International Journal of Aquatic Science
ISSN: 2008-8019
Vol 15, Issue 01, 2024

An Experimental Investigation on Self-Healing Pervious Concrete

Aishwarya R. Shrikhandkar[1], Devyani A. Kadam[2], Mayur M. Sonavane[3], Tushar D. Kolhe[4], Prof. R.S Kedar[5], Prof. R. K. Kakpure[6]

Email: [1]aishwaryashrikhandkar42@gmail.com, [2]devyanik2512@gmail.com, [3]sonwanemayur31@gmail.com, [4]kolhe4569@gmail.com, [5]kedar_ravindra@yahoo.com, [6]rutujakakpure@gmail.com

Abstract: ***Pervious concrete is a type of concrete with a high void content, which allows water to pass through it more easily than traditional concrete. This makes it a good choice for applications such as parking lots, sidewalks, and driveways, where it can help to reduce storm water runoff and improve water quality However, pervious concrete is also more susceptible to cracking than traditional concrete due to its high porosity. This can be a problem in areas where the concrete is exposed to heavy traffic or extreme weather conditions. Self-healing concrete is a type of concrete that can repair itself when it cracks. This is typically done by incorporating bacteria or other microorganisms into the concrete mix. When the concrete cracks, these microorganisms are activated and produce minerals that fill in the cracks and seal them. Self-healing pervious concrete is a type of pervious concrete that has self-healing capabilities. This is typically done by incorporating self-healing bacteria into the concrete mix. When the concrete cracks, these bacteria are activated and produce calcium carbonate, which fills in the cracks and seals them.***

Keywords: self-healing, bacteria, bacillus sub stiles, pervious concrete, permeable concrete

1. INTRODUCTION

Pervious concrete has emerged as a sustainable solution for managing storm water runoff in urban areas by allowing water to permeate through its porous structure. However, one of the primary challenges faced by pervious concrete is its susceptibility to cracking, which can compromise its structural integrity and reduce its effectiveness in managing storm water. Traditional methods of repairing these cracks often require costly and time-consuming interventions, leading to increased maintenance efforts and downtime.

To address this challenge, researchers and engineers have turned their attention to self-healing materials, which have the potential to autonomously repair cracks and extend the service life of concrete structures. Self-healing mechanisms mimic the natural healing processes observed in living organisms, offering a promising solution to enhance the durability and performance of pervious concrete. This project aims to investigate the feasibility and effectiveness of various self-healing mechanisms in pervious concrete. By exploring different approaches such as autogenous healing, capsule-based healing, biological healing, and fiber-reinforced healing, we seek to assess their ability to repair cracks and restore the integrity of pervious concrete under different environmental conditions. Through a comprehensive experimental investigation, this study aims to contribute to the advancement of self-healing materials and pave the way for the development of resilient and sustainable infrastructure systems. By integrating self-healing mechanisms into pervious concrete, we can not only enhance its

durability and longevity but also reduce the environmental impact associated with maintenance and repair activities. The findings of this research have the potential to revolutionize the way we design and adoption of self-healing pervious concrete has the potential to promote sustainable urban development and mitigate the adverse effects of storm water runoff on the environment and public health

2. LITERATURE REVIEW

[1] Salunkhe patil S.S., Patil O.D., Dhemare A. M., Jadhav S.A., Bhirud S.V. (2018), A review on mix Design for pervious concrete. The main aim of this review study is to study the effect of different sizes of aggregate and the different mixes on the properties of pervious concrete. As the pervious concrete can be the solution for increasing infiltration of water into the ground and decreasing the runoff due to its porous nature.

[2] Muhammad Zeeshan (2020), "A Study on Compressive Strength of Pervious Concrete" This paper presents the end result of the relative learn of different researches, to find out the optimum compressive strength concrete mix made without fine aggregates. As well as, to look for the aftereffect of aggregate/cement proportion, w/c ratio, and size of aggregates on the compressive strength of pervious concrete.

[3] Chaitanya balajirao ghatol (2020), "bacteria-based self-healing Concrete incorporated with industrial waste (fly ash) for the development of sustainable
Concrete" In this project bacteria is used, the research is carried out by using M25 grade concrete with replacement of 2.5%,5%,7.5%,10%, Bacteria by keeping Fly ash as 5%,7.5%,10%,12.5% constant and is carried out to determine the optimum percentage of replacement at which maximum compressive strength is achieved, the properties of the material are analyzed.

