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Peel 'o' Filter – A Natural and Sustainable Way to Filter Water

Dr. Vaishali Mishra,

HOD Chemistry, ITL Public School, Sector -9, Dwarka New Delhi-110077.



ABSTRACT

In rural areas, groundwater pollution is a big problem where not only germs aren't the only danger to drinking water but heavy metals, pollutants, and pesticides can get into supplies too. Certain fruit and vegetable peels can indeed be used to remove pollutants like dyes, pesticides, and heavy metal ions like lead, cobalt, copper, arsenic, etc. from drinking water through the process of adsorption and also maintain the pH. These pollutants adhere to the surface of the fruit and vegetable peels and are therefore removed from the water. Citrus peels were proven to remove 96 percent of lead ions. A promising and cost-effective way of purifying water naturally can be done at home in easy steps and no lab is required.

KEYWORDS: *Bio peels, Pollutants, Adsorption, Cost, Water purification*

AIM: To make clean water available in remote/rural areas using domestic waste.

INTRODUCTION

Peel 'o' filter is a modern technology designed to purify water in an inexpensive way using household waste, specifically kitchen waste. It is eco-friendly and has six layers of fruit and vegetable peels, arranged according to their pore sizes, which are capable of removing harmful ions from water and adding more nutrients to it.

The process of filtration of water using peels is based on the principle of adsorption and Desorption.

Adsorption: The phenomenon of attracting and retaining the molecules of a substance on a surface of a liquid or solid leading to a higher concentration on the surface in comparison to the bulk is called **adsorption**.

The molecular species or substance, which concentrates or accumulates at the surface, is termed **adsorbate** and the material on the surface of which the adsorption takes place is called **adsorbent**.

Metal adsorption depends on the nature of the **adsorbent surface** and **species solution**. The amount of adsorption is a **minimum at pH 2** and increases as pH increases. The maximum adsorption occurs **at pH 6–8** for banana and orange peels. But adsorption decreases when pH increases further.

Why Use PEEL 'O' filter?

Clean drinking water is vital for all human beings. But unfortunately, not everybody has access to safe and uncontaminated water. **3-4 million people**, especially **children**, die annually from **water-related diseases**.

There have been numerous technologies developed to provide clean drinking water specifically to remove metal toxicants from polluted waters- silica, alumina, activated carbon, and resins have all been proven successful but most of them are expensive. **We bring to you some of the most inexpensive, accessible, and simple ways to clean water**, specially designed for rural areas.

Using water from **Brazil's Parana River** and locally grown bananas, researchers at **Sao Paulo State University** have demonstrated that dried banana peels can successfully remove copper and lead from contaminated water. We made this the basis of our research and on experimentation, found the same properties exhibited by many other fruit peels.

PROCESS

LAYER 1 – CLOTH: The cloth filter is a simple and cost-effective technology for **reducing the contamination of drinking water**. Water collected in this way has a greatly reduced pathogen count - though it will not necessarily be perfectly safe, it is an improvement for poor people with limited options. The cloth filter provides less than ideal purification on its own - usually filtering is an initial step, to be followed by further disinfection.

LAYER 2 – NEEM LEAVES: Neem contains **98 % water** and more **carbohydrates**, with low quantities of other nutrients like **protein, amino acids, vitamins**, etc. When water is passed through it, all these nutrients are released into the water removing impurities and making it healthy.



LAYER 3 – BANANA PEELS: Banana peels can keep pollutants away from slipping into your water. Compounds in the peels contain **nitrogen, sulfur, and organic compounds such as carboxylic acids**. These acids contain **negatively-charged electron pairs** which can **attract metals that are commonly found in water**, such as **lead or copper** because they typically have a **positive charge** and **coagulation** takes place.

The peels could be a cheap new way to detect heavy metal contamination in drinking water. During our experiments, we observed that the **smaller the size of banana pieces more the adsorption rate**. (This is due to adsorption being a **surface phenomenon** and by making smaller pieces, we increase the surface area.) Using

dry banana peels is more beneficial as rotting is not a problem anymore. We can use the same banana peels up to **11 times** without replacement. We get Cu and Pb contaminated water from leaving lukewarm water inside a



pipe for at least 24 hour

s.

