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Research paper



Utilization manufactured sand as fine aggregate for concrete quality

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Abstract

Utilization Manufactured sand (M-sand) in this case of ash sandstone wash as a substitute for sand on concrete mixture is used as a result of the crisis in availability of the main material of concrete, ie natural materials such as sand used in concrete manufacture foundries. M-sand from the production of crushed stone then collected and washed which will be used as a mixture of sand on the concrete. The results of m-sand optimally utilized for the mixture of fine agregate substitution of concrete with compressive strength test to produce high quality of concrete. The mixture used is 50% m-sand and FA, from the results of the compressive strength test showed the utilization of m-sand can be used as a quality concrete

Keywords: *M-Sand; Fine Aggregate; Waste; Compressive Strength; Concrete Quality.*

1. Introduction

The development of construction in Indonesia occurred so fast, many studies have been done to develop construction technology ranging from construction materials to technology used in the construction itself, with manufactured sand is an effective approach to reduce the natural resource depletion and environmental impact of cement concrete industry[1]. Several utilization of waste can be used for optimalization of concrete construction materials because. the construction of high-rise buildings currently demands good quality materials, almost 70% of the use of materials from the building is concrete so that to meet the construction of high-rise buildings will be demanded high-quality concrete [2]. The development of these construction materials can be seen from the many types of added materials used as additives in the normal concrete mortar. These added compotitions aim to improve the concrete to be better and reduce waste. The condition of material difficulties experienced by foundries in Indonesia started in 2009, where the sand of bangka as the main material of sand in Jakarta area is constrained by various causes, so the supply becomes less smoothly, besides consistency to quality not in accordance with the requirement. The non conformace for 1% mud will require the addition of 7 kg/m3 cement, for fine fine fine (smaller than spec) will impact more free water usage which means more cement use to achieve the same quality, in addition to the effect of bleeding then cracked concrete. M-sand is widely considered as an alternative of the river sand recently, and to clarify the influence significance and influence mechanism of MS characteristic parameters on its concrete performance is essential to its scientific application[3]. Utilization of m-sand to reduce the use of sand. Global warming issues caused by environmental damage are the dominant factors causing the difficulty of obtaining sand material, government regulation to regulate sand mining, crushed stone, regional autonomy including things that make people involved in determining policy direction, making it harder to get sand material, so that the material is scarce, the more expensive and the more unusual the expected quality is required and all these things will affect the quality of concrete products, the cost of concrete composition that affects the price of competitiveness, and the smooth service to customers will be disrupted. As an effort to find a solution to overcome the mentioned above, it is necessary to conduct study on the possibility of using m-sand material with production capacity ± 1000 m3/day, with condition not fulfill the specification for concrete material, ± 19% mud level, by washing to be used as a substitute material for sand needs in addition to attempting to reduce cost reduction programs to enhance competitiveness. Foundries successfully recycle and reuse the sand many times in a foundry [4]. The utilization of such materials in concrete not only makes it economical, but also helps in reducing disposal concerns [5]. The goal of this paper is to know the effect of m-sand against compressive strength and increase the use of m-sand up to 50%.

2. Literature review

In recent years, manufactured sand (m-sand) produced by crushing stone deposits is being identified as a suitable alternative source for river sand in concrete [6]. Sand is the one of main constituents of concrete making, which is about 35% of volume of concrete used in construction industry [7]. Review Concrete is the most widely used material in the construction of buildings and infrastructure development [8]. Fundamentally, concrete should be economical, strong, and durable.

The construction industry recognizes that considerable improvements are essential in productivity, product performance, energy efficiency, and environmental performance [9].The development of foundries industry is a promising business in Indonesia as a developing country. Indonesia still badly needs concrete as the main material to carry out the construction of other types of structures, roads, bridges and other infrastructures. Reuse of waste materials as construction material is very much essential to achieve sustainable construction. Utilization of waste materials as construction material not only help in protection of environment

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but also result in monetary savings [10]. According to [11] the suitability of crushed stone ash waste as fine aggregate for concrete has been assessed by comparing its basic properties with that of conventional concrete. The strength characteristics of the concrete depend on the nature of the constituent material and its combined action. Fine aggregate is one of the important constituents as far as the strength characteristics of the concrete are concerne. Increasing demand and decreasing natural sources of fine aggregate for the production of concrete has resulted in the need to identify new sources of fine aggregates. The most commonly used river sand as a fine aggregate in the production of concrete and mortar raises the problem of acute shortage in many areas. At the same time increasing amount of crushed stone ash is available from crusher as waste. This ash removal is a serious environmental problem.

