

Green Air Conditioning in Hand with Waste Management: Coconut Pith as an Artificial Air Conditioner

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Abstract—The mean surface temperature of earth has always been on an increasing rate ever since the early 19th century by about 0.8 °C. This increase in temperature has affected every sphere of human life including our homes. The summers have become longer as an effect of global warming thereby increasing the temperature in our houses making life in our concrete houses impossible. The present most widely used solution to this problem is the usage of air conditioners. In this paper, an alternative eco-friendly method of providing natural air conditioning to houses is proposed. This helps in reducing the energy consumption for the same. By this project, a natural air conditioning system was implemented in a house, the room was kept under observation and inference was obtained that it helps to reduce the room temperatures by 10°C. This was obtained by using Coconut pith as an insulating agent on roof tops to bring down the temperature inside the house. This project is cost efficient as coconut pith is available locally free and adds up to the aim of energy conservation and also waste management as coconut pith is a waste product of the coir industry and its accumulation has been a major environmental problem for the industry.

Index Terms—Coconut pith, temperature, eco-friendly, global warming, roof tops, natural air conditioning

I. INTRODUCTION

This project was aimed at providing a natural air conditioning system in a small residential area. The residential colony considered was Nehru Nagar colony, Kuriachira, Kerala. Natural air conditioning using coconut pith was provided to one of the houses in the colony and a study was considered to note down the reduction in the temperature. The main motivation for this project is the high increase in atmospheric temperature due to global warming and the increasing rate of energy consumption. Another cause leading to the use of coconut pith as a solution to the above problem is the accumulation of the waste from the wide spread coir industries in Kerala.

II. NEED FOR PROJECT

A. Present Scenario of Houses

The early history of houses began with caves leading to huts. It later lead to houses build using bricks, concrete and

glasses. A majority of the population rely on concrete for construction, the same being a stronger material. The main disadvantage of using concrete was its conducting property. During summers, despite the insulation provided in the concrete walls, a part of heat still penetrates into the houses during the day. Even during night the condition fails to better as the insulation does not let the heat pass through. So, considering the thermodynamics principle, the superlative solution would be to provide insulation on the ceiling. [1]

B. Present Scenario of Temperature

Global warming is one of the most ubiquitous and grave issues of 21st century, thereby demanding exigent attention to reducing the energy consumption. United Nations Framework Convention on Climate Change (UNFCCC) proposed that measures to reduce emissions are the most prominent alternative to control the rapidly varying climate. [2] Energy Information Administration quoted in their report that 98 percent of carbon dioxide emissions can be directly credited to energy consumption. The chief objective of a majority of organizations has developed into a trend of operating in a green manner. [3] Being one of the in progress problems, it has proved itself to be unavoidable and hence producing lingering long-term effects on human health. Recent researches by the medical scientific community has confirmed the effects of environmental factors due to global warming on human pathology, in particular , the morbidity by a cardio-respiratory disease as a result of increase in temperature. [2]-[4]. This problem was recognized and worked out by the usage of coir pith as an insulating material for dwellings.

Fig. 1-Fig. 3 projected future changes in mean annual surface air temperature (°C) in the 2020s, 2050s and 2080s with respect to baseline (1961–1990). [5]

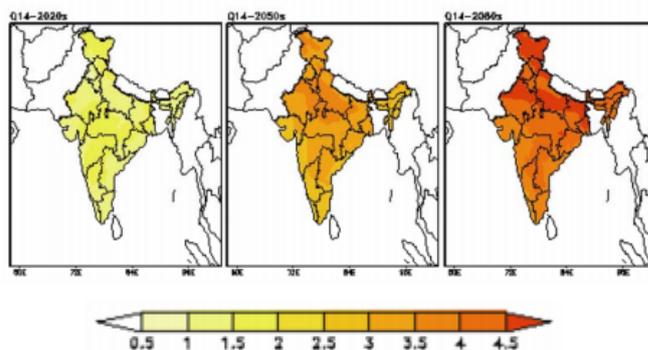


Fig. 1. Projected future changes in mean annual surface air temperature (°C) in the 2020s with respect to baseline (1961–1990)

