

Treatment of Urinal Waste Water using Natural Coagulants



P. Balamurugan, K. Shunmugapriya

Abstract: The treatment of yellow water which is collected from a urinal is treated in a way to reuse it as a flushing water effectively. An existing methodology was differently tried and worked it out to treat the yellow waters. The two parameters were concentrated much for the safety reusing of the treated yellow water. Those two are Odor and Color which has a great impact in the reusing. There are many existing methods to treat the yellow water and reusing it for gardening purpose and reusing many more. But those methods involve addition of chemicals and very high cost of budgeting. The core of the project is to treat that yellow water effluent in a natural method without using any chemicals. We tried with many of the natural coagulants such as Vetiver, Guava leaf, Tamarind, Rose and more. But the result was not concluded. Hence, we got existing methodologies using natural materials and we colloid them to a single structure and the process carried. The process consists of a Dilution, Aeration and two filtrations of Sand filter and Carbon filter. While those yellow water passing through those chambers sequentially it gets its results as the Aeration part removes the foul odor while Sand and Carbon filters removing the color in the yellow water. Eventually the phenomenal result is achieved.

Index Terms: Natural coagulants, Urinal water, Dilution, Aeration

I. INTRODUCTION

Water is an inevitable natural resource that is sentenced for the living of Humans and functioning of an Environment. Also, there is a Global threatening that water gets scarce due to the pollution we are creating. We Engineers having much more responsibility on making the water immortal for our future Generations and Environment. So cutting down of fresh water usage is very much essential as much as possible. Toilets and urinals flushing can consume quite a lot of water supply, especially in commercial places. Responsible use of fresh water means ensuring that all water-consuming fixtures in public areas are operating properly, with no leaks or drips. A faucet leak of one drop per second can waste 3–7 gallons of water per day. As with Urinals, pre-1992 urinals can use up to 5 gallons per flush. Current International Plumbing Code requires a maximum flow rate of 0.5 to 1.6 gallons per flush. Usually we will treat the household effluents that is grey water

harvesting. By the same way of many techniques or methods the Human urine waste water also harvested and can be recycled. Generally the waste water treatment methodology involves many process of treatment to make an efficient controlled quality of water. Similarly, we can also employ the strategy for the treatment of Human urine waste water. Normally, the treatment method for the waste water effluent from municipal bodies depends upon the rate of effluent and their characteristic. Similarly, here the characteristics of the Human urine waste water need to be assessed so that the treatment methodology can be structured. There are many chemical and mechanical process to carry over the treatment of the waste water for reusing. That chemical process makes way of a use of a chemical which is a boom for unhealthy environment. So there are some Engineers who took responsibilities and found many methods to treat the waste water effluents in treasured natural methods. While moving to the natural methods of recycling and reusing we can achieve an effective result of the treatment with standards. There are no limitations for the method of recycling. The ultimate aim of the recycling is to get an output of water which is safe to be reused. The idolized Golden theme of our project is to recycle the Human urine waste water effluent in a path of a sustainable way by using natural materials. Also to reuse those recycled water for flushing the same urinals. Thereby it will cut down the cost and usage of normal water for flushing drastically. The main objectives of the study are:

- To treat the yellow water effluent from Urinals
- To reuse the treated water for flushing
- To reduce the water used for flushing
- To minimize the cost of treatment
- To replace the use of Reactive Chemical materials and methods
- To optimize the effluent from urinals by recycling it
- To lead in a zero-discharge plant

II. MATERIALS AND METHODOLOGY

NATURAL MATERIAL –VETIVER

A scientific name of the vetiver is *Chrysopogon zizanioides*, it is rich in Indian region. The production of vetiver is about 250 tons per annum in worldwide. The oil is yellowish-brown and viscous. Its odor is described as deep, sweet, woody, smoky, earthy, amber and balsam. With all the referred details we started our trial and error process with the Vetiver Roots and Leaves (Fig.1). We made the leaves and root of the Vetiver plant into powdered form.

Revised Manuscript Received on 30 July 2019.

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Then the raw sample was collected from the source and the coagulants are reacted with them for duration of about 30 minutes. After the reaction of the coagulant materials with the raw sample and it is filtered with the filter paper to filter out the raw sample (Fig.2). As a result, while using the Root and leaves of vetiver we can only remove the odor with an efficiency of about 95%.

