10.48047/jocaaa.2024.33.08.212

A PREDICTION ON CROP WATER REQUIREMENT FOR IRRIGATION PLANNING AND SCHEDULING AT RESERVIOR TO MAINTAIN ENVIRONMENTAL STRATEGIES

Dr.R.Bala murugan[1] Dr.S.Selvamuthukumar[2],

[a,] *Associate professor , Department of Civil engineering , Annamalai university, Chidambaram, India.*
[b] *Assistant Professor , Department of Civil Engineering, Government College of Engineering, Tanjavore,India*

Abstract

In India agriculture is the mainly uses the water, so that well planned usage of water in agriculture is very much important. Nowadays in India severe shortage of water is developing and hence becoming scarcity of water for agriculture. The main motive of the project is to conserve water with the help of software that determines all the needs for the crop to grow. The initial site information such as soil details, cultivation area, and water resources are collected. Additionally, a survey is made to get the exact information on cultivated crops. With the data obtained using the software's namely CROPWAT and CLIMWAT, the geographical details can be estimated. A station is chosen, and the rainfall data is obtained. Referring to the values obtained from the station, the values are then inputted into the CLIMWAT software. This provides the data regarding the climate and the site's rainfall. We now move to the crop details and other parameters required with the climate and rainfall details being done. As we have already visited the site, the soil samples were collected prior. Sieve analysis and jar tests were conducted to determine the soil type and texture. After the determination of soil, the soil type is selected in the CROPWAT model, and then the soil data is inputted. The crops mainly grown in that surroundings were obtained by the survey made, and now this data is inputted into the CROPWAT software. This extracts the details of the crop needs, such as the water required, the soil needed, and the time to sow and harvest. The water source nearby the selected site is the Poondi reservoir, and the water requirement data is inputted, and the water/ irrigation details are obtained. With this data, we know at what interval, when, and how much water is needed for the crop to grow. Thus, with this information obtained, the excessive use of water can be regulated, and water can be conserved. This is an excellent source of knowledge for anyone new to agriculture.

Keywords— CROPWAT, CLIMWAT, Poondi Reserviour.

1. Introduction

India comes under countries which faces serious water scarcity. Agriculture being the back bone of Indian economy and the country depends on agriculture which comprises around (81%) there is a huge demand for water in the agricultural sector. For Indian agriculture it is very important to have a better understanding of the complicated interactions between crops cultivation, climate and water. Food waste has become a habit for the people which has put a strain on the economy and also damages our environment. Emissions of green- house gas increases due to the food waste which will contributes the change in climate so it is essential to stop food loss and food waste. Food loss means the portion of food we lost during harvest, till the retail level. Food waste means the part of the food that was wasted by the retail level or consumer. To find the root causes for this problem we clearly distinct the two problems, a problem for everyone from the farmers or the producers to Shop-owners and customers who can help till end. An essential thing to produce the crops are food and water. Hence, using the 2-model software's such as CLIMWAT and CROPWAT in the project we made an attempt to calculate the crop water requirements of main crops in various agro-ecological zones. CROPWAT is to calculate the irrigation scheduling, crop water requirements and irrigation supply to different types of crops. CLIMWAT gives to the stations at its database, monthly mean values for long-term based on to Penman-Monteith method: monthly total and effective rainfall. mean daily minimum temperature, mean daily maximum temperature, mean sunshine hours or solar radiation, mean relative humidity, mean wind speed,

10.48047/jocaaa.2024.33.08.212

The main objective of this project was, managing crops efficiently according to the different conditions of weather, temperature and rainfall. This project is also done to find out water required for crops in different seasons in a particular location.Effective water management means reducing wastage of water by calculating the water necessary to the particular purpose and the water that was used for that purpose. Water conservation is different from that of water efficiency. Water efficiency mainly focuses on reducing waste but not on restricting usage, and also, we will get a particular data of the exact water we required and monthly, daily, dates of climate for that crop. This gives bright future to the agriculture and also very useful for the growing up farmers. The procedure of determining the amount of water required by the crops is critical. Farmers will save a lot of money, effort, and, most critically, water resources by using this strategy. This water resource appears to be depleting with each passing year; therefore, we can add the exact amount of water required by estimating how much water is required over the period of crop growth. This also aids in the maintenance of a healthy soil moisture level that is rich in nutrients.

