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WHAT MAKES EARTHEN POT A SUSTAINABLE DESIGN SOLUTION FOR WATER STORAGE IN RURAL INDIAN CONTEXT?

Subtitle: Vision, Thinking and Philosophy in context to Sustainability

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Abstract: In this techno savvy era, where the world is taking a shift from offline retail to e-commerce, small things of our daily usage which we are ignorant about makes us to stop and ask ourselves, “*how is this element from the past still surviving in the present?*” That is a question which strikes many minds when they think about earthen pots. What makes it sustainable? Is it the form which has a million beliefs attached to it or is it the material that biodegrades into the nature? The earthen pots are still used for storing and cooling water. Isn't it ironic that a basic pot created on a potter's wheel is competing with the machine made modern water purifiers? This article focuses on the unceasing existence and usage of earthen pots despite of the new advancement in technologies.

Key words: *earthen pot, water storage, form and function, sustainable design, modern day water purifiers, rural India*

1. Introduction

India is a land of diverse traditions and culture. Advancement in technology can't take back from us the traditional practices and methods of consuming resources. A grassroots alternative to hi-tech filtration systems is earthen pots¹. It is important to understand that the innovation and technology have their roots inspired from the ancient practices and equipment. Like the concept of current water purifiers is nothing but an inverted pot with a stopper. The slight innovation in the design has increased its function multifold. Even though the current water purifiers can serve the purpose perfectly, there are few moments when humans realize that their made technology fails in many situations and the need becomes to switch back to the early adopted methods.

This research paper follows up the strong history behind the earthen pots, traditional beliefs and practices attached to it. The article discusses the design value of the form, materials and functionality of the pots connecting it to the history and the present scenario. Further, this article refers to how the ancient traditional beliefs influence our lifestyle and sustains the form. Indeed, the age old practices have the strong base grounds from which the modern technology can take inspiration from but may not win over. This paper concludes with an improvised design concept for earthen pots in terms of material and form which filters water naturally and is made fit for consumption, especially for rural India who doesn't have access to modern techno water purifiers and refrigerators.

2. HISTORY-Ancient Traditional Water Storage Technique

When gods and demons were churning the ocean (*sheersagar*) for the divine nectar (*mahamrita*), an earthen pot emerged. This is believed to be the first pot (*matka*) created by potters².

The beginning of Indian pottery was processed with the start of Indus Valley Civilization. There is proof of pottery being constructed in two ways: handmade and wheel-made. *Harrappan* and *Mohanjodaro* cultures heralded the age of wheel-made pottery, characterized by well-burnt black painted red wares.



Figure.1 efficient system of Harappans of Dholavira, developed for conservation, harvesting and storage of water (source: whc.unesco.org)

Apart from step wells, people used *paar system* in western Rajasthan for storing water. It is a common place where the rainwater flows from the *agar* (catchment) and in the process percolates into the sandy soil. *saza* (open well), *johad* (small earthen check dams), *Naadha* (stone check dam), *rapat* (percolation tank) and *Kunds* were constructed to meet the growing water demands in different areas of the country

According to the RigVeda, all life on this planet is evolved from *apah* (water). Earlier humans preferred staying close to water bodies as they realized their survival and existence depends on water. Later on, with migration from one place to another, they started adopting ways to store and transport water. The water was stored in large earthen containers which kept water cold. It was usually designed with broader base and thin neck

to make it easier to carry on head or by the waist. Others used gourds made from shells of vegetables to store water. Every available drop was stored in to it and gourd was buried in ground. They used their knowledge of the environment to find these gourds whenever water was in short supply³.



Figure 2. ANCIENT EARTHEN POTS, Source: (www.indisnetzone.com)



Figure3.GOURD, source (www.colinstattoos.com)

3. Significance of the Indian traditional beliefs

Earthen pots are one of the most tangible and iconic elements of regional art. The use of earthen pot has not been constrained to water storage only. One can find “*matka*” in every Indian house. Interestingly, one can never find a pot kept empty as it indicates the life getting void. Ayurveda texts recommend drinking water stored in copper pots, because copper is believed to have anti-microbial, antioxidant, anti-carcinogenic and anti-inflammatory properties⁴. Whether it is a traditional healing ritual⁵, worshipping deities or marriage ceremonies, there is usage of basic earthen pots. The form is considered auspicious and sacred and is intimately related to the very birth to the last ash remains of the body. One can jot numerous beliefs and practices related to the earthen pot which is continuing to the current day as well, makes it persistent.