If it is possible to use this crushed stone ash in the manufacture of concrete and mortar with partial or complete replacement of natural river sand, this will not only save the construction cost but at the same time will solve this ash removal problem.

3. Material experiment

a) Material used

Table 1: Material Data to Mix Trial Bangka's Sand 50% + M-Sand 50% + Fly Ash 20%

No.	Item	Name of Supplier	Weight	Water (%)	Absorption %	Used %	Max Size mm	PAS 30 %	FM	% finer than 0,075 mm
1	Cement	Gresik	3,15			0,8				
2	Fly Ash	Suralaya	2,14			0,2				
3	Sand 1	Bangka	261	5,1	0,76	50		47,80	2,57	
4	Sand 2	Wash stone Ash (RUMPIN)	259	9	2,38	50		33,00	3,14	2,05
5	Spli 1-2	ADHMX	261	200	1,2	100	25		6,95	0,67
6	ADD	BASF-POZZOLITH 100R	1,02			0,3				

b) Steps

As for the sequence of experiments or experimental steps, are as follows:

1) Material testing in Laboratory.
2) Laboratory washing experiments.
3) Mortar compressive strength experiment comparative with Bangka Sand (river sand).
4) Trial Mix to look for correlation w/c to strength.
5) Evaluation of Trial Laboratory results.

c) Experiment Set Up

The washing system will be made using, the screw system utilizes the former waste wash project which fails, although it is necessary to experiment in advance to know the effectiveness of the tool on the quality of ash, and the capacity of the tool.



Fig. 1: Tube Container Material.



Fig. 2: Material Washers.

The first step of the experiment was carried out on a laboratory scale by washing the stone ash to obtain the quality of stone crushed in accordance with the requirements, ie stone ash with a mud content of less than 7%. Then the m-sand is used as a concrete mixture with a 50% percentage of the total sand requirement in 1 m3 of concrete.

4. Result and discussion

From the results of laboratory tests produced data as follows:

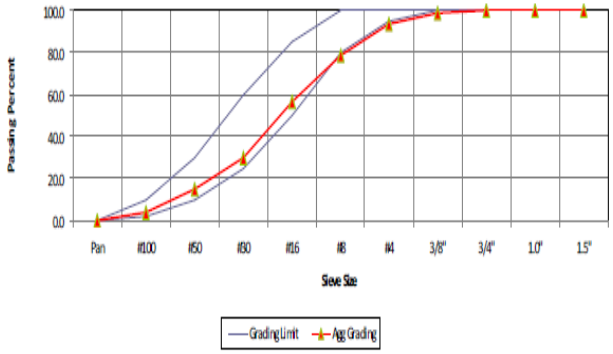


Fig. 3: Grading Material of Bangka Sand / Belitung.

By looking at the fineness of the bangka sand for a 50% sieve of 20%, for a 30% sieve of 40%, and a sieve of 40 is 100% and all still within usable limits.

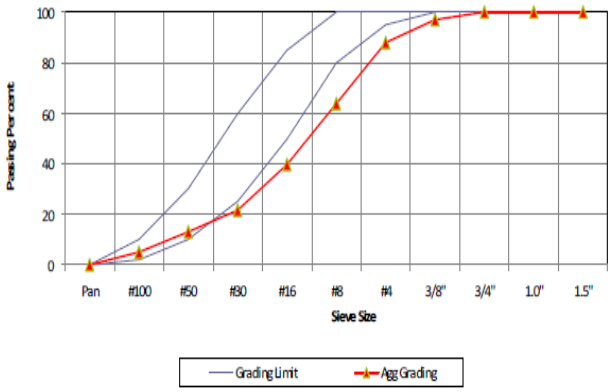


Fig. 4: Grading Material of M-Sand.

From the picture above shows that a 3/4 sieve of 100% means m-sand is finer than bangka sand which means better mixing of concrete because the air cavity in concrete will be filled with ash so that the mixture is more solid than pure bangka sand. River sand was replaced by manufactured sand (M-sand) at replacement levels of 20,40,60,80 and 100% [12].

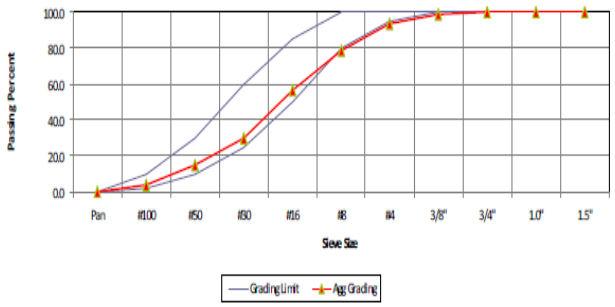


Fig. 5: Grading combined of Bangka sand and M-Sand.