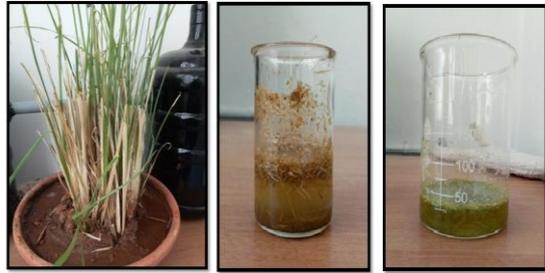


Fig. 1 Raw sample with Root and Leaves powder as coagulants



Fig.2 Sample after Filtration through filter paper

NATURAL MATERIAL – CHARCOAL

Activated charcoal is a potent natural treatment used to trap toxins and chemicals in the body, allowing them to be flushed out so the body doesn't reabsorb them. It's made from a variety of sources, but when used for natural healing, it's important to select activated charcoal made from coconut shells or other natural sources. Firstly, Charcoal is heated in oven and after heating the charcoal it is then put into contact with the freshly collected raw sample from the urinal system. Unfortunately, the result was not copied up well with the Charcoal due to some reactions (Fig.3).



Fig.3 Dipping the charcoal into the Sample

NATURAL COAGULANT MATERIALS

The natural coagulant materials such as Papaya leaf, Guava leaf, Neem leaf and Sugarcane Baggase are chosen from the existing natural Coagulant materials based on their

performance of their tendency to absorb the organic and inorganic compounds which is present in the urinal waste water. These natural coagulants have the tendency to remove the bacteria in the Urinal effluent. Also, they will neutralize the foul odors in the sample. We collected those Papaya leaf, Neem leaf, Guava Leaf and Sugarcane baggase and made their leaves into powdered form. Since the more fineness of a materials will perform well in the absorption of the chemical elements in the sample. After making it into powder form it is soaked in the fresh sample which is collected in our College.



Fig.4 Natural Coagulant Materials

After soaking the Natural Coagulant materials into the sample that we collected then it is filtered with the porous paper. Finally, we failed to achieve a result in this methodology.



Fig.5 Coagulants soaked in the sample

NATURAL MATERIAL – LIME

Lime is an effective material widely used in treatment of water and wastewater. The results of the lime treatment are effective removal of microorganisms and organic matters. In this study, lime as a natural material. Lime is made into powder. We got two forms of Lime and each form of Lime is tested individually. The Lime is soaked into the freshly collected urinal sample from the urinals. After the filtration process the colour of the urinal sample before treating with lime and after treated with lime is compared to get results in colour. As a result, the colour of the sample is partially removed by the natural coagulant Lime (Fig.6). Similarly, the sludge of the Lime which is collected in the filter paper is disposed to the agricultural land site as it increases the pH of the soil.

NATURAL MATERIAL – ORANGE PEEL

The research demonstrates that absorption time depends on the initial concentration of the dyes as well as the chemical structures of the particular dyes being tested, but absorption can occur at just 25 Celsius rather than elevated temperatures.



Orange peel was washed with deionized water to remove particulate material from their surface. After that, they were dried in sun. The dried materials were ground using pulverizer (Fig.7).

The ground orange peel was then sieved through 400 microns sieve to get uniform geometrical size for use. Then, they were dried in an oven at 100°C for 4 h. The dried orange peel powder was kept for experimental use. After sieving the orange peel powder which is dried in the Sun, it is now ready to soak into the urinal waste water effluent.

Next to the reaction the treated sample is filtered with the filter paper (Fig.8). Obviously the smell is removed from the sample and the colour concentration is increased.



Fig.6 Filtration of Lime which is soaked into the urine Sample



Fig.7 Sun dried orange peel and sieving of orange peel powder



Fig.8 Orange peel powder soaked with urinal sample

NATURAL MATERIAL – KELANELI

Similarly, Kelaneli is also sun dried for about 6 hours and then it is powdered. The more fineness of the absorbent will make

the reaction of the absorption more effective. The powdered and Sun dried Kelaneli is then immersed into the fresh urinal waste water which is collected from our college. It is left undisturbed for a time of hours. Then it is filtered with the filter paper. Resulting with the removal of odor and presence of color in the final sample (Fig.9).



