

Original Article

Assessment of Opinion and Awareness of the Construction Industry on Suitability of M Sand as a Replacement to River Sand

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Abstract

Fine aggregates are an essential raw material required for concrete production. Majority of the fine aggregate demand is supplied through natural river sand. However, river sand mining is not sustainable in the long run and impacts the environment severely. A more sustainable and cost-effective replacement to river sand should be adopted quickly. Manufactured sand or M sand is a promising alternative to river sand. The suitability of M sand as a replacement to river sand and the opinions and perspective of the construction industry were assessed by doing a comprehensive literature review and collecting data from industry professionals through a questionnaire. The questionnaire was assessed under their categories such as performance, economy, environmental and general. Respondents were also asked to grade their presumed knowledge on each category being assessed, in order to evaluate the validity of individual opinions. The results indicated that the opinion of construction industry professional's regarding M sand on economic and environmental aspects are similar to the findings of the literature. However, the professionals opinions regarding performance aspects of M sand was mostly mixed and contradicts with literature findings. Professionals who rated their knowledge highest had different opinions about M sand indicating the presence of severe misconceptions and inadequate knowledge within the industry. To overcome this, industry professional's knowledge on M sand should be raised by providing accurate information about M sand and its benefits. Furthermore, the industry professional's opinions acknowledged that M sand is being currently underused within the industry. They were confident that in future, M sand use would increase drastically.

Keywords: *M Sand, River Sand, Fine aggregates, Awareness, Construction industry.*

Introduction

The world population grew rapidly over the past few decades and this has resulted in a rapid infrastructure growth across the globe. This rapid growth has created an immense pressure on the construction sector to manufacture massive quantities of concrete worldwide. And the raw materials used for concrete has a large influence in the cost of the infrastructure being developed. In the raw materials used for concrete, natural river sand forms about 35% of the total raw materials the use of sand as a raw material has already surpassed its natural renewal rate [1]. The use of river sand has led to an excessive amount of sand mining. Because of this, the environment has been damaged severely. So it is essential to look for other substitutes for river sand which is more eco-friendly and cost effective [2]. River sand is not available locally which results in it being transported to long distances which is not economical or environmental friendly while M sand is available locally which makes it attractive to customers. When price of M sand and river sand is compared, normally M sand is almost 50% cheaper than river sand [3].

Even when natural sand replaced completely with alternatives such as with M sand and quarry sand, the strength properties deem to be preserved. But total replacement of natural sand with M sand or quarry sand resulted in low workability of the concrete. Therefore it is only recommended for low workability purposes [4]. It has also been studied that replacing 50% of river sand with M sand in concrete production generated superior results in strength and durability properties when compared to traditional concrete produced with river sand [5]. Even with the benefits associated with M sand, it is seen that the use of M sand in the construction industry still relatively low compared to river sand even as a partial replacement. It is fair to assume that the knowledge regarding M sand the construction

industry plays a vital role in promoting or eliminating its use in construction applications. Therefore this study aims to assess the degree of awareness and opinions of the construction industry with regard to the suitability of M sand as a replacement to river sand in construction applications.

Research Methodology

A comprehensive literature review was carried out on M sand and natural river sand mainly focusing on their performance, economic and environmental aspects. Using the information collected through the literature review, a questionnaire was compiled. Important data which is essential for this research was collected through the questionnaire given to industry professionals such as Civil engineers, Quantity surveyors, academics in Civil engineering field and contractors. With careful consideration, eight questions were compiled in following contexts.

1. Workability of concrete made with M sand compared to river sand.
2. Strength of concrete made using M sand compared to river sand.
3. Durability of concrete made using M sand compared to river sand.
4. Overall cost of production of M sand compared to river sand.
5. Environmental impact caused by production of M sand compared to river sand.
6. Availability M sand compared to river sand.
7. Current use of M sand in construction industry in comparison to river sand.
8. Use of M sand in future construction industry in comparison to river sand.

The respondents were asked to give their opinion out of the 5 responses shown in Table I, based on how they view the attributes of M sand compared to river sand.

Choice No	Response
1	Significantly low
2	Relatively low
3	Approximately the same
4	Relatively high
5	Very high

Table I Type of responses presented in the questionnaire

The presumed knowledge level was measured by including a question where the respondents are required to rate their presumed knowledge level for the relevant category on the scale of 1 to 10 (1 - very low, 10 - very high).the questions were categorized as shown in Table II.