4. What makes earthen pots sustainable?

In this virtual world, where everyone are behind technology and advancement, there are people who still rely on the traditional methods of water purification. This makes earthen pot sustainable. It has the values and beliefs attached to its form and function. Moreover, the material decomposes back to nature without polluting the environment. Its

functionality causes zero percent exploitation of resources indeed! It is a refrigerator which doesn't require electricity. Thus, earthen pots are feasible to the masses who can't afford expensive purifiers. Moreover, water purifiers are influenced by the geographical factor in terms of availability of resources, which in India isn't available to all.

Potters have been forming vessels from clay bodies for hundreds of years. When nomadic men settled down and discovered fire, the firing of clay pots was not far behind. These first pots were fired at low temperatures and were thus fragile and porous. Ancient potters partially solved this by burnishing the surfaces with a rock or hard wood before firing. These low-temperature fired pots were blackened by these fires.

The ancient Egyptians were involved in pottery on a much larger scale. They utilized finer clays and fired the pieces at much higher temperatures in early kilns that removed the pots from the direct fire so they were not blackened from the fire.

Pottery is clay that is modeled, dried, and fired, usually with a glaze or finish, into a vessel. Pottery must be fired to a temperature high enough to mature the clay, meaning that the high temperature hardens the piece to enable it to hold water. An integral part of this firing is the addition of liquid glaze (it may be painted on or dipped in the glaze) to the surface of the unfired pot, which changes chemical composition and fuses to the surface of the fired pot. Then, the pottery is called vitreous, meaning it can hold water.

The primary mineral of clay is kaolinite; clay may be generally described as 40% aluminum oxide, 46% silicon oxide, and 14% water. There are two types of clays, primary and secondary. Primary clay is found in the same place as the rock from which it is derived—it has not been transported by water and thus has not mixed with other forms of sediment. Primary clay is heavy, dense, and pure. Secondary or sedimentary clay is formed of lighter sediment that is carried farther in water and deposited. This secondary clay, a mixture of sediment, is finer and lighter than primary clay.

The design is well thought of with a big belly and a small opening at the mouth. The big belly helps the women carry up to 3 pots of water on head while fetching water from a long distance. The water acquired with such a trouble is very precious and has to be protected. The artisan has designed the pot in such a way that narrow mouth helps preventing spillage. This ergonomically created design is still sustainable water storage and transporting method.

5. Evolution of the modern technology from traditional earthen pots



Figure 4. the basic pot, the modified pot and the new inverted pot-current water purifier, (sources: www.whichfortpottery.com), (www.ojhas.org), (www.royalfreshsolution.com))

Rightly said, “*Necessity is the mother of invention*”. Water storage in earthen pots was easy, but soon people realized it’s difficult to pour out water by tuning the heavy water filled pots. Even as the water level goes much deeper, the water cannot be taken out by putting a smaller utensil. This problem gives rise to a modification to earlier design. The earthen pots with attached tap were made for easy water pouring and saving each drop wisely. Later on with advancement in technology filters were added to it for better water purification but the concept of an inverted pot became the foundation for the new water purifier’s development.

6. Modern day water purifiers

Indian markets are full of different brands of water purifiers. Moreover, each brand has many designs. The basic functionality of each water purifier remains the same, that is: to sustain water for a couple of days and make it germs free for consumption.

The root design concept of a water purifier originates from a basic inverted earthen pot. To make the design more contemporary and aesthetical; there are variations in the form and shapes. The forms have become sleeker and lighter compared to the bulky earthen pot structures. The new innovation in designs and purification technology is hence looking forth for better ways to sustain water storage.

Modern day water purifiers are fully automatic distillers where they filter tap water to the drinking water by removing bacteria, cysts and virus from the water by letting it pass through enormous filters. The water that finally comes out from the purifier (water filters/ RO’s) is totally safe for consumption.

Following are the filtration techniques used by modern water purifiers⁶

1. *Mineralization technique* - One usually observes packed bottles of mineral water. The water is nothing but boiled, distilled and further added with medical stone to achieve the purpose of mineralization.

2. *Ozone, ultraviolet disinfection* - Ozone and UV Ray’s treatment is the most common technique used by the latest water purifiers like aqua guard. They kill all the harmful bacteria present in the water and sterilize it.

3. *Reverse osmosis membrane* - Reverse osmosis is the main technique of our RO systems at home. Its principle is based on a membrane separation technology, this method with the pressure of the water through the synthetic membrane; the membrane allows only pure water through, while the contaminants are excluded. Operation of the system depends on several factors, such as fluctuations in water pressure, membrane life; membrane pore blockage will affect the water quality.

4. *Micro-filtration and ultra-filtration method* - Micro-filtration is made of cellulose or polymer materials, micro porous membranes, using its uniform pore size to retain the water particles, bacteria, colloids, etc., so as not to be removed through the membrane and get filtered out leaving forward the clean drinking water.