Fig 1 Poondi Dam

2. Experimental Investigation

COLLECTION OF SOIL SAMPLE

During the visit of the site, the soil samples were collected. The soil sample was then tested to determine the soil's type and texture. Once these values are determined, the type of soil is selected from the list of available soils present in the CROPWAT model software. An approximate amount of at least 6kg of soil was collected.

SIEVE ANAYLSIS

The first test that is done to determine the type and grade of soil is Sieve analysis. The sieve analysis is an analytical or scientific method of determining the particle size distribution of the material. This technique involves stacking of different sizes of sieves where the biggest sieve size is placed at the and the finest sieve size is placed at the bottom. They are stacked below in a decreasing order of size. When the material is placed on the top sieve and sifted, the discrete particles are collected in each sieve after rigorous shaking and finally passes through the finest sieve. The sieves sizes that were used for the experiment are 300-micron, 600- micron, 150 -micron, 1.18mm ,4.75mm, 2.36mm, and pan.

S. No	Sieve size	Material retained	Percentage	Cumulati	Cumulative

10.48047/jocaaa.2024.33.08.212

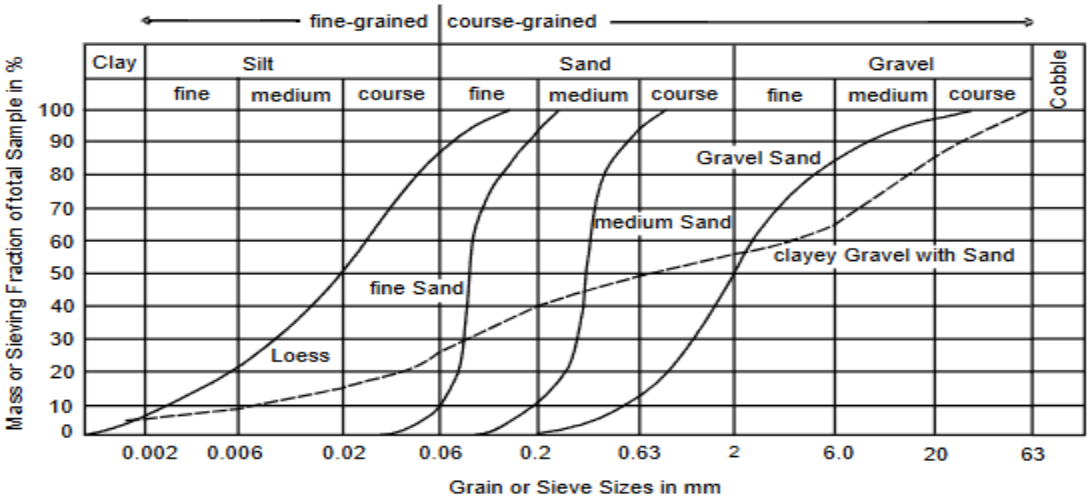


Table 1 Particle Size Distribution

10.48047/jocaaa.2024.33.08.212

		(grams)	retains (%)	ve percentage retain (%)	passing (%)
1	4.75 mm	0	0	0	100
2	2.36 mm	175	8.98	8.98	91.77
3	1.18 mm	287	14.08	21.26	76.74
4	600 microns	198	11.76	29.02	68.98
5	300 microns	620	30.61	65.63	34.37
6	150 microns	398	40	97.03	8.97
7	Pan	176	8.97	100	0
		= 1890 grams	=100 %		

PYCONOMETER TEST

After determining the type of soil, we need to find out the texture of soil in order input it into the CROPWAT software. This test is done to find out the texture of the soil sample that was collected from the field. To begin, an empty glass jar is required for this experiment. The next step is to add a soil sample to 1/3 of the jar. Pour the vacant space in the jar with water, leaving a thin gap at the top for air. The jar is then aggressively shaken until all of the soil and water are thoroughly combined. Then carefully lay the jar on the tray. Set a timer for 1 minute to see the sand layer form, which will be visible at the bottom of the jar due to it being the heavier particles. Then after an hour, we can observe the formation of the silt layer. After 24 hours, we can observe the formation of the clay texture layer too. By measuring the relative distance of these texture layers, we can find out the % sand, silt, and clay, and using these values, we can input them into the soil pyramid chart to find out the texture of the soil.