Question No	Category
1,2,3	Performance
4	Economic
5	Environmental
6,7,8	Use and availability

Table II Categorization of questions

This knowledge level data is critical to analyze the responses in more practical manner as it allows to check the validity of the responses against the presumed knowledge of the respondent.

Results and discussion

As shown in Fig. 1 & Fig. 2, the majority of respondents deem to think that strength and durability of concrete made of M sand is not different from the concrete made of river sand. Some studies conducted on the strength aspect of concrete made of M sand suggest that compressive and flexural strength can be increased with partial replacement of M sand up to a certain extent [6][7].

When it comes to workability, many studies support to establish the fact that use of M sand results in low workability of the concrete [4] due to the angular form and relatively rough surface of sand particles [7]. The results shown in Fig. 3 indicates that most would agree to this or stay neutral to this phenomenon. The respondents who agrees with

literature also rated their knowledge to a relatively high level. This indicates that this fraction of respondents are somewhat knowledgeable in this regard.

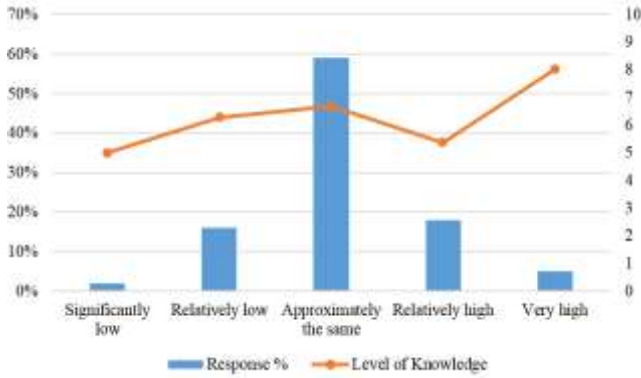


Fig. 1 Strength of concrete made with M Sand compared to river sand

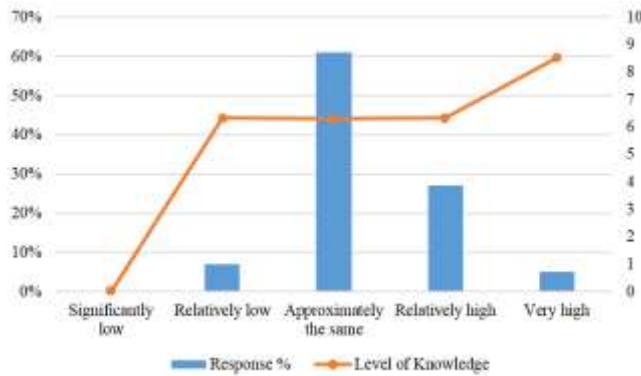


Fig. 2 Durability of concrete made using M Sand compared to river sand

It can be seen that the respondents who provided their opinion as approximately the same which agrees with literature, tend to rate their knowledge at moderate levels. It also can be observed that industry professionals who rated their knowledge the highest has made quite extreme opinions which deviates from the existing knowledge. However this portion is relatively low compared to the majority.

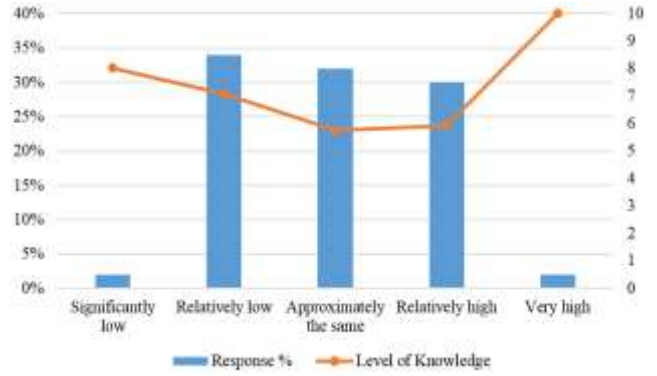


Fig. 3 Workability of concrete made with M Sand compared to river sand

It has been established that the M sand is a cost effective replacement for river sand when it comes to economical production of concrete [4] [5]. Around 60% the industry professionals also tend to think that the overall cost can be reduced as shown in Fig. 4.