Fig.9 Soaked and sample after treating with the Kelaneli

FILTRATION – COCONUT COIR WITH CHARCOAL

The coconut coir is finely powdered and then it is heated in the muffle furnace with a temperature of about 550°C. The coir is heated in the muffle furnace for about 3 hours. Similarly, Charcoal is also heated with oven for the same duration at a temperature of about 100°C. After the materials are prepared then the small scale Filter is made with the materials that we prepared. Firstly, the charcoal was put into the bottom layer of the filter bed, next to the charcoal layer coconut coir which is heated in the oven is placed. Then normal coconut coir finally the top layer is filled by Fine aggregates. Finally, the color and odor was not removed as expected and ends with low efficiency of removing the color and odor.



Fig.10 Charcoal is heating in the oven @100°C

FILTRATION – SAND AND CHARCOAL FILTER (RAW SAMPLE)

In this method of treatment the filtration carries two steps of one is Sand filter made of fine aggregates beds of different grading and by charcoal filter. But before the filtration process the waste water effluent which is collected from the urinals is let in an aeration chamber for some time. Then the aerated samples are fed into the filters of sand and charcoal. Aeration is the first stage of the treatment in this method. The dry urinal samples are collected from our college. As our sample does not have any possibilities to contain such large kind of suspended particles in it we can directly go for an aeration process without screening process.



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Then the samples are mixed with the cow dung and it islet into the Aeration chamber. The purpose of the cow dung which is mixed with urinal sample is to speed up the growth of microorganisms in the sample during the aeration.

Because, the increase in microbial organisms will make the foul odor producing microbes to decompose and will boost the treatment and the efficiency. Aeration of the Sample mixed with the cow dung is carried for an Hour without any interruptions. Aeration is done by the Aerator motors of Table sized units.

Next to the Aeration of the Sample water, it is left undisturbed for about 30 minutes for settling continuously.



Fig.11 Aeration of the Sample with Cow dung

FILTRATION

A small scale of Sand filter is made according to the volume of the sample. The arrangements of the sand filter beds are, Fine Aggregates, Chips, 12mm Metals. The Fine Aggregates and Chips, 12mm metals are cleanly washed with the water to remove those naturally present impurities in them Next to the Sand filter the sample is directly passed to the Charcoal filter. Collectively, due to some defects in our methodology the result was not attained as much we expected.

FILTRATION – SAND & CHARCOAL FILTER (DILUTED SAMPLE)

Generally, the urinals will be cleaned with come amount of water during the flushing of the urinals after its usage. So, that amount of water which is flushed is found out and the dilution of the sample with that amount of water is done. Finally, the sequence of the treatment process will continues.

CALCULATION OF THE RATIO

As per GB Manual, Amount of water used is 1.893 liters/flush

Average lpcd of Human urine is 0.6 to 2.6 l/p/day

Average person usage of urinals is 6 to 7 times a day

Amount of water used per person/day = 7×1.893
= 13.251 liters

Let's assume lpcd as 2 liter/day/person

Ratio of (Sample:Water) = $2/13.251$
= 1:6.625

Finally, the ratio of Sample:Water is 1:6.625.

DILUTION

The sample is collected from the urinals of our college in a raw state. Then the dilution is done with the calculated ratio (1:6.625).

SAND FILTER

A small scale of Sand filter is made according to the volume of the sample. The arrangements of the sand filter beds are, Fine Aggregates, Chips, 12mm Metals. The Fine Aggregates and Chips, 12mm metals are cleanly washed with the water to remove those naturally present impurities in them. The

sample after passing into the Sand filter is shown in the picture and the Aerated sample is also kept near the sample passed through the Sand filter for an easy comparison.

CHARCOAL FILTER

The diluted sample which is passed through the Sand filter then let into the Small scale Charcoal filter. The Charcoal filter has an efficiency to remove remaining odors and Colour. Finally, the successive methodology has been arrived with this. The Color and the Odor of the diluted sample was removed in the Sand and Charcoal Filter. The water took 5 to 8 minutes to pass the filter completely and the result can be verified whether the Color and odor is removed or not. Henceforth, the trial is successful and the water can be used for flushing.