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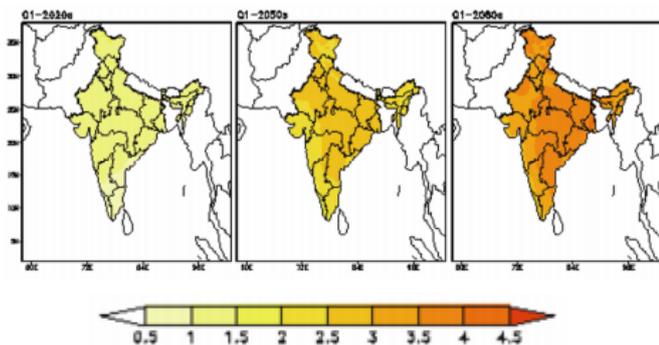


Fig. 2. Projected future changes in mean annual surface air temperature (°C) in the 2050s with respect to baseline (1961–1990)

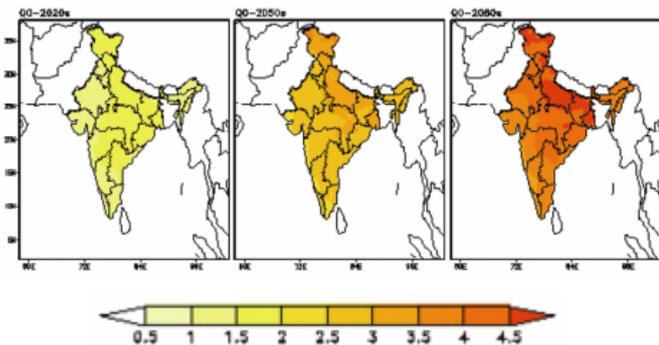


Fig. 3. Projected future changes in mean annual surface air temperature (°C) in the 2080s with respect to baseline (1961–1990)

C. Present Scenario of the Coir Industry

Coir industry is one of the oldest industries of India. Despite of being an industry 150 years old, it still has not achieved any major professional approach or rather any measure to strengthen the competitiveness in the field. In a study by the KITCO, [6] it was observed that the tribulations faced by the coir industry are versatile and multi-dimensional, environmental degradation being one of its unparalleled problems. Coconut pith, put to a use to the society, to provide comfort at a major level, conquers its title as waste as it accomplishes the noble theory of waste management [7].

III. CHALLENGES

A. Seasonal Nature of the Project

Natural air conditioning using coconut pith is a need of the summer, which as per the traditional Indian calendar is from May 20th to July 20th. Despite of having further longer summers, storing and maintaining the coconut pith was still a major issue during winters since air cooling was not a need of the hour.

B. Storing of the Coco Pith

Disposing coconut pith after a single use would only further account to environmental pollution. The fact that it can be reused up to ten years, has made it a point that coconut pith, when not in use, had to be stored until the next summer. Coconut pith although with a uniform composition, is still a very loosely bounded substance and hence has to be maintained in such a way that it does is not subjected to any aerial pressure.

C. Periodical Sprinkling of Coco Pith

It is a usual pattern of the Indian climate to give at least one rain every two week even during summers. Irrespective of it occurring as per schedule, coconut pith had to be manually watered once every two week.

IV. CHARACTERISTICS

The characteristics and benefits of Coconut Pith as per the Coir Board SFURTI Scheme, Sponsored by GOVT of India / NABARD (UPNRM) has been mentioned below. [7]

A. Chemical

Coconut pith has a high water holding capacity and hence has been widely used as hydroponics. It has an acceptable pH of 5.8 to 6.8 and an EC less than 0.5 to 1.00. Superior property of wet ability and property to buffer supply and retain nutrients against leaching have been few of the prominent chemical properties. [7], [8]

B. Physical

Coconut pith, locally known as coco pith, has unique water holding capacity, a good aeration competence and very low shrinkage rate. It also has the aptitude to retrain the physical properties for a longer stretch of time. Fig. 4 shows the physical state of the coir pith as obtained from the industry.



Fig. 4. Coconut Pith

C. Biological

It does not entertain the growth of any weeds, pests or proliferating diseases. [7] [8]

D. General

Coconut pith is odorless and congenial to handle. It is a natural and renewable resource and has a uniform composition. [7]

E. Technical

Table below gives the various technical specifications of Coconut Pith. [7]

Table I depicts the general technical specifications of coconut pith as per data obtained in the market.