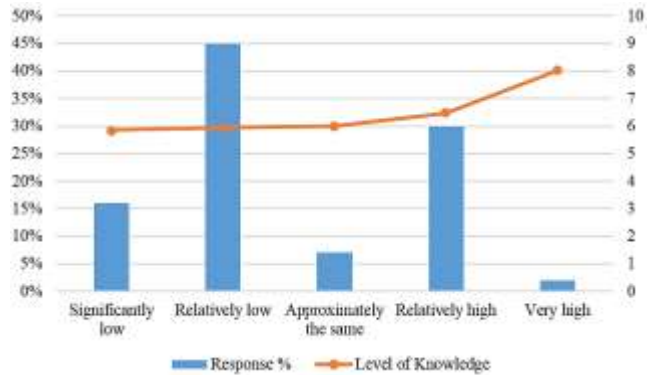


Fig. 4 Overall cost of production of M Sand compared to river sand

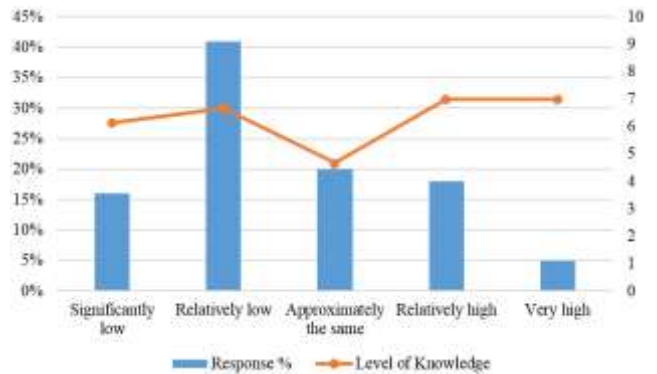


Fig. 5 Environmental impact of M Sand production compared to river sand

When the industrial professionals were asked to give their opinion on the impact of M sand production on the environment, majority of them (55%) believes

that the impact is less than that of river sand as exhibited in Fig. 5.

When it comes to the current availability of M sand, the results indicates that the overall opinion is somewhat divided among the high and low availability. However the level of knowledge the respondents assigned for extreme opinions are relatively low. Also majority of the professionals suggest that the current use of M sand is also relatively low or significantly low compared to river sand. However, people who gave their opinion as “significantly low” also marked their knowledge at low level. In overall it is fair to assume that the awareness with regard to M sand availability and use in the local industry is not at a satisfactory level.

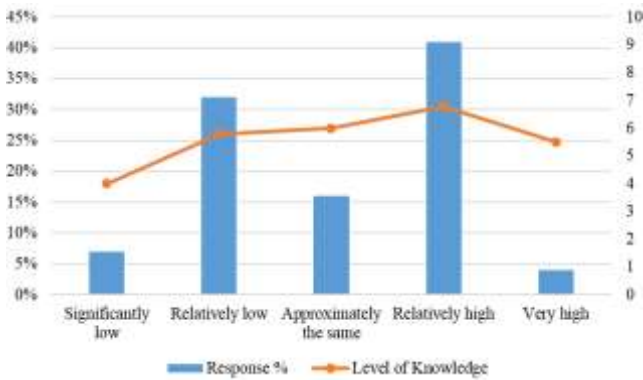


Fig. 6 Availability of M sand compared to river sand

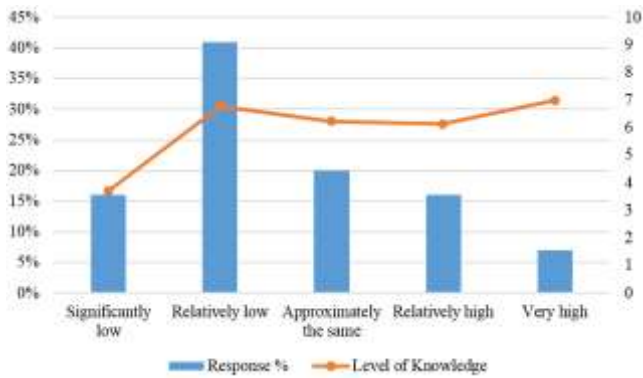


Fig. 7 Current use of M sand in construction industry in comparison to river sand

When it comes to the future use of the m sand, almost 70% of the industry professionals were optimistic and predicted that the future use will be increased. In the other hand respondents who predicted low use also rated their knowledge the least. In overall, it is

evident that the opinion of the industry is in favor of increased utilization of M sand as a replacement to river sand.