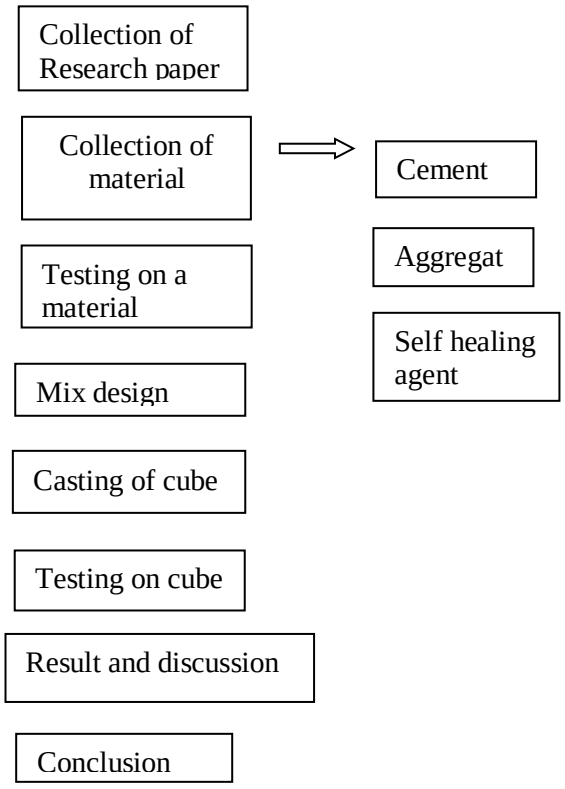
[4] Salmabanu Luhar, Suthar Gourav (2015), "A Review Paper on Self Healing Concrete"In this research The selection of the bacteria was according to their survival in the alkaline environment such as B. pasteurii, Bacillus subtiles and B. spharicus which are mainly used for the experiments by different researchers for their study. The condition of growth is different for different types of bacteria. For the growth, bacteria were put in a medium containing different chemicals at a particular temperature and for a particular time period. Bacteria improves the structural properties such as tensile strength, water permeability, durability and compressive strength of the normal concrete which was found by the performing different type of experiment on too many specimens had varying sizes used by different researchers for their study of bacterial concrete in comparison with the conventional concrete and from the experiment it was also found that use of light weight aggregate along with bacteria helps in self healing property of concrete. For gaining the best result a mathematical model was also introduced to study the stress-strain behavior of bacteria which was used to improve the strength of concrete.

[5] Dev Pratap Mani Tripathi , S. M. Ashraf Hussain, Praneet Madhav (2017), An Experimental Study on "Pervious Concrete (Mix-Ratio, Strength and Porous Properties)"
This paper represents the experimental methodology and experimental results related to strength, Mix ratio and water absorption. Cubes of size 150mm×150mm×150mm height are prepared to investigate both these properties. This investigation is carried out at the end of 1 day, 3 day, 7 day and 28 days for Strength of pervious concrete and for water absorption. Different concrete mix proportions such as 1:4, 1:5, 1:6, and 1:7 with different sizes of gravel such as 20 mm,12.5mm and 9.6 mm should be used to check both these properties of pervious concrete.

Objective

1) To increase the durability and service life of pervious concrete structure.
2) To reduce the need for maintenance and repairs.
3) To develop self healing pervious concrete that is very cost effective.
4) To improve load bearing capacity and skid resistance.
5) To promoting groundwater recharge and reducing storm water runoff.

3. METHODOLOGY



4. MATERIAL PROPERTIES

4.1 Cement

Portland Pozzolane Cement (ACC – Suraksha 43 Grade) is typically used, but other types of cement, such as ordinary portland cement (OPC) sulfate-resistant cement or low-alkali cement, and others type of cement may be used depending on the specific application.