Fig 3 Pyconometer Test

3. Analytical Investigation

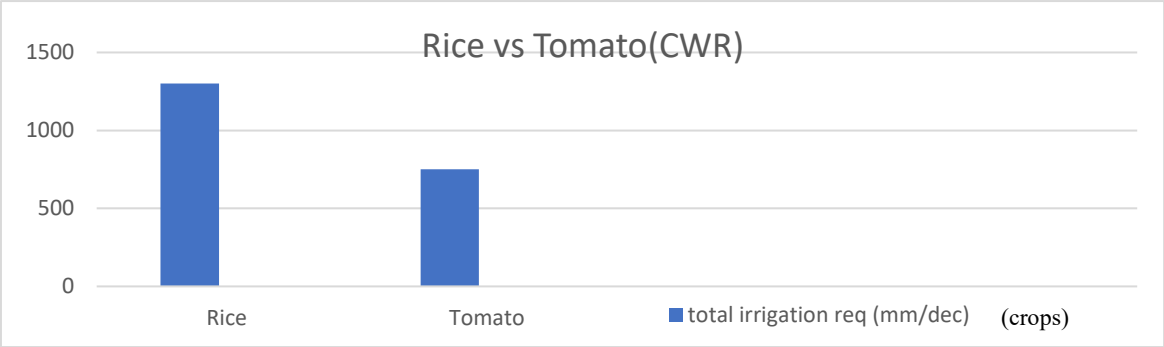
10.48047/jocaaa.2024.33.08.212

CLIMATIC AND RAINFALL DETAILS

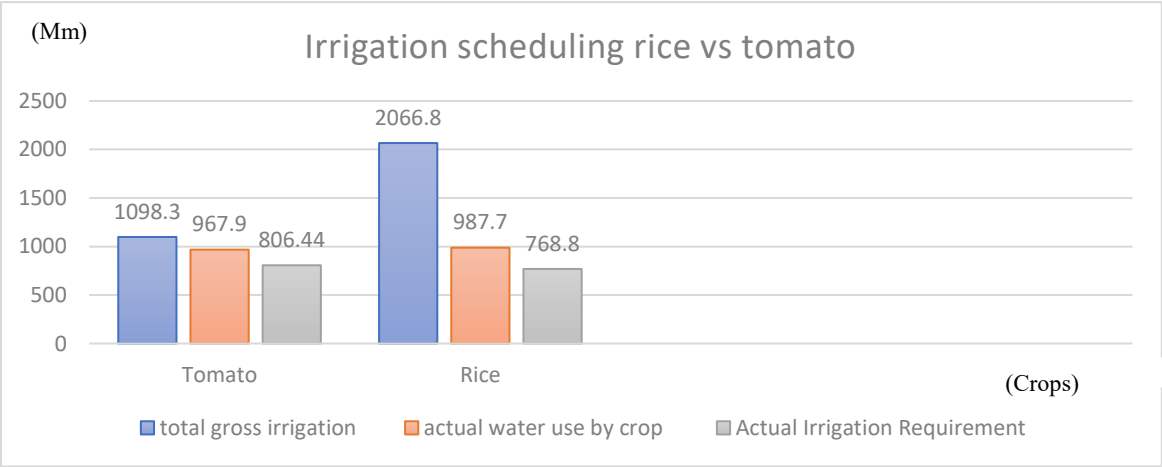
Poondi is located in Tamil Nadu's Tiruvallur district. The Poondi lake, also known as the SathyamoorthiSagar reservoir, is an important water source for Chennai. Poondi's climatic characteristics are primarily tropical, with brutal summers with extremely high temperatures and considerable rainfall in the winter.The climatic data like humidity, wind speed, sun hours, maximum temperature, and minimum temperature, has been obtained by the Model Software known as CLIMWAT. This is a model software developed by FAO which is helpful in obtaining the climatic and weather details of a particular area. CLIMWAT contains the databases of all the available weather or meteorological stations for various countries. Firstly, the country is selected, and within the country, we have to select the station of the site location or at least the station closest to the site location. By selecting the MET- station, a weather file is created, and then we are supposed to save the file in a folder. While selecting the weather/Et_0 option in the CROPWAT software, we can open up a weather detail file instead of manually entering the data into the table. The weather data automatically loads up after clicking on the MET- station details file.

4. Results & Discussions

Results show that for rice, crop evapotranspiration (ETc) varied from 0.68 mm to 6.83 mm the total crop evapotranspiration is 1157.9mm and the water required for crop differs from 0.7mm to 31.3mm the total irrigation requirement is 1300.2 mm for rice. Results show that for tomato, crop evapotranspiration (ETc) varied from 4.02 mm to 8.26 mm the total crop evapotranspiration is 941.9mm and the crop water requirement varied from 8.1mm to 68.1mm the total irrigation requirement is 751.8 mm for Tomato.