Fig.11 Complete system of the methodology

III. RESULTS AND DISCUSSION

NATURAL MATERIAL – VETIVER

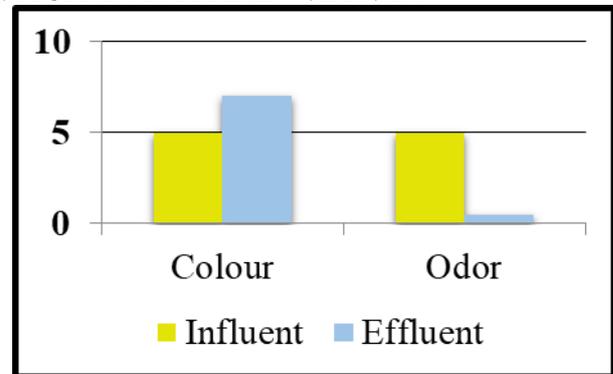


Fig.12 Vetiver Result

- Vetiver has the tendency to reduce odor to a greater extent. But it increases the colour of the raw sample.

NATURAL MATERIAL – CHARCOAL

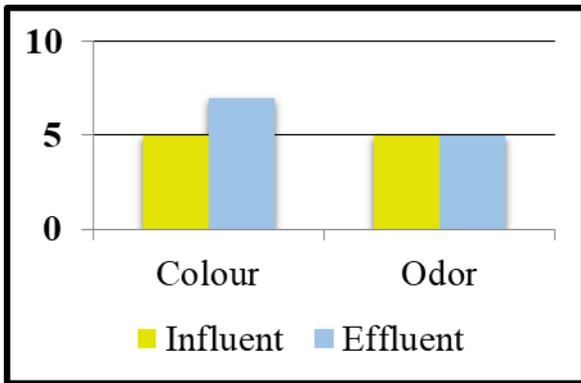


Fig.13 Charcoal Result

➤ In charcoal the colour has been increased due to the colour present in the charcoal and the odor has no effect of change in the addition of charcoal.

NATURAL COAGULANT MATERIALS

- PAPAYA LEAVES POWDER,
- NEEM LEAVES POWDER,
- GUAVA LEAVES POWDER,
- SUGARCANE BAGASSE POWDER

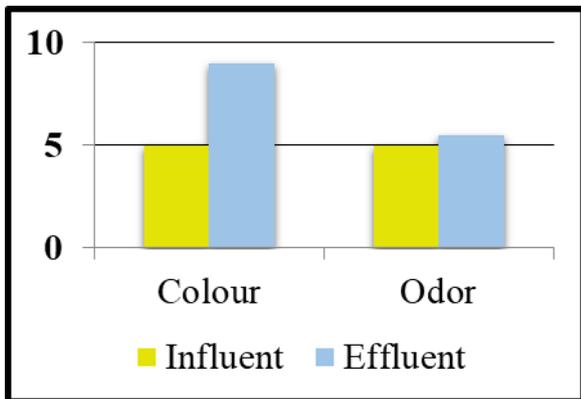


Fig.14 Natural Materials Result

Addition upon different Natural materials like papaya leaves, neem leaves, guava leaves and sugarcane bagasse has increased the color enormously and the odor content to a small extent.

NATURAL MATERIAL – LIME

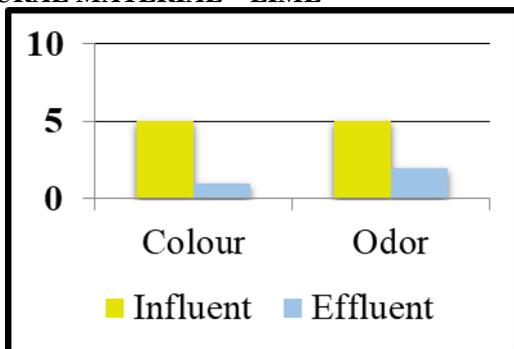


Fig.15 Lime Result

Lime has considerably reduced both the parameters the colour and the odor.