TABLE I: TECHNICAL SPECIFICATIONS

Technical Specifications	
Specifications	Estimated values
Water holding capacity	700 to 800%
Nitrogen	0.5%
Phosphate	0.03%
Potash	0.25%
Organic carbon	9 to 10 %
pH	6 to 7
Conductivity	< 0.5 milliohms
C/N ratio	<35.1
Total organic matter	75 to 85 %
Cationic exchange capacity	60-130 (meq/100g)
Air filled porosity	10-12 % V/V %
Lignin	65-70(W/W dry basis %)
Total pore space	94-96%
Ash	3-6% (dry basis)
Cellulose	20-30 %
Color	Light to dark brown

V. EMPLOYMENT OF COCONUT PITH

Coconut Pith was spread on the concrete terrace in a, (accepted via observation), thickness of one inch. Water was sprinkled over the laid coconut pith and unplaited coconut leaves were positioned over them. After installation, within ten hours, the room temperature was observed to have reduced by a significant rate, thus making the temperature difference between the interior and exterior of a house to about 10 to 20 degree Celsius from the earlier difference of 5 degree Celsius. The tannin components of the coconut pith, which stain the water, leading to its high water retention capacity, has aided the watering of the coconut pith to an average of once in two weeks as per observation. Despite of holding water in the coconut pith on the terrace, it was observed that the former did not witness any wet marks on the ceiling thereby assuring no leakage of water.



Fig. 5. Dried Coconut Pith



Fig. 6. Dried coconut pith after two weeks



Fig. 7. Water sprinkled coconut pith

Fig. 5 shows the dried Coconut Pith arranged on the roof of a house in the residential colony, Nehru Nagar colony, Kuriachira, Kerala. Fig. 6 shows the dried coconut pith after two weeks and Fig. 7 shows the water sprinkled coconut pith arranged on the roof top. [9]

Regardless of being titled a byproduct and a waste, this use of coconut pith as an artificial air conditioner gave it a new stance of being seen as eco-friendly. The verity that the coconut pith can be used up to 10 years as it does not produce the conventional glitch of bad odor on being mixed with water and does not pollute the same, has added to the fact that

it does not produce a disposable hazard. Coconut pith, a conventional waste of the coir manufacturing industry is locally accessible as blocks of 650gm briquette or five kilograms from the market. The venture projected its cost effectiveness as the overall cost accounted for an approximate of 200 Indian rupees.



Fig. 8. Brochure of Neopeat by 'STERLING'

Fig. 8 shows the brochure of coir pith produced by an Indian company, STERLING.

VI. OBSERVATION TABLE

TABLE II: OBSERVATION TABLE-1ST TO 15TH

Days	Temperature without Coir pith	Temperature with Coir pith
1	32°	27°
2	32°	27°
3	32°	27°
4	32°	27°
5	32°	27°
6	32°	27°
7	32°	27°
8	32°	27°
9	32°	27°
10	32°	27°
11	32°	27°
12	32°	27°
13	32°	27°
14	32°	27°
15	32°	27°

Table II gives the first 15 days data of the temperature variation with and without the coir pith. It was observed that during summer the temperature inside the house without coir pith insulation was 32°C and after providing natural cooling using coir pith was 27°C

Table III gives the data of the temperature from the 15th to 19th with and without the coir pith. It was observed that during summer the temperature inside the house without coir pith insulation was 32°C and after providing natural cooling using coir pith was 29°C.

TABLE III: OBSERVATION TABLE-1ST TO 15TH

Days	Temperature without coir pith	Temperature with coir pith
16	32°	29°
17	32°	29°
18	32°	29°
19	32°	29°

The red Fig.s show that the coirpith dries up the temp increases and this can be altered by sprinkling water on the coir pith.

TABLE IV: OBSERVATION TABLE-1ST TO 15TH

Days	Temperature without Coir pith	Temperature with Coir pith
20	32°	27°
21	32°	27°
22	32°	27°
23	32°	27°
24	32°	27°
25	32°	27°
26	32°	27°
27	32°	27°
28	32°	27°
29	32°	27°
30	32°	27°

Table IV gives the data of the temperature from the 20th to 30th with and without the coir pith. It was observed that during summer the temperature inside the house without coir pith insulation was 32°C and after providing natural cooling using coir pith was 27°C.

