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Performance of Recycled Aggregate Concrete Using Silicate Glass Powder and Mining Powder

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ABSTRACT

Concrete because of its specialties which are flexibility resilience and the economy is the most extensively used material in the construction sector. The concrete comprises cement, aggregates, and admixtures. The urbanization growth rate in India is increasing rapidly due to the rapid growth in industrialization. Hundreds of concrete structures are being constructed daily. This increases the demand for the raw materials needed for construction i.e. cement, aggregates, sand, etc. The increase in demand leads to depletion of natural resources and environmental degradation, also this rapid industrialization results in the demolition of old concrete structures to build new ones. This present study aims to investigate experimentally the use of recycled aggregates and partial replacement of cement using silicate glass powder and mining powder one at a time as a mineral admixture for abrasion strength in cement concrete. In this study, there is replacement of cement partially with silicate glass powder (SGP) and mining powder (MP) at varying proportion (2.5%, 5%, 7.5% and 10%). There replacement of the aggregate is done with recycled coarse aggregate (RCA) which is fixed at 20 % in all samples to investigate the abrasive resistance. From this study, it was noticed that in silicate glass powder, the abrasive strength of recycled aggregates concrete remains almost same till the sample containing 5% of silicate glass. On further increasing the silicate glass content from 5% to 10%, there is sudden decrease in the weight loss was noted. For mining powder abrasive strength of recycled aggregates decreases with the increase in mining powder till 2.5%. On further increasing the amount of mining powder content from 2.5% to 10% gradual decreases in the weight loss was observed. It was found that the replacement of cement partially with the silicate glass powder and the mining powder both will increase the abrasiveness of concrete at varying proportions (2.5%, 5%, 7.5% and 10%).

Keywords - Recycled aggregate, Silicate glass powder, Mining powder, Abrasive resistance

INTRODUCTION

Concrete because of its specialties which are flexibility resilience and the economy is the most extensively used material in the construction sector. According to global usage, it is the second most commonly used after water. Today, the construction industry all over the world is using resources at a very high level due to which it will be very difficult to meet the

demand coming in the future. Aggregate has the highest mining in the world. Fine and coarse aggregates are limited natural resources and are being consumed at a very high rate by the construction industry. The total production of concrete at the annual rate is approximately about $1m^3$ per person. The use of aggregates is fast happening around the world and has reached 49 billion metric tons since 2015. Due to the new and modern construction, the utility of the old structures is decreasing, due to which they are being demolished. According to the report of the Central Pollution Control Board, Delhi, the total production of solid waste in India is 48.5 million tones, out of which 14.5 million tons of waste is produced from the construction field and only 3% of that solid waste is reused. 70-75 per cent aggregate is used to make concrete which has 60-65 per cent course aggregate and 35-40 per cent fine aggregate. From an environmental point of view, the emission of carbon to make a ton of aggregate is 0.0046 million tons of existing carbon while on the other hand 0.0024 million ton of existing carbon is emitted to make 1 ton of recycle aggregate. This has created a negative impact on the environment because the concrete industry is being consumed with natural resources at a fast rate and the landfills are being jam-packed with concrete waste. Seeing the growing awareness of the conservation of the environment and its safety, waste disposal for planners and engineers has become a matter of major concern. Environmentalists and researchers did a lot of research to use the waste derived from the demolition of buildings and structures instead of natural aggregates in concrete mixes. So the use of recycled waste to get the disposal of concrete waste has become a very attractive option today. Increasing awareness of the conservation of natural resources and reducing carbon emissions the use of recycled aggregate has begun in concrete mixes today. It is very easy to recycle concrete waste. This process involves removing and crushing the concrete waste so that we can get aggregate of good quality and size. The application of recycled concrete in concrete mixes has made the use of construction waste quite effective. The use of recycled aggregates in the construction industry boosts the possibilities of the reuse of a lot of material in concrete. The application of recycled aggregate in concrete is the key to reducing construction waste in landfills and keeping the environment safe.