IRRIGATION SCHEDULING



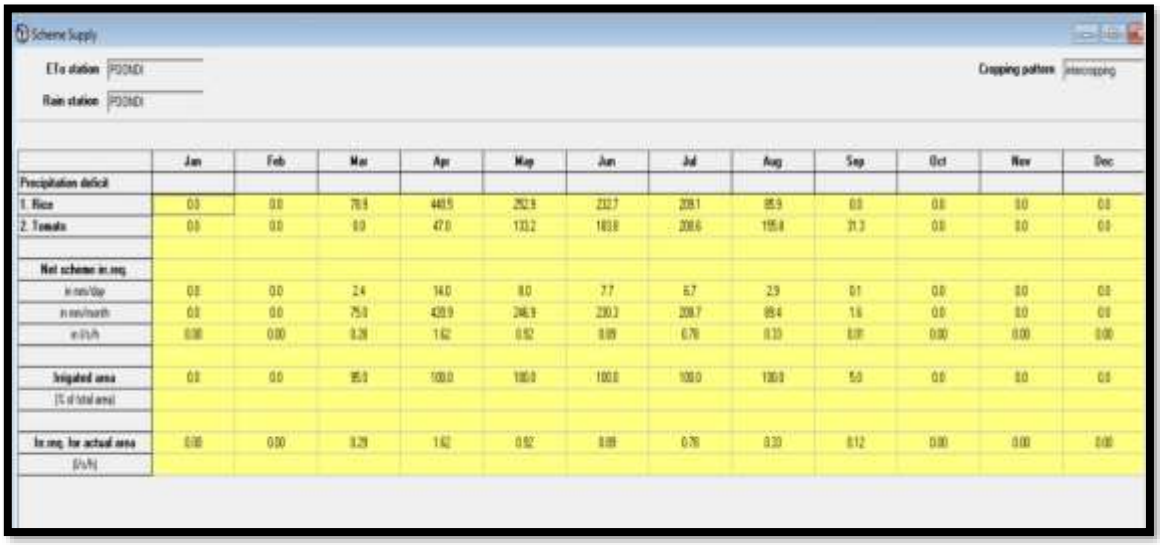
From the above graph, rice uses a lot more quantity of water than tomato. But the actual water needed by

10.48047/jocaaa.2024.33.08.212

the crop is quite similar, but the gross irrigation value differs because when the rice is planted, the agricultural land must be prepared correctly. The water is mixed with nutrients to enrich the soil and the water is also used for the puddling process as well.

CROP SCHEME

It is a strategy in which crops are cultivated on specific farm plots for a certain length of time to maximize agricultural yields while preserving soil fertility. As a result, the most lucrative use of resources, such as land, labor, capital, and management, is linked to a cropping design.The following table shows the scheme result obtained for both rice and tomato crop



5. Conclusion

To conclude, the climatic data was verified successfully using CLIMWAT and then it was verified using the CROPWAT. The total avg. Eto was found to be 5.56 mm/day. The rainfall data is also verified and inputted into the CROPWAT software. The annual effective rainfall is found to be 483.5 mm. After the testing of the soil sample which was collected from the site, the soil falls under the under category of well graded soil and texture of the soil is confirmed as sandy loam type of soil. From the questionnaire survey, the crops that are selected for the project is rice and tomato as they are the most commonly grown crops in that region. The initial planting date for both rice and tomato are as 19-04-2022.The crop water requirement (CWR) for the rice crop is computed as 1300.2 mm/dec, whereas for tomato it is found to be 751.8 mm/dec. The total gross irrigation for rice is very high when it is compared to tomato. The total gross irrigation for tomato is 1098.3 mm and 2066.8 mm for rice. The cropping pattern is selected and the scheming is also computed automatically with the help of the CROPWAT software.

REFERENCE

1. Mohan, A., Prabha, G. and V., A. 2023. Multi Sensor System and Automatic Shutters for Bridge- An Approach. International Journal of Intelligent Systems and Applications in Engineering. 11, 4s (Feb. 2023), 278–281.
2. Prabha , G. , Mohan, A. , Kumar, R.D. and Velrajkumar, G. 2023. Computational Analogies of Polyvinyl Alcohol Fibres Processed Intellgent Systems with Ferrocement Slabs. International Journal of Intelligent Systems and Applications in Engineering. 11, 4s (Feb. 2023), 313–321.