7. Essential nutrients in water

The water formula is H₂O, but only distilled water has this structure. Water presents in nature contains, even if in traces, minerals which very important for our health: salt and oligo elements dissolved during its way through the soil or its flowing in rocky streams which are essential for the body. Sometimes water purifiers remove these elements while filtering water. In mineral water, these salts and minerals are artificially added.

Calcium is essential to the body for teeth and bones formation, blood coagulation; correct functioning of our nervous system. Calcium ions are contained in underground water. Magnesium is, with sodium and calcium, among the most commonly found in drinking water. In humans magnesium is important for many metabolic functions and for muscular and nervous activity. The daily recommended intake is 150-500 mg. Copper is an essential element for our health, but it is toxic at high concentration. A daily intake of 1.2 mg is recommended. Food rich in iron is very important, particularly for children and women in fertile age. The recommended daily intake is 10 mg. Iron is usually contained in low amount in drinking water.

Ground water contain many toxic mineral as well like phosphates, sulphates, nitrates, arsenic and lead which can be toxic to the human body even when consumed in small amounts.

There are health risks involved with consumption of demineralized water such as it direct effects on the intestinal mucous membrane, metabolism and mineral homeostasis or other body functions. Little or no intake of calcium can lead to weaker bones and frequent tooth bleeding. Moreover, it may also lead to loss of body immunity to fight against diseases. Earthen pot sustains these minerals in the water and makes it healthy for drinking as compared to distilled water.

8. Is plastic containers safe for water storage?

It is commonly witnessed in Rural India that people store water in plastic bottle as they are easily available. But are plastic bottles, *water safe* for consumption?

Bottled water can last only for a couple of days and then starts emitting bad odor. Studies show that the plastics used for bottles contain chemicals having estrogenic activity, even when they claim otherwise. Researchers believe some of the contamination of water in the plastic containers may have come from the plastic containers. Leaching of chemicals into the water is related to the plastic bottles being exposed to either low or high temperatures. Anti-bottled-water-campaigns and organizations, such as Corporate Accountability International, typically argue that bottled water is no better than tap water, and emphasize the detrimental environmental side-effects of disposable plastic bottles.

Water is usually stored in plastic bottles in the refrigerator which contains CFC (Chloro Floro Carbons). Moreover, refrigerator water is too cold to quench thirst. In fact, most of the people in Rural India rely on earthen pots as natural refrigerators as it doesn't require electricity as electricity isn't available in these places and the temperature is just apt for the throat.

9. Benefits of drinking water from earthen pots

Earthen pots have pores. When water is poured into the pot, a small part of it exits through these pores and evaporates from the surface of the pot, thus making the pot (and

remaining water) cooler than before. Another benefit of clay water pots is the alkaline nature of clay. The alkaline clay interacts with the acidity of water and provides the proper pH balance. This water can help curb acidity and in turn provides relief from gastronomic pains. Water stored in an earthen pot is gentle on the throat. It is an ideal drink for people suffering from cough or cold. More importantly the earthen pot transfers the coolness to the water according to the climatic conditions; which is the special quality of earthen pot that no other container has.

10. Which are more reliable - new water purifiers or ancient earthen pots?

The new technology based water purifiers are sleek and contemporary. The material used in its construction is unbreakable and assures prolonged storage. The additional filters bring to us more clean and purified water. Since, the water treated can be stored for a couple of days. These purifiers are made from unsustainable materials and are not decomposable. This in turn results in releasing harmful products in nature.

On the contrary, when it comes to storing water, the earthen pots occupy the primary position⁷. The earthen pot transfers the coolness to the water according to the climatic conditions; which is the special quality of earthen pot that no other container has. It helps to improve metabolism and virility and is gentle on throat⁷. Moreover, if the water is stored in glass vessels there is no harm; and there is no benefit either. Also, Water should neither be stored nor used from an aluminum vessel. The Aluminum mixes with water, goes into our intestines and the body leading to various diseases. Water stored in plastic containers contain harmful chemical like Bisphenol A which poses a health hazard.

Further the earthen pots are good for slow cooking due to its porous nature. Do we ever give a thought to what life would be like if the various appliances we've come to rely on were to suddenly stop working? In this case earthen pots work as refrigerator which does not require electricity⁸. Earthen pots results in no harmful by-products during the production of pottery. Clay scraps and imperfect pieces produced off the jiggering machine or from slip casting may be re-mixed and re-used.

11. Design inspiration

Underground water is the naturally pure form of drinking water. The rain water seeps into the earthen sand bed and gets purified by different layers of sand of different sizes. The water then gets stored below these layers of sand which can be pumped out with a hand pump or by digging a well.