NATURAL MATERIAL – ORANGE PEEL

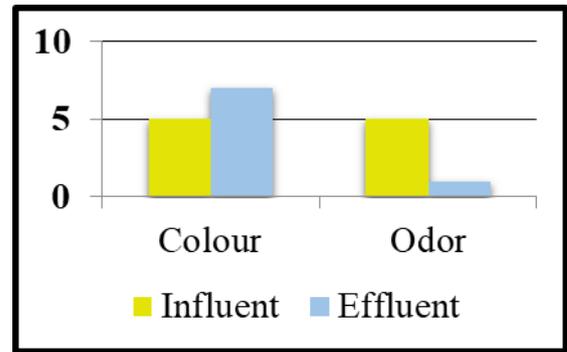


Fig.16 Orange Peel Result

While the addition of orange peel has reduced the odor to a greater extent but the color is being increased.

NATURAL MATERIAL – KELANELI

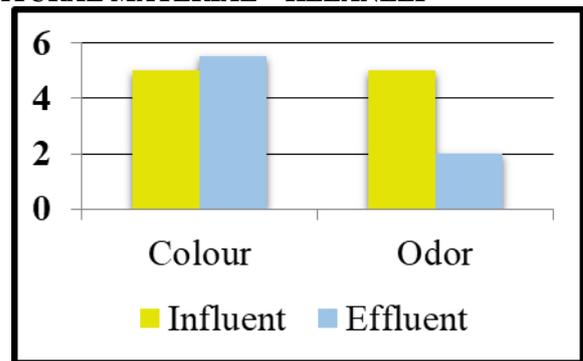


Fig.17 Kelaneli Result

➤ In Kelaneli there a slight increase in color and odor is being reduced to some amount.

NATURAL COAGULANTS – COCONUT COIR WITH CHARCOAL

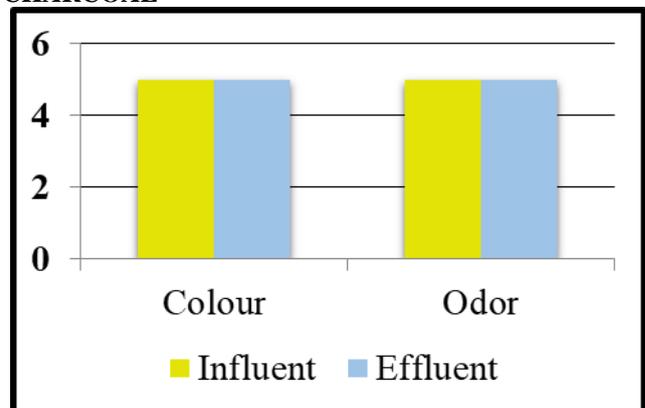


Fig.18 Coconut coir with charcoal

➤ This natural material coconut coir with charcoal doesn't have any effect on these physical parameters, the color and the odor.
➤ It has been neither increased nor decreased.

AERATION AND FILTERATION – COWDUNG

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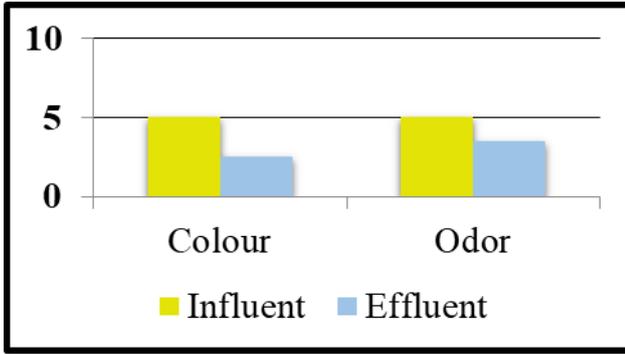


Fig.19 Cow dung Result

Cow dung has the efficiency to remove the color but not the odor.

AERATION AND FILTERATION – SAND FILTER (Raw Sample)

The Raw sample after aeration that has been passed into sand filter removes the odor and color nearly to 80%.