10.48047/jocaaa.2024.33.08.212

3. Mohan, A., & K, S. . (2023). Computational Technologies in Geopolymer Concrete by Partial Replacement of C&D Waste. International Journal of Intelligent Systems and Applications in Engineering, 11(4s), 282–292.
4. Mohan, A., Dinesh Kumar, R. and J., S. 2023. Simulation for Modified Bitumen Incorporated with Crumb Rubber Waste for Flexible Pavement. International Journal of Intelligent Systems and Applications in Engineering. 11, 4s (Feb. 2023), 56–60.
5. A Mohan, K. S. Dhaya Chandhran, M. Jothilakshmi, L. Chandhrkanthamma, Thermal Insulation and R-Value Analysis for Wall Insulated with PCM, International Journal of Innovative Technology and Exploring Engineering volume 12 S, 912-921, 2019.
6. Tholkapiyan, M., Mohan, A., Vijayan, D.S. Spatial And Temporal Changes Of Sea Surface Phytoplankton Pigment Concentration over Gulf Of Manner, India Oxidation Communications, 2021, 44(4), pp. 790–799
7. Tholkapiyan, M., Mohan, A., Vijayan, D.S., Tracking The Chlorophyll Changes Using Sentinel-2A/B Over The Gulf Of Manner, India, Oxidation Communications, 2022, 45(1), pp. 93–102
8. A Jothilakshmi, M. , Chandrakanthamma, L. , Dhaya Chandhran, K.S. , Mohan Flood control and water management at basin level-at orathur of Kanchipuram district International Journal of Engineering and Advanced Technology, 2019, 8 , International Journal of Engineering and Advanced Technology 8 (6), 1418-1421
9. Mohan, A., Saravanan, J.., Characterization Of Geopolymer Concrete By Partial Replacement Of Construction And Demolition Waste – A Review., Journal of the Balkan Tribological Association, 2022, 28(4), pp. 550–558.
10. Srividhya K , Mohan A, Tholkapiyan M, Arunraj A, “Earth Quake Mitigation (EQDM) Through Engineering Design”, Materials Today : Proceedings, Volume 22, 1074-1077, (2020).
11. Mohan, A, Experimental Investigation on the Ecofriendly External Wrapping of Glass Fiber Reinforced Polymer in Concrete Columns, Advances in Materials Science and Engineering, Volume 2021, Article ID 2909033, 12 pages .
12. Mohan, A., Prabha, G., Balapriya, B., Deepika, M., Hemanthimekala, B. Tribological Investigations on the Properties of Concrete Containing Recycled Plastic Aggregate, Journal of Balkan Tribological Association, 27(6), pp. 1010–1020 (2021).
13. Ayyasamy, L.R., Mohan, A., Rex, L.K., ...Vijayan, D.S.: Enhanced Thermal Characteristics Of Cuo Embedded Lauric Acid Phase Change Material, Thermal Science, 26(2), pp. 1615–1621 (2022).
14. Tholkapiyan, M., Mohan, A., Vijayan, D.S.: Tracking The Chlorophyll Changes Using Sentinel-2A/B Over The Gulf Of Manner, India, Oxidation Communications, 45(1), pp. 93–102 (2022).
15. Dr.G.Velrajkumar, R.Muralikrishnan, A.Mohan, R.Bala Thirumal, P.Naveen John: Performance of GGBFS and silica fume on self compacting geopolymer concrete using partial replacements of R-Sand, materials today : proceedings, Volume 59, Part 1, Pages 909-917 (2022).
16. D. S. Vijayan , A. Mohan , C. Nivetha , Vidhyalakshmi Sivakumar , Parthiban Devarajan , A. Paulmakesh , And S. Arvindan: Treatment of Pharma Effluent using Anaerobic Packed Bed Reactor, Journal of Environmental and Public Health, Volume 2022, Article ID 4657628, 6 pages (2022).
17. Ayyasamy, L.R., Mohan, A., Vijayan, D.S., ...Devarajan, P., Sivasuriyan, A.: Finite element analysis of behavior and ultimate strength of composite column , Science and Engineering of Composite Materials, 29(1), pp. 176–182, (2022).
18. S. Lavanaya Prabha, A. Mohan, G. Velrajkumar, A. Mohammedharoonzubair., Study On Structural Behaviour Of Ductile High-Performance Concrete Under Impact And Penetration Loads ., Journal of Environmental Protection and Ecology 23, No 6, 2380–2388 (2022) .
19. Lavanya Prabha.S,Surendar, M, Prabha, G, Mohan, A., Study on polyester resin concrete for applications in chemical & power plant industry, Journal of Ceramic Processing Research. 2023, 24(5), pp. 884–893
20. Gurusamy.V, Anbarasu, M. Vijayakumar, Y.K., AIP Conference Proceedings, Behaviour of concrete-