Need of study

After reading a lot of literature, it has been found that research is being done to use recycle aggregate in a proper way in a new concrete mix. Recycled aggregates have been used in non-structural construction works but in some research area it used as structural concrete.

1. This study involves the use of RCA thus it aims at making the production of recycled aggregate concrete more economical and environment friendly.
2. The research on the amount of glass powder as cement replacement and mining powder to analysis the abrasion strength of concrete is limited.

EXPERIMENTAL WORK

The experimental program was planned to examine the abrasive strength of recycle aggregate concrete (RAC). The objective of the study is to vary the percentage of replacing cement with silicate glass powder (SGP) and mining powder (MP) as 2.5%, 5%, 7% & 10% while keeping the replacing of recycled coarse aggregates (RCA) constant as 20%. The test program have the activities mentioned below:-

- Procurement of materials including aggregates, cement, demolished concrete waste for recycled aggregates, supplementary cementitious materials (Silicate Glass Powder and Mining Powder).
- Crushing of the demolished concrete specimens to obtain recycled coarse aggregates.
- Testing of the natural and recycled aggregates for their properties physically such as specific gravity, absorption of water and the testing of cement for its consistency, soundness and final and initial setting time.
- Design of the nominal mix of M25 and test specimens

casting.

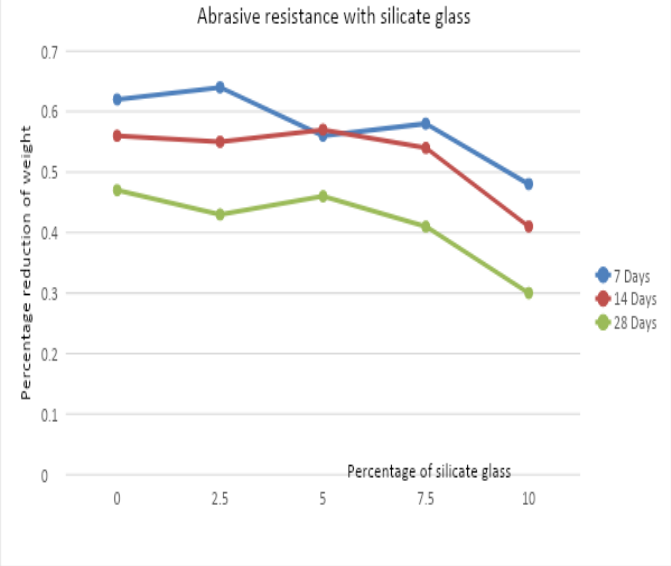
- Specimens testing for abrasive value at curing ages of 7, 14 and 28 days.
- Analysis of the results for various tests.

Tests on hardened concrete specimens

Abrasive Resistance

For each mix cubes (70×70×70 mm) were cast for abrasive strength test on the curing ages of 7, 14 and 28 days respectively. One sample consisted of 3 specimens in the form of cube. Natural coarse aggregates were replaced with RCA at fixed 20%and cement was replaced at varying 2.5%, 5%, 7.5% and 10%. The 7, 14 and 28 day test results were examined.