From the picture above looks 3/4 sieve of 100% means the mix between m-sand and sand of bangka still enter the gradation limit. if above the graph can not be used as well as under the lower limit.

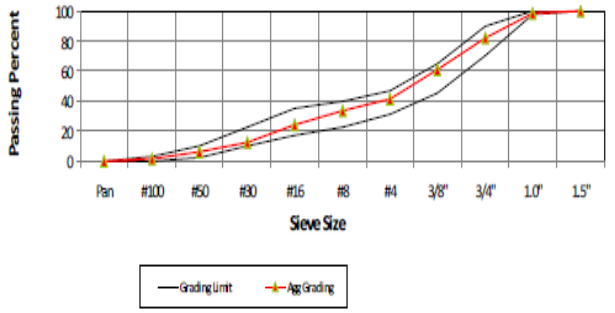


Fig. 6: Material Combined Max. 25mm.

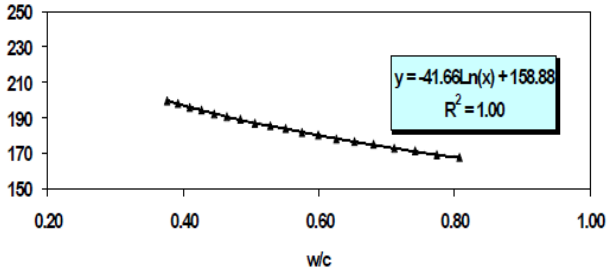


Fig. 7: Free Water Requirement per M3 to Slump 12 Cm.

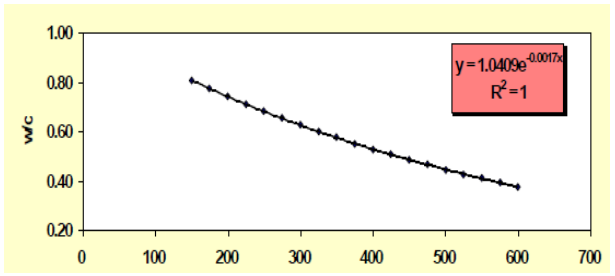


Fig. 8: Correlation W/C to Compressive Strength.

Table 2: Mix Design Concrete of Bangka 50%, M-Sand 50%, Split 100%, Fly Ash 20%

No.	Quality (K)	Slump (cm)	Deviation kg/cm²	Goal kg/cm²	Fas	S/A (%)	Material Composition (SSD)								Admixture			Weight of Concrete kg/m³
							Cementitous kg/m³	Cement	Fly Ash	Stone Ash kg/m³	Sand Sumedang	Split 1/2.5 kg/m³	Split 2-3.5 kg/m³	Water lt/m³	Type F lt/m³	Type D lt/m³	Type G lt/m³	
1	100	12 ± 2	30	148	0,808	52	208	166	42	511	511	952	0	168	0	0,62	0	2,349
2	125	12 ± 2	30	174	0,774	51	219	175	44	499	499	959	0	170	0	0,66	0	2,348
3	150	12 ± 2	30	199	0,742	50	231	185	46	488	488	966	0	171	0	0,69	0	2,346
4	175	12 ± 2	30	224	0,711	50	243	195	49	478	478	972	0	173	0	0,73	0	2,344
5	200	12 ± 2	30	249	0,681	49	257	205	51	467	467	976	0	175	0	0,77	0	2,343
6	225	12 ± 2	30	274	0,653	48	270	216	54	457	457	980	0	177	0	0,81	0	2,341
7	250	12 ± 2	30	299	0,626	48	285	228	57	447	447	982	0	178	0	0,86	0	2,340
8	275	12 ± 2	30	324	0,600	47	300	240	60	437	437	984	0	180	0	0,90	0	2,338
9	300	12 ± 2	30	349	0,575	47	316	253	63	427	427	984	0	182	0	0,95	0	2,337
10	325	12 ± 2	30	374	0,551	46	333	267	67	417	417	983	0	184	0	1,00	0	2,336
11	350	12 ± 2	30	399	0,528	46	351	281	70	408	408	981	0	185	0	1,05	0	2,334
12	375	12 ± 2	30	424	0,506	45	370	296	74	398	398	978	0	187	0	1,11	0	2,333
13	400	12 ± 2	30	449	0,485	45	390	312	78	389	389	974	0	189	0	1,17	0	2,332
14	425	12 ± 2	30	474	0,465	44	410	328	82	380	380	969	0	191	0	1,23	0	2,331
15	450	12 ± 2	30	499	0,446	44	432	346	86	371	371	963	0	193	0	1,30	0	2,330
16	475	12 ± 2	30	524	0,427	43	455	364	91	362	362	956	0	194	0	1,37	0	2,329
17	500	12 ± 2	30	549	0,409	43	479	383	96	353	353	947	0	196	0	1,44	0	2,329
18	525	12 ± 2	30	574	0,392	42	505	404	101	343	343	938	0	198	0	1,51	0	2,328
19	550	12 ± 2	30	599	0,376	42	531	425	106	334	334	927	0	200	0	1,59	0	2,328