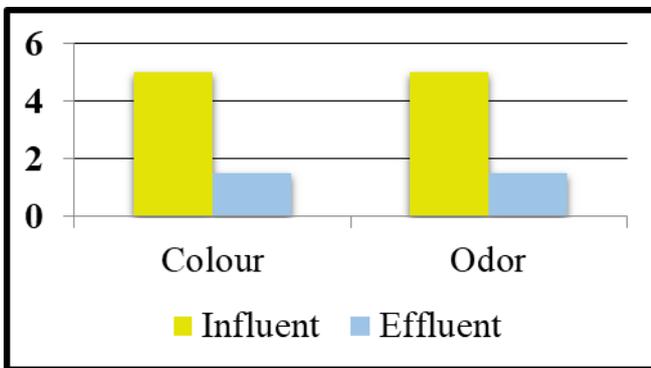


Fig.20 Sand Filter Result

AERATION AND FILTERATION – CARBON FILTER (Raw Sample)

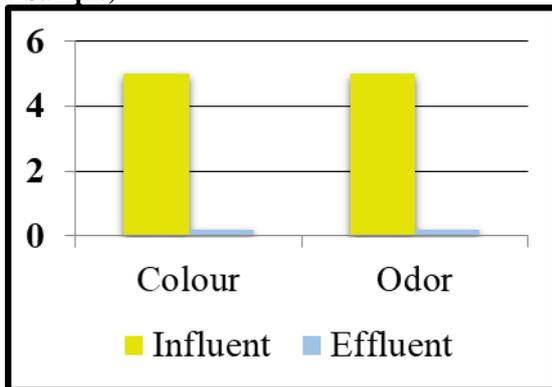


Fig.21 Carbon Filter Result

The Effluent coming from the carbon filter is free from color and odor. This Treated sample is assured that it has no objectionable odor and color and hence can be used for Flushing purpose.

ODOUR REMOVAL EFFICIENCY

The graph represents (Fig.No.22) the results of odor obtained when tested with various Natural materials stated previously. Inferring from this we can say that VETIVER and the CARBON FILTER has the highest efficiency in removing odor from the human urine. In the second place, orange peel

plays a vital role in removing the odor. In addition to this, Lime stands good in the removal of odor.

COLOUR REMOVAL EFFICIENCY

The graph (Fig.No.23) represents the results of color obtained when tested with various Natural materials stated previously. Inferring from this we can say that CHARCOAL and the CARBON FILTER has the highest efficiency in removing color from the human urine. Secondly Lime and Cowdung has Equal efficiencies in removing the color.

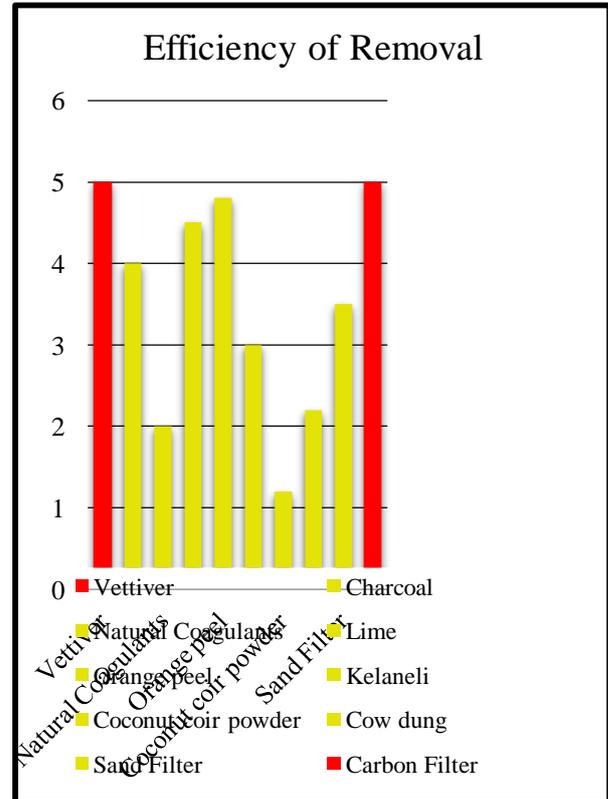


Fig.22 Results of comparison of Odor with different natural materials.

