri Lanka is an island we have plenty of resources around the country. Now a day's offshore sand is extracted using pumps and dredgers in the Watthala Nigamboo sea area (15Km Away from the costal) and they are pumped Muthurajawela. Sand is stored as stock piles until the Cl- content is decrees to acceptable limit (allowable maximum Cl- ion in sand 0.075%wt of sand). They are sold at around Rs: 4000/= per cube under perdition of GSMB.

2 Methodology

2.1 Resource Distribution Map

As the study was focused on the sand deposited from Kalu Ganga, the area to be surveyed was selected around Kaluthara-Benthera sea area (115km^2). Sea survey was done using a boat over a period of 6 days and grab samples were collected at each grid point as shown in the figure 1.

Physical properties of each sample were recorded and resource distribution map was plotted.

2.2 Cl^- Content

During the study Muthurajawela offshore sand pumping station was visited to study the sand pumping procedure. Offshore sand samples from different stock piles which were pumped at different years were collected to test the Cl^- content (BS 1377: Part 3: 1993) along the time period (Figure2). As we followed a chemical analysis (Using $AgNO_3$, NH_4SCN, con: HNO_3, and Ferric Alum Indicator) the results were accurate to two digits.

A figure of 0.075% by weight of the sand was arrived at as a conservative limit for allowable Cl^- ion content in offshore sand for metal-embedded concrete (Dias 2002). Offshore sand saturated with sea water has a Cl^- content around 0.3%, where as if the seawater is gravity drained; it is reduced to the acceptable limit of 0.075%.

Offshore sand taken from top, middle and the bottom of the stock pile were tested for chloride ion content and it was found that top and bottom layer content more chloride ions than the middle layer (Figure3). Cl^- content in the top layer was increased due to evaporation of sea water from the stock pile, and it was due to capillary reaction in the bottom layer. And it was found that the action of an average rain fall to western province will be enough to reduce the Cl^- contents

to below acceptable levels, even at the top of a stockpile and the bottom of the stockpile

3 Results

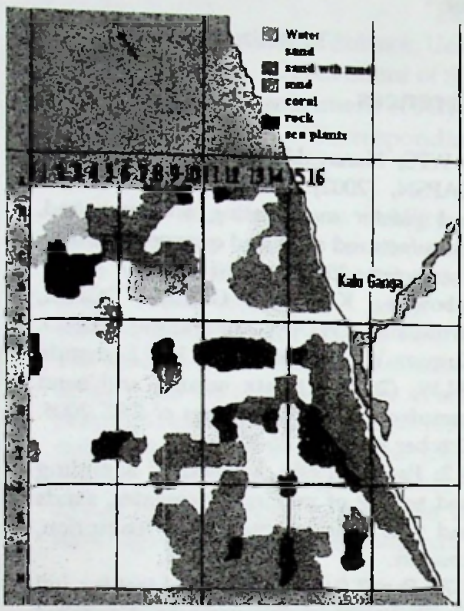

Figure 1
Resources distribution map on Kaluthara-Benthota sea area

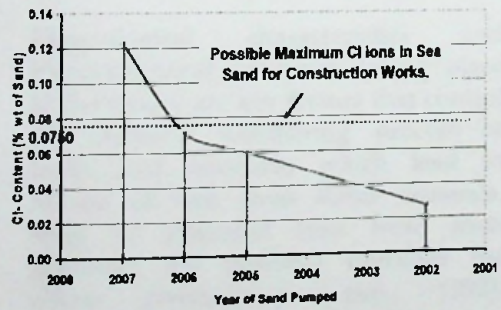

Figure 2. Variation of chloride content with the time

4 Discussion

Although there is a huge offshore sand resource around the country still we haven't got the maximum benefit of it.

To reduce the environmental impact of river sand mining offshore sand is the best alternative however demand on offshore sand is still low because of the ignorance of the people about the use of offshore sand for their construction works. It is also alternative that poses the greatest concerns, primarily with respect to its Chloride content (known to promote corrosion of reinforcement and suspected of enhancing efflorescence) and shell content (which was suspected of having negative effects on workability and permeability) (Chapman and Reoder, 1970).

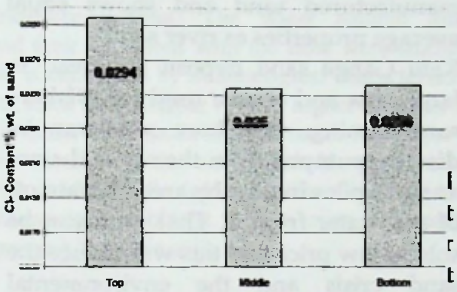

Figure 3. Chloride ion variation from the top to bottom of the sand stock pile pumped on 2007

But, there are some BS limits, which describe the shell content in offshore sand. The most commonly used limit for total chlorides is the 0.075% limit by weight of sand.

The moister content of the sand after drainage would depend on the grading of the sand. Sands with low D_{50} have grater capillary action and retain more moisture (Boskalis, 2002). In hot and dry environment moisture content lost due to evaporation and the Cl^- content will be higher than expected.

Reinforced concrete made using offshore sand with acceptable Cl^- content are not susceptible to efflorescence or early corrosion (Dias 2002).

Both uncrushed aggregates offshore sand and river sand have similar properties but they differ from crushed aggregate as quarry dust and

manufactured sand because of the particle shape (Dias 2002).

5. Conclusion

Although the grading of offshore sand can be variable, they are generally within the BS 882 limits, and can be used for concrete, mortar and pasters.

Gravity drained offshore sand contain acceptable Cl^- content and can be used for construction works. Rain water washed off more and more Cl^- ions from sand.

Offshore sand was much better than manufactured sand and shows equal average properties as river sand.

Kalu Ganga sand deposit is spread in large area and can be used for offshore sand mining. Offshore sand can be directly pumped from the sea and store as stock piles in near by area to drain off of sea water from it. That sand can be sold at low price and this will reduce the sand crisis and the environmental impact on river sand mining.

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