Poll Res. 39 (February Suppl. Issue) : S119-S122 (2020)

ISSN 0257–8050

SUSTAINABLE HOUSE HOLD WATER PURIFICATION INTEGRATED WITH NATURAL COAGULANTS AND SOLAR TECHNOLOGY

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(Received 28 September, 2019; accepted 25 November, 2019)

ABSTRACT

Safe drinking water is a prime concern in rural areas of developing countries like India. Contaminated surface water often is the main source that may cause fatal infections, especially in less immunized children under five years. The problem attracted researchers mind to design and develop solar based sustainable technique for the purification of house hold water at affordable rates for these remote areas; where community water treatment facilities are still long awaited and in queue. At individual level also these people are not capable of affording reverse osmosis systems. We have tried a conceptual sustainable technique to treat house hold water without specialized skills and heavy investment, within affordable cost using natural coagulants and solar energy. Reduction in turbidity by 55%, TDS by 43%, TSS by 80%, hardness by 50%, BOD by 85%, COD by 84% proved the concept a potential water purifier. Coagulation and disinfection of the order of 62.5% was achieved by natural coagulants/disinfectants. Heavy metal chromium contamination was also removed by 60%. Though the initial batch experimental results were very exciting leading to 60% removal of contaminations on an average, yet there is lot of scope to modify these techniques. This research will not only spread awareness about natural coagulants and solar disinfection in rural and remote communities, but will also save millions of lives worldwide from water-borne diseases.

KEY WORDS : Sustainable, House hold, TSS, BOD, COD etc.

INTRODUCTION

A safe drinking water in rural areas is a burning issue not only in India but also in every developing country. Though Governments are taking care for the same yet there is an urgent need to develop such a sustainable house hold technology using solar radiations that can be adopted by the rural people. Purification means to remove all the undesired matters; so as to make the water fit and safe for drinking purpose at domestic level within affordable cost. This research focuses the low cost house hold water treatment techniques using natural coagulants and solar radiations directly or indirectly. Sterilization and distillation using solar radiations are the most common practices being adopted for a long with little investment and no side effect. The said processes produce purest form of water for medical and research purposes. Our study is limited to purify water making it potable within permissible limits of BIS through disinfection and other purification techniques using solar radiations directly, indirectly or both.

Literature Review

Activated carbon for filtration is very expensive and many researchers replace it by agro and horticultural wastes which are potential adsorbent of heavy metals and other impurities. The techniques are not only cost effective but simple that can be handled by rural people (Sharma, *et al.*, 2015, 2016, 2016, 2017, and 2019; Ayub, *et al.*, 2014).

Heavy metals are carcinogenic in nature and cannot be removed by sedimentation or filtration. So

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the filters are needed to be modified to eradicate the heavy metals contaminations (Ayub, *et al.,* 2014). Though the water appears to be clear after filtration yet, there may be some heavy metals and pathogen contaminations. There are not good facilities in remote areas to treat such contaminated water. Researchers motivated to develop a sustainable, easy operative and low cost device to prepare potable water.

Many researchers have worked on advance water and