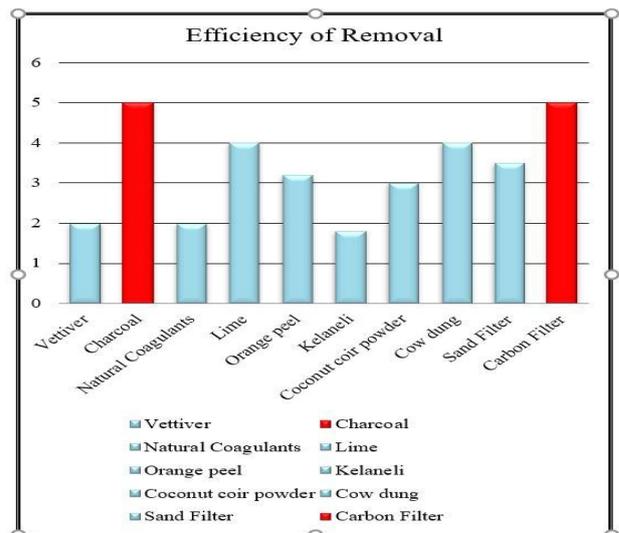


Fig.23 Results of comparison of Color with different natural materials

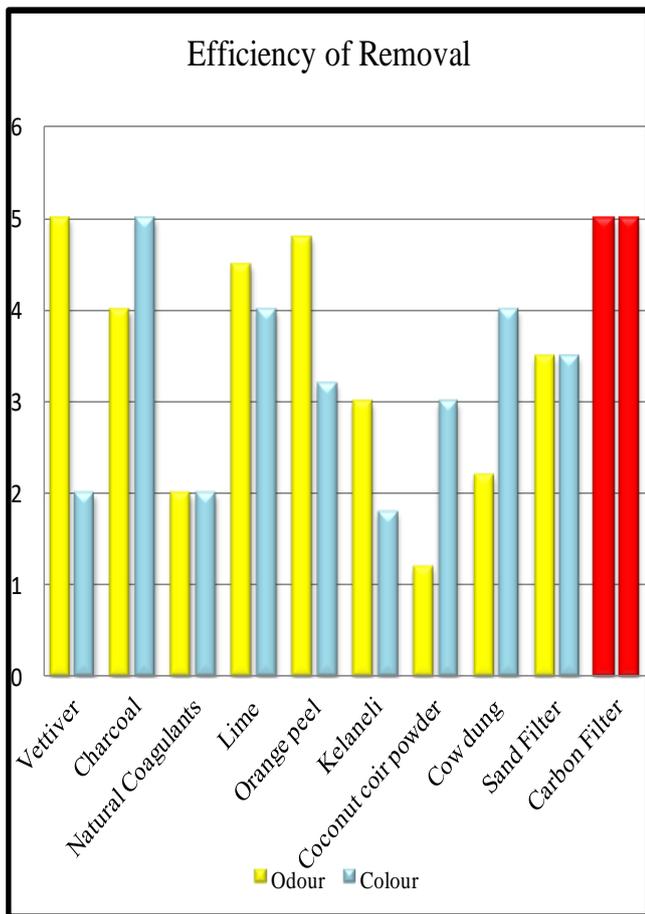


Fig.24 Results of comparison of both the Color and odor with different natural materials

COMPARISON OF ODOUR AND COLOUR

The Above graph represents the comparison of results of both color and odor obtained when tested with various Natural materials stated previously. From the information cited in the graph it is clear that CARBON FILTER removes both the parameters color and odor successfully. Moreover in the second place lime would be efficient in removing the parameters required for flushing.

IV. CONCLUSION

The following are the conclusion of the results which acquired in the treatment of urinal waste water by using natural methods. The urinal sample is collected from the urinals and treated by various natural materials. Among that Sand filter and Charcoal filter results consistently in removing the Colour and Odor. The system of treating the yellow water effluent will gives the required standards of result for flushing the water in the urinals. The Cost of the treatment of the effluent is also economical. The treatment system can be easily portable to any conditions. Small footprint is required to accommodate the Yellow water treatment plant with Natural materials. Adding, 15% of the water gained for flushing by recycling the urinal effluent. That is for an each complete cycle of recycling, the Human urine waste water is filtered, becomes purer and contributes added 15% for the flushing tank. This method can be well integrated for places where people accumulate or gather for their benefits and requirements such as Schools, Colleges, Commercial malls, Public places and much more.

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