VII. MEETING CHALLENGES

A great disadvantage often referenced about coconut pith is its fine physical nature and the threat of being vulnerable to the slightest winds. One of the solutions proposed is its possibility of being occupied in bags accessorized with tubes to facilitate watering. This arrangement makes the watering of the coconut pith to an observed average of once in two weeks, (manually), comfortable. These bags as well projects an ease in placing the coconut pith on the roof tops and also in storing the same subjected to seasonal changes.

VIII. BROADER PERSPECTIVE

Summer is one season with a low production but a greater consumption of electricity. Depending on the nature for air conditioning aids reverting power used by A/c to the industries. Wasting power makes the state powerless, thus affecting the industry thereby forcing the factories to lay off. The problem thus brings up a standstill of allied business and thus poverty to people who depend on the same. The ease in the transportation of coconut pith in a compressed form, as briquettes, helps it to be exported to remote areas, devoid of the local availability of the same but yet is attacked by long summers. The implementation of coconut pith joins hand in discarding the practice of burning off of coconut pith on road sides as a measure of waste disposal, further reducing the heat being liberated to the environment by the same. Thus exploitation of the nature can be diverted towards capitalizing it.

IX. CONCLUSION

Coconut Pith has been traditionally employed as organic manure. This project proposes the application of coconut pith as an insulator for buildings from the building up heat. The average difference of the temperature interior and exterior to a house in Thrissur, Kerala is almost 5 degree Celsius. This project proved that the realization of coconut pith as an air conditioner has helped increase this difference up to 10 to 20 degree Celsius. The human body temperature threshold is between 27°Celsius to 33°Celsius. Usage of coconut pith on concrete ceilings, to prevent entry of heat, has helped maintain the room temperature at the most conductive limit of 32°Celsius thus making life inside houses comfortable.

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REFERENCES

- [1] M. Kekanovic, A. Ceh, and I. Hegedis, "Respecting the Thermodynamics Principles of the Heat Transfer - as the Most Important Condition for Achieving High Energy Efficiency in Buildings - Energy of the Ground and Heat Pumps - the Most Reliable Alternative Energy Source," in *Proc. 3rd IEEE International Symposium on Exploitation of Renewable Energy Sources*, Subotica, Serbia, March 11-12, 2011, pp. 79-83.
- [2] A. S. Khan and S. A. Chowdhury, "GHG Emission Reduction and Global Warming Adaptation Initiatives by UNFCCC," in *Proc. 2012 2nd International Conference on the Developments in Renewable Energy Technology*, Jan 5-7, 2012, pp. 1-6.
- [3] B. Yamini and D. V. Selvi, "Cloud Virtualization: A Potential Way to Reduce Global Warming," *2010 II international workshop on education Technology and Computer Science*, 2010, Nov. 13-15, pp. 55-57.
- [4] V. Petras, G. Czibula, S. Dana, M. Popa, and D. Cursu, "Identifying the impact of global warming on population using a clustering based

approach," *American Journal of Hypertension*, vol. 22, no. 8, pp. 842-857, 2009.

- [5] K. K. Kumar, S. K. Patwardhan, A. Kulkarni, K. Kamala, K. Koteswara Rao, and R. Jones, "Simulated projections for summer monsoon climate over India by a high-resolution regional climate model (PRECIS)," *Current Science*, vol. 101, March 3 2012.
- [6] KITCO Consultants, "Survey on status of Coir Industry in Kerala," Annual Report, KITCO, January 2011
- [7] C. D. Skaria, "Innovations in Coconut Pith," unpublished.
- [8] S. A. Jabasingh and C. V. Nachiyar, "Response surface approach for the Biodegradation of pretreated coir pith using *Aspergillus nidulans* SU04 for cellulose production," in *Proc. Second International Conference on Sustainable Energy and Intelligent System (SEISCON 2011)*, July. 20-22, 2011, pp. 711-716.
- [9] A. Yoza, K. Uchida, A. Yona, T. Senjyu, T. Funabashi, and K. Chul-Hwan, "Comparison of Operational Cost in Smart Houses with Introduction of Heat Pump or Gas Engine," *ELSEVIER, Energy Conversion and Management*, vol. 50, pp. 530-538, 2009.



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