LAYER 4 – APPLE PEELS: The presence of **highly toxic anions such as Chromate (CrO_4^{2-}), Arsenate (AsO_4^{2-}), and Arsenate** in drinking water is a major health concern in many parts of the world.

Zirconium cations (Zr^{2+}) are immobilized onto the apple peel surface and used for the extraction of these anions. The **adsorption** and **desorption** studies revealed that **the adsorption mechanism involves electrostatic interactions**. Overall, Zr^{2+} is an effective adsorbent to adsorb adsorbate CrO_4^{2-} and AsO_4^{2-}



LAYER 5 – ORANGE PEELS: **Activated carbon** which is a very good adsorbent, obtained from orange peel is used for the **removal of heavy metal ions like Cr^{3+} , Cd^{2+} , Co^{2+} and Ni^{2+} (adsorbate)** from water by adsorption. Copper ions (Cu^{2+}) exhibit the **greatest adsorption on activated carbon orange peel because of its size and pH conditions**. Adsorption capacity varies as a function of pH.

Equilibrium, thermodynamic and kinetic studies were carried out for the biosorption of **Cd^{2+} and Ni^{2+} ions** from aqueous solution using the grafted **copolymerization-modified orange peel**.

The residues of banana and orange peels can be processed and converted to adsorbents because they have **large surface areas, high swelling capacities, excellent mechanical strengths**, are convenient to use, and have great potential to adsorb harmful contaminants such as heavy metals.



LAYER 6 – CUCUMBER PEELS: Cucumber peel removes **Pb (II)** from water under several varying conditions such as **pH, adsorbent dosage, and contact time**. **Maximum metal sorption** was found to occur at the initial **pH of 5.0**.

The adsorption capacity was found to be **28.25 mg/g** for an initial Pb (II) concentration of **25 mg/l at 25° C**. With the loss in Pb (II) ion removal efficiency, it could be **regenerated using 1M HNO_3 during repeated sorption-desorption cycles** and showing recovery of **93.5%**.

TDS

Less than 300
300 - 600
600 - 900
900 - 1,200
Above 1,200

Rating

Excellent
Good
Fair
Poor
Unacceptable

TESTING OF pH:

Water Sample	pH
Tap Water	5.6
RO Water	6.8
Peel O Filter water	6.9

The permissible range of pH in drinking water: pH indicates the intensity of acidic and basic character at a given temperature.

Indian standard specifications for drinking water: **pH 6.5 to pH 8.5**

WHO standard specifications for drinking water: **pH 7.0 to pH 8.5**

	Layer 1	Layer 2	Layer 3	Layer 4	Layer 5	Layer 6
Harmful ions removed	Cloth	Neem	Banana	Apple	Orange	Cucumber
	Reduce Pathogen counts	Act as Disinfectant	Remove Lead and Copper	Remove Chromate, Arsenate & Arsenite	Removes Cr^{3+} , Cd^{2+} , Co^{2+} , and Ni^{2+}	Removes lead and color dyes

CONCLUSION

- Since the **TDS value** is within the prescribed limit as set by The U.S. EPA, the water **purified by peels** is suitable for drinking.
- Since the **pH value** is within the prescribed limit as set by India Jal Board and WHO, the **purified water** is suitable for drinking.

ADVANTAGES

- ✓ Eco friendly
- ✓ Cost-effective
- ✓ Reuses waste material
- ✓ Everything can be done at home itself.

DISADVANTAGES

- The material gets decayed quickly, so has to be changed frequently.
- It is time-consuming.
- Pesticides cannot be removed completely by this method.

FUTURE SCOPE

Its main purpose is to help people in remote areas to get clean, drinkable water using domestic waste like peels. It also adsorbs useful ions from peels.

This technology is already being used by some families in Chandni Chowk, Delhi. The pipework there is very old. So when the water passes through them, Cu ions from these pipes get dissolved in water, making it harmful

to drink. If this technique is being used currently by some families in Delhi, the capital of India, then why can't this be used with some improvements in other parts of the country, especially rural areas?

In this age of pollution, this is an easy and effective way to purify water using biodegradable waste with no pollution. With further experiments and innovations, there may come a time when we all will be using these instead of RO filters which release harmful gases and are non-biodegradable.

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