Sr. No	Property	Results
1	Fineness modulus	4.67 %
2	Consistency	30%
3	Initial setting time	45 min
4	Final setting time	580 min

4.2 Aggregate

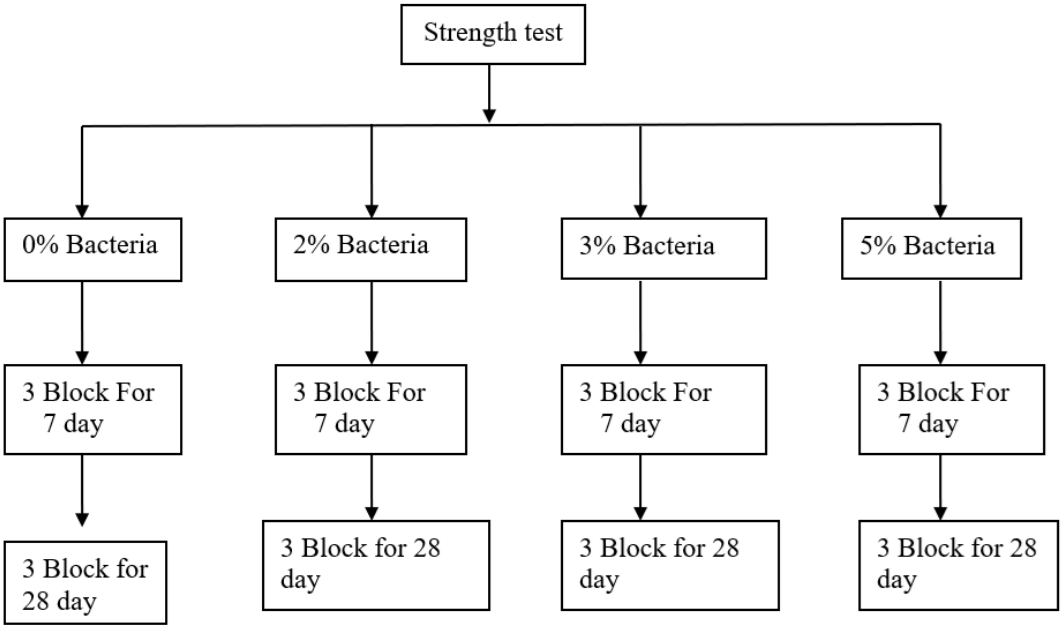
Coarse aggregates are typically used in pervious concrete. The aggregate are passing from

12mm IS sieve and retained on 10mm IS sieve.

5. MIX DESIGN

Sr No	Properties	mix
1	Mix proportion (C:A)	1:2.93
2	Water cement Ratio	0.35
3	Cement	450 kg/m3
4	Course Aggregate	1317.76kg/m3
5	Water absorption	1.20 %
6	Grade of Concrete	M20

.
Bacteria is prepared and added in pervious concrete mix in specific proportion this include three combinations in varied quantities of solution in concrete during mixing. Following chart represents the total quantity of blocks casted for the testing.



6. RESULTS AND DISCUSSION:

6.1 Compressive strength for 7 day
Dimension = 150 mm x 150 mm

Samples	Dimension of concrete block (L x B)	Surface area of block	Total load in Kilo Newton	Load in Newton	Load in N/mm^2
0%	150 x 150	22,500	263	263000	11.703

2%	150 x 150	22,500	242	242000	10.743
3%	150 x 150	22,500	265	265000	11.785
5%	150 x 150	22,500	299	299000	13.288

7. SUMMERY AND CONCLUSION

7.1 Summery: -

The project focuses on enhancing the self-healing capabilities of pervious concrete by incorporating bacteria into the mix at varying percentages (2%, 3%, and 5%). After conducting tests, it was observed that the mix containing 5% bacteria exhibited superior strength compared to the other mixes after 7 days.

7.2 Conclusion

The inclusion of bacteria in pervious concrete shows promise for improving its self-healing properties. The mix with 5% bacteria demonstrated the highest strength after 7 days, suggesting that this percentage could be optimal for achieving the desired performance. Further research and experimentation could delve deeper into optimizing bacterial content and assessing long-term durability to fully harness the potential of self-healing pervious concrete.

8. REFERENCES

[1] Chaitanya Balajirao Ghatol (2020), "Bacteria-based self-healing concrete incorporated with industrial waste (fly ash) for the development of sustainable concrete" Mgm's Jawaharlal Nehru Engineering College Aurangabad, Volume 7, Issue 8.