Figure 1 Comparison of abrasive resistance at different curing ages

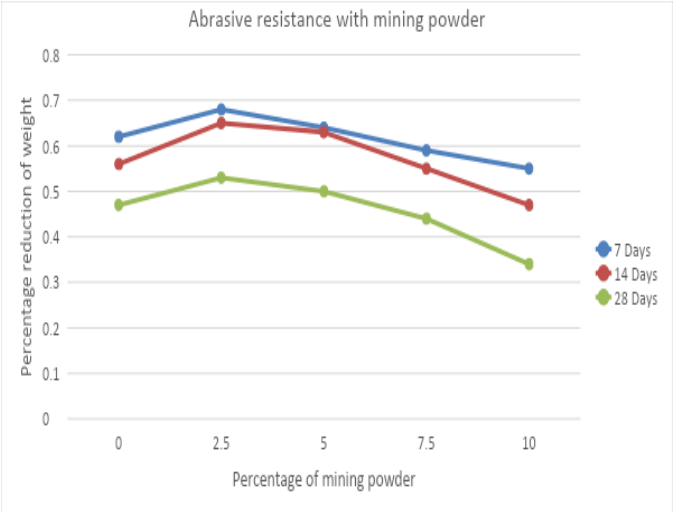


● For 7 days- Abrasive resistance of recycled aggregates concrete remains almost same till the sample containing 2.5% of silicate glass. On further increasing the silicate glass content from 2.5% to 5%, a sudden decrease in the percentage of weight loss was noted. From 5% to 7.5%, slight increase in percentage of weight loss was observed. From 7.5% to 10 %, sudden decrease in percentage of weight loss was observed.

● For 14 days- Abrasive resistance of recycled aggregates goes through approximately the same amount of abrasion till the sample containing 5% of silicate glass. On further increasing the silicate glass content from 5% to 10 %, a sudden decrease in the percentage of weight loss was noted.

● For 28 days- Abrasive resistance of recycled aggregates goes through approximately the same amount of abrasion till the sample containing 5% of silicate glass. On further increasing the silicate glass content from 5% to 10 %, a sudden decrease in the percentage of weight loss was noted.

Figure 2 Comparison of abrasive resistance at different curing ages



● For 7 days – Abrasive resistance of recycled aggregates decreases with the increase in mining powder till the sample containing 2.5%. On further increasing the mining powder content from 2.5% to 10%, a gradual decrease in the percentage of weight loss was noted.

●Similar trend was also observed for 14 and 28 curing days.

REFERENCES

[1] Al-Akhras, N.M., 2006. Durability of metakaolin concrete to sulfate attack. Cement and concrete research, 36(9), pp.1727-1734.

[2] Awoyera, P.O. and Okoro, U.C., 2019. Filler-ability of highly active metakaolin for improving morphology and strength characteristics of recycled aggregate concrete. Silicon, 11(4), pp.1971-1978.

[3] Braga, M., De Brito, J. and Veiga, R., 2012. Incorporation of fine concrete aggregates in mortars.

Construction and Building Materials, 36, pp.960-968.

[4] Bhagyasri, T., Prabhavathi, U. and Vidya, N., 2016, March. Role of Glass Powder in Mechanical strength of concrete. In IRF International Conference.

[5] Chesner, W.H., 1992. Waste glass and sewage sludge frit use in asphalt pavements. In Utilization of waste materials in civil engineering construction (pp. 296-307). ASCE.

[6] Chesner, W.H., Collins, R.J., MacKay, M.H. and Emery, J., 2002. User guidelines for waste and by-product materials in pavement construction (No. FHWA-RD-97-148, Guideline Manual, Rept No. 480017). Recycled Materials Resource Center.

[7] Dabiri, H., Sharbatdar, M.K., Kavyani, A. and Baghdadi, M., 2018. The Influence of Replacing Sand with Waste Glass Particle on the Physical and Mechanical Parameters of Concrete. Civil Engineering Journal, 4(7), pp.1646-1652.

[8] Evangelista, L. and de Brito, J., 2007. Mechanical behaviour of concrete made with fine recycled concrete aggregates. Cement and concrete composites, 29(5), pp.397-401.

[9] Hamad, B.S. and Dawi, A.H., 2017. Sustainable normal and high strength recycled aggregate concretes using crushed tested cylinders as coarse aggregates. Case Studies in Construction Materials, 7, pp.228-239.

[10] IS 2386:1963 (Part III) "Methods of tests for specific gravity of aggregates, Bureau of Indian Standards" New Delhi.

[11] IS 2386:1963 (Part I) "Methods of tests for sieve analysis of coarse and fine aggregates, Bureau of Indian Standards" New Delhi.

[12] IS 456:2000 "Code of practice Plain and Reinforced Concrete, Bureau of Indian Standards" New Delhi.

[13] IS 4031:1988 (Part IV) "Methods of tests for standard consistency of cement, Bureau of Indian Standards" New Delhi.

[14] IS 4031:1988 (Part V) "Methods of tests for determination of initial and final setting time of cement, Bureau of Indian Standards" New Delhi.