From the concrete experiments, it was shown that 50% m-sand after washing (mud content meets the standard) with 50% Bangka Sand produce the same compressive strength as 100% Bangka Sand mix. So from the base of the experiment then made a plan to make a washing plant to obtain or improve the quality of the M-sand which during this high mud content is ± 19%.

5. Conclusion

From the above experimental data, the following conclusions can be drawn as follows:
High mud content in the stone ash can be lowered by washing using clean water, so stone ash material quality meet qualifies.
The compressive strength using 50% m-sand combined with 50% bangka sand with mud content as required, produces the same compressive strength as 100% of master bangka.
The use of m-sand can lower the cost of materials, this is because the price of m-sand is cheaper than bangka sand.
M-sand can neutralize the organic content in the sand of Bangka is sometimes high.
The use of m-sand can improve the grading of material combinations, because the dispersion of stone ash grains is between the split grains and the sand of Bangka
For Bangka Sand with low fine agregate (smooth), Stone ash can neutralize the weakness, so obtained fine agregate and gradation of the ideal Sand.

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References

[1] W. Shen et al., "Mixing design and microstructure of ultra-high strength concrete with manufactured sand," Constr. Build. Mater. vol. 143, pp. 312–321, 2017.
[2] R. Hidayawanti, S. Legino, and D. Harjanto, "OPTIMIZING THE UTILIZATION CEMENT SLAG AND FLY ASH OF," no. March, pp. 14–18, 2018.
[3] W. Shen et al., "Influence of manufactured sand's characteristics on its concrete performance," Constr. Build. Mater. vol. 172, pp. 574–583, 2018.
[4] R. Siddique, G. de Schutter, and A. Noumowe, "Effect of used-foundry sand on the mechanical properties of concrete," Constr. Build. Mater. vol. 23, no. 2, pp. 976–980, 2009.
[5] R. Siddique and G. Singh, "Utilization of waste foundry sand (WFS) in concrete manufacturing," Resour. Conserv. Recycl. vol. 55, no. 11, pp. 885–892, 2011.
[6] P. Nanthagopalan and M. Santhanam, "Fresh and hardened properties of self-compacting concrete produced with manufactured sand," Cem. Concr. Compos. vol. 33, no. 3, pp. 353–358, 2011.
[7] R. N. U. Shanmugapriya T., "Optimization of Partial Replacement of M-Sand by Natural Sand in High Performance Concrete with Silica Fume," Int. J. Eng. Sci. Emerg. Technol., vol. 2, no. July, pp. 73–80, 2012.
[8] M. Padmanabhan and P. H. Paulose, "Behaviour of Concrete Made by Partially Replacing Fine Aggregate with Foundry Sand and Quarry Dust," pp. 3279–3282, 2018.
[9] M. Popek and Ł. Sadowski, "Effect of selected mineral admixtures on mechanical properties of concrete," Key Eng. Mater., vol. 728, 2017.
[10] R. Siddique, G. Singh, and M. Singh, "Recycle option for metallurgical by-product (Spent Foundry Sand) in green concrete for sustainable construction," J. Clean. Prod., vol. 172, pp. 1111–1120, 2018.
[11] J. A. Mary, "An Experimental Investigation on Stone Dust as Partial Replacement of Fine Aggregate in Concrete," vol. 3, no. 5, pp. 229–232, 2014.
[12] K. Praveen Kumar and Radhakrishna, "Characteristics of SCC with Fly Ash and Manufactured Sand," IOP Conf. Ser. Mater. Sci. Eng., vol. 149, no. 1, p. 012111, Sep. 2016.