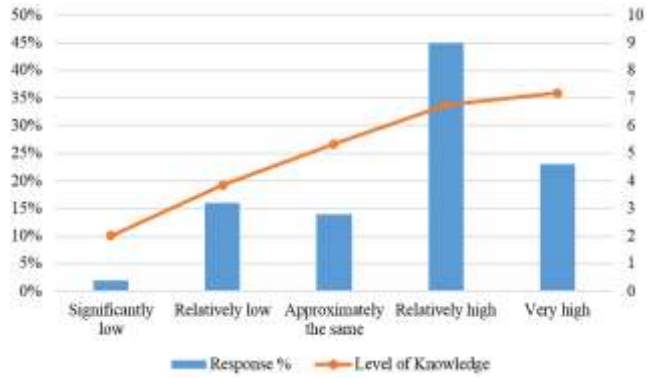


Fig. 8 Future use of M Sand in construction industry compared to river sand

Category	Average level of knowledge	Standard Deviation
Performance	6.40	2.6
Economic	6.13	2.78
Environmental	6.25	2.67
Use and availability	6.09	2.56

Table III Average knowledge level

Table elaborates the self-assigned average level of knowledge for each category investigated in the study. Even though not much deviation can be observed, it is evident that respondent’s knowledge on performance aspect shown to be more promising compared to other categories. In the other hand the awareness on use and availability of M sand deem to be scarce. However the high standard deviations of all data indicates that the self-assigned knowledge levels varies in much broader range.

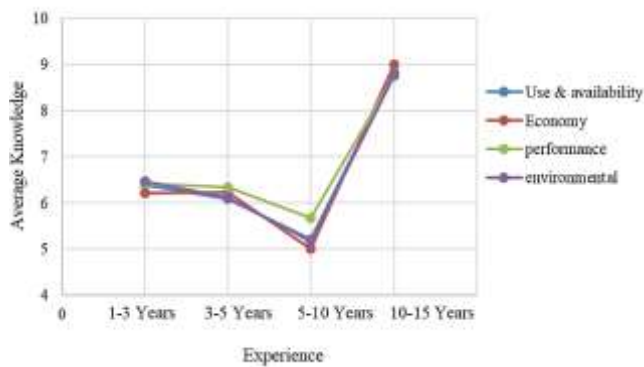


Fig. 9 Association between experience and knowledge level

The association between experience of the participants and the level of knowledge is shown in the Fig. 9. Generally it is expected to increase the knowledge as the experience grows. But still this can be governed by the exposure to the updated knowledge associated with the industry. In overall, mid-career professionals with 5-10 years of experience had the lowest average self-assigned knowledge about M sand. It was also observed that even though professionals who are highly experienced and rated their knowledge the highest, failed to provide opinions which are valid in terms of existing updated knowledge.

Conclusion

In order to promote an alternative to river sand it is important that the construction industry understand the advantages and disadvantages of such alternatives. Without such awareness among industry professionals, it is difficult to assume that implementation of such alternatives will take place. This study aims to assess the degree of awareness and opinions of the construction industry with regard to the suitability of M sand as a replacement to river sand in construction applications.

From the study it was determined that majority of the industry professionals tend to agree with the existing scientific knowledge regarding the performance, economic, environmental and availability aspects regarding the M sand in comparison to river sand. Out of these aspects, opinions regarding performance aspect showed the highest reliability. In the other hand use and availability aspect showed considerable lack of awareness and confidence.

Even though the opinion of the industry is at a satisfactory level. It is also important to notice that

significant fraction of the industry professionals show lack of awareness in many aspects. Also both overestimation and underestimation of own knowledge found to be significant as indicated by the outcomes of the study. This could be overcome by providing awareness programs through relevant professional institutions about the use of sustainable and environmentally friendly fine aggregates like M sand.

On the positive side, the industry professionals were optimistic and predicted that the future use will be increased. This sort of confidence is important for the promotion of M sand as a fine aggregate replacement in the construction industry

River sand is most preferred because M sand and river sand do not have a drastic price difference and constant river sand supply through illegal means to the industry.

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