[15] IS 4031:1988 (Part XI) "Methods of tests for specific gravity of cement, Bureau of Indian Standards" New Delhi.

[16] IS: 8112:1989 "Specification for ordinary Portland Cement grade 43, Bureau of Indian Standards" New Delhi.

[17] Khatib, J.M., 2005. Properties of concrete incorporating fine recycled aggregate. Cement and concrete research, 35(4), pp.763-769.

[18] Kou, S.C., Poon, C.S. and Chan, D., 2007. Influence of fly ash as cement replacement on the properties of recycled aggregate concrete. Journal of materials in civil engineering, 19(9), pp.709-717.

[19] Law, D. and La Rosa, E., 2011. Impact of sulphate exposure on blended cements. In 12th International Conference on the Durability of Building Materials and Components (pp. 1-8). Durability of Building Materials and Components.

[20] Lee, S.T., Swamy, R.N., Kim, S.S. and Park, Y.G., 2008. Durability of mortars made with recycled fine aggregates exposed to sulfate solutions. Journal of Materials in Civil Engineering, 20(1), pp.63-70.

[21] Liang, J.F., Wang, E., Zhou, X. and Le, Q.L., 2018. Influence of high temperature on mechanical properties of concrete containing recycled fine aggregate. Computers and Concrete, 21(1), pp.87-94.

[22] Limbachiya, M.C., Leelawat, T. and Dhir, R.K., 2000. Use of recycled concrete aggregate in high-strength concrete. Materials and structures, 33(9), p.574.

[23] Mahmoodian, M. and Alani, A.M., 2017. Effect of temperature and acidity of sulfuric acid on concrete properties. Journal of Materials in Civil Engineering, 29(10), p.04017154.

[24] Malik, M.I., Bashir, M., Ahmad, S., Tariq, T. and Chowdhary, U., 2013. Study of concrete involving use of waste glass as partial replacement of fine aggregates.

IOSR Journal of Engineering, 3(7), pp.8-13.

[25] Matias, D., de Brito, J., Rosa, A. and Pedro, D., 2014. Durability of concrete with recycled coarse aggregates: influence of superplasticizers. Journal of materials in civil engineering, 26(7), p.06014011.

[26] McNeil, K. and Kang, T.H.K., 2013. Recycled concrete aggregates: A review. International journal of concrete structures and materials, 7(1), pp.61-69.

[27] Muduli, R. and Mukharjee, B.B., 2019. Effect of incorporation of metakaolin and recycled coarse aggregate on properties of concrete. Journal of cleaner production, 209, pp.398-414.

[28] Prajapati, R. and Mishra, C., Effect of Replacement of Cement & Aggregate by Glass Powder & Recycled Aggregate on Flexural Strength of Concrete.

[29] Sastry, V.R. and Ram Chandar, K., 2013. Dump stability analysis of an open cast coal mining project. Min. Eng. J, 15(1), pp.16-23.

[30] Singh, B. and Jain, R., 2018. Use of waste glass in concrete: A review. J. Pharmacogonosy & Phytochemistry, pp.96-99.

[31] Sun, J.S., Dou, Y.M., Chen, Z.X. and Yang, C.F., 2011. Experimental study on the performances of cement stabilized iron ore tailing gravel in highway application. In Applied Mechanics and Materials (Vol. 97, pp. 425-428). Trans Tech Publications Ltd.

[32] Thomas, J., Thaickavil, N.N. and Wilson, P.M., 2018. Strength and durability of concrete containing recycled concrete aggregates. Journal of Building Engineering, 19, pp.349-365.

[33] Yahia, Y.I., Alsharie, H., Suliman, M.O. and Masoud, T., 2017. Effects of wood ash and waste glass powder on properties of concrete in terms of workability and compressive strength in Jaresh city. Open Journal of Civil Engineering, 7(3), pp.423-431.

[34] Zega, C.J. and Di Maio, Á.A., 2011. Use of recycled fine aggregate in concretes with durable requirements. Waste management, 31(11), pp.2336-2340..