10.48047/jocaaa.2024.33.08.212

encased steel Castellated beam: A review , 2023, 2782, 020163

21. Mohan, A., Tabish Hayat, M.: Characterization of mechanical properties by preferential supplant of cement with GGBS and silica fume in concrete, Materials Today: Proceedings, 2020, 43, pp. 1179–1189.
22. Dharmar, S., Gopalakrishnan, R., Mohan, A.: Environmental effect of de nitrification of structural glass by coating TiO2, Materials Today: Proceedings, 2020, 45, pp. 6454–6458.
23. Prabha, G., Dinesh Kumar, R.,Alteration for fine aggregate of concrete with the use of m-sand and low density polypropylene plastic waste as sustainable solution, Journal of Green Engineering, 2020, 10(5), pp. 2291–2303
24. V.Saravana Karthika, A.Mohan, R.Dinesh Kumar and Chippymol James, Sustainable Consideration by Characterization of Concrete through Partial Replacement of Fine Aggregate Using Granite Powder and Iron Powder, Journal of Green Engineering, Volume-9, Issue-4, December 2019, 514-525.
25. Mohan A, Saravana Karthika, Ajith J, Lenin dhal, "Investigation on Ultra-High Strength Slurry Infiltrated Multiscale Fibre Reinforced Concrete" Materials Today: Proceedings 22(2020) 904-911.
26. Prabha, G ,Mohan, A ,Chithra, M., Flexural Behaviour Of Ferrocement Slab Panels Withpolyvinyl Alcohol Fibres, Journal of the Balkan Tribological Association, 2022, 28(5), pp. 704–717.
27. Suriya, S ,Lavanya, V, Kumar, M.M ,Mohan, A ,Kumar, S.A., Catastrophic effects of climate change on child health, Climate Change Impact on Groundwater Resources: Human Health Risk Assessment in Arid and Semi-AridRegions, 2022, pp. 279–289.
28. Mohan, A., Velrajkumar, G.,Prabha, G., Vijayan, D.S. , Ajith, J. Non-Destructive Test On Reinforced Concrete Corroded columns Produced With Flyash, Journal of Environmental Protection and Ecology, 2023, 24(1), pp. 114–125
29. Vijayan, D.S.,Mohan, A.,Revathy, J.,Parthiban, D.,Varatharajan, R.,Evaluation of the impact of thermal performance on various buildingbricks and blocks: A review, Environmental Technology and Innovation, 2021, 23, 101577
30. Goplalakrishnan, R., Mohan, A., Ponrajsankar, L. Vijayan, D.S.Characterisation on toughness property of self-compacting fibrereinforced concrete, Journal of Environmental Protection and Ecology,2020, 21(6), pp. 2153–2163.
31. Dhaya chandhran, K.S.,Jothilakshmi, M.,Mohan, A., Tholkapiyan, M., Performance evaluation and R-value analysis for thermally insulated PCM wall with fluted sheets, Materials Today: Proceedings, 2020, 22, pp. 912–918.
32. Gopalakrishnan, R., Sounthararajan, V.M., Mohan, A., Tholkapiyan, M., The strength and durability of fly ash and quarry dust light weightfoam concrete, Materials Today: Proceeding, 2020, 22, pp. 1117–1124.
33. Vijayan, D.S., Ayyasamy, L.R., Sharma, A.S., Devarajan, P., Sivasuriyan, A., Finite element analysis of behavior and ultimate strength of composite column, Science and Engineering of Composite Materials, 2022 29(1), pp. 176–182.
34. Thenmozhi, S., Mohan, A., Santhanam, K., Christo, M.S., Enhancing lime mortar carbonation using natural polymers from Prosopis Juliflora, European Physical Journal Plus, 2024, 139(12), 1092