Figure 5: sand bed for purifying rain water (source: www.kscst.org.in)

12. New design proposal for water storage

Natural earthen pot filter can be manufactured by mixing, potters clay with sawdust or other combustible material like husk. The combustible material is grounded and sieved, later burned out by firing at temperatures low enough to preempt verification of clay but high enough to burn out the combustible material. This can be achieved by firing the pot at a temperature of 900-950 degree C.

This will result in an earthen pot structure with small pores to prevent bacteria to pass out but large enough to keep a good rate of flow of water.

The pot is suspended inside a copper receptacle with a lid and tap. Now as the water flows from the porous earthen pot, it is treated with a bed of sand, gravel, compressed charcoal finely packed together. As the water seeps through the sand bed, chemical and leas impurities are filtered out.

The copper receptacle makes the water good for consumption. As the water seeps down from the sand bed it gets collected in the container. This water is naturally filtered and free from germs and bacteria. The tap can let easy access to the water for drinking.

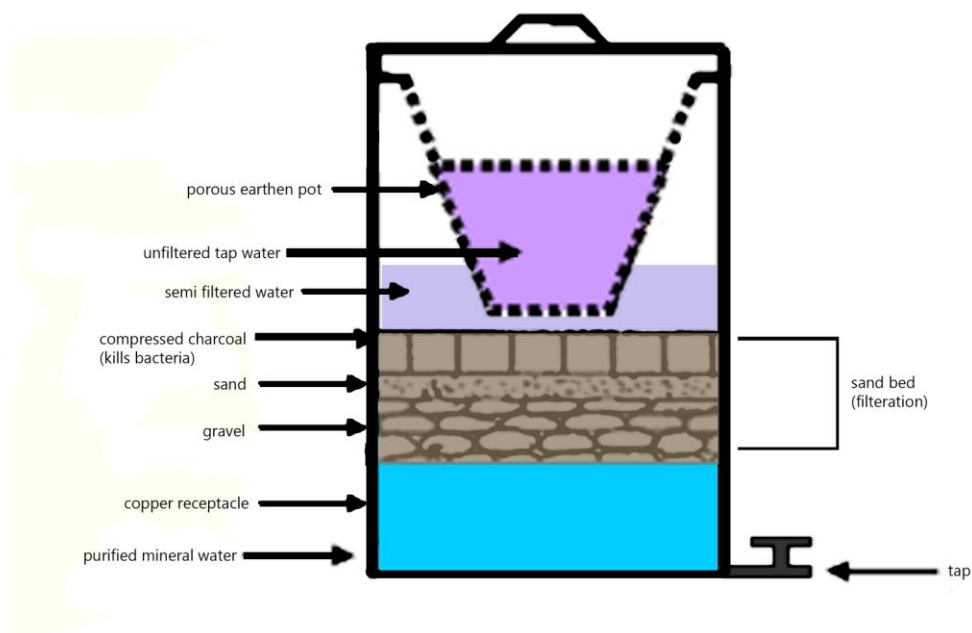


Figure 6: natural earthen pot filter design

13. Design testing and analysis

The final filtered water is good for consumption as it includes all the necessary minerals required by the body. As the water runs through the sand bed, it kills disease causing bacteria present in the water. The copper receptacle adds copper content to the water making it good for digestive system, faster healing wounds; maintain cardiovascular health and beats hypertension. The filtered water contains sufficient iron content required for daily body intake.

The water filtered out by the natural earthen pot filtration may not be the most filtered water but it is definitely, healthy for consumption and better alternative for the people in technology deprived areas of India.

14. Conclusions

Even though humans are progressing and exploring new ventures for development, the biggest setback of it is exploitation of resources. The limited resources are getting exploited and depleted resulting in unequal distribution of resources among the people.

Need of the hour is to go sustainable! It will be difficult to survive if we go away from nature. Earthen pots can cool water without electricity. After breaking it depletes into the ground. Indeed it can be reused and recycled. The design value of earthen pots makes it hundred percent ecofriendly.

The proposed design concept offers a natural filtration and water purification technique. This is not expensive and can be made at home. Doctors suggest drinking water from natural filtration is better than chemically treated water as human body would need few bacteria to develop immunity within the body.

Over the period of time India's simple style of molding clay went into an evolution. A number of distinct styles emerged from this simple style, but beliefs attached to it did not change. Truly, ancient traditional beliefs influence our lifestyle and have resulted in sustaining the form of earthen pots. Hence, the age old practices have the strong base grounds from which the modern technology can take inspiration and could be redesigned in such a way that the human needs for water and its storage are accomplished.

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