[2] Muhammad Zeeshan (2020), "A Study on Compressive Strength of Pervious Concrete" CECOS University Peshawar, Khyber Pakhtunkhwa, Pakistan,

[3] Salunkhe patil S.S.Patil O.D., Dhemare A.M.,Jadhav S.A., Bhirud S.V. (2018), "a review on mix design for pervious concrete" Bharati Vidyapeeths College of Engineering, Kolhapur (India).

[4] S.N.abhishek, pritam a. Deshmukh (2019), "Mix Proportion of Materials in Pervious Concrete", Shivajirao S. Jondhle College of Engineering & Technology, Asangaon, Maharashtra. Volume: 06 Issue: 02.

[5] P.V.Yatish reddy, Dr. G B Ramesh kumar (2019) A review on the pervious concrerte Saveetha School of Engineering Saveetha Institute of Medical and Technical Sciences, Chennai – 602 105, TN, India Volume 6, Issue 5

[6] Aditya Vishvanath Mhatre,2 Bhavik Ramesh Bhanushali, 3 Mohammed Rohaan Muslim Sheikh, Prof. Nikhil Ingle (2021) Design And Testing Of High Strength Pervious Concrete For High Traffic City Pavements Like Mumbai Department of Civil Engineering, Rizvi College of Engineering, Bandra, Mumbai, India. Volume 8, Issue 4

[7] Mohan dangi , mohit kumar prajapati (2021) detailed analysis of pervious concrete School of Engineering and Technology, Vikram University, Ujjain (M.P.)

[8] S. Rajesh Kumar (2015), "characteristic study on pervious concrete srm Institute of Science & Technology, SRM University, Chennai. Volume 6, Issue 6

[9] M. HarshavarthanaBalaji1, M.R.Amarnaath, R.A.Kavin, S. Jaya pradeep (2015) design of eco friendly pervious concrete Knowledge Institute of Technology, Kakkapalayam, Salem – 637 504, Tamil Nadu, India. Volume 6, Issue 2

[10] Mohammed Sonebia, Mohamed Bassuonib, Ammar Yahiac (2016) Pervious Concrete: Mix Design, Properties and Applications Department of Civil Engineering, University of Sherbrooke, QC, Canada

[11] K.mounika dr.k.chandramouli j.sree naga chaitanya (2018) experimental study on bacterial concretessrg international journal of civil engineering
[12] Praneet Madhav, Dev Pratap Mani Tripathi, S. M. Ashraf Hussain (2017) An Experimental Study on Pervious Concrete (Mix-Ratio, Strength and Porous Properties) Allenhouse institute of Technology, Rooma, Kanpur Vol. 6 Issue 12
[13] Salmabanu Luhar, Suthar Gourav (2015) A Review Paper on Self Healing Concrete Research Scholar, Malaviya National Institute of .4, Jaipur
[14] M.Monishaa, Mrs.S.Nishanthi. (2017) experimental study on strength of self-healing concrete Dr. Sivanthi Aditanar College of Engineering, Tiruchendur. Tamilnadu, India.
[15] Rishabh Joshi, Sharda Prasad Rai (2018) an experimental study on self healing of concrete using bacillus subtiles in cultured form 1Shri Ramswaroop Memorial University, Barabanki, Uttar Pradesh, India Volume 6, Issue 2
[16] Anil Kumar, Atal Mishra, Sikandar Kushwaha, Tushar Shahu, Nitika Singh (2023)self healing concrete by the use of species bacillus subtiles of bacteria Goel Institute Of Technology And Management, Lucknow, India. Volume:05/Issue:12
[17] Z M Hussein, A H Abedali, A S Ahmead (2019) Improvement Properties of Self -Healing Concrete by Using Bacteria College of Agricultural Engineering Science, Baghdad University, Iraq
[18] M. Pavan kumar, J. Vinod, K. Madhu (2020) to study self-healing of concrete using bacillus subtiles, bacteria Sanketika Vidya Parishad Engineering College, Visakhapatnam Volume: 07 Issue: 08
[19] Prof. Mayur R. Kukadiya1, a) and Prof. Ajaysinh Vaghela (2022) Enhancement of Self-Healing Concrete Using Bacillus Subtile Bacteria as an Ingredient School Of Engineering RK University Rajkot, Gujarat, India
[20] Raj Abhishek (2018) A Brief Study on Self-Healing Concrete School of Engineering & IT, Arka Jain University, Jamshedpur, Jharkhand, India Volume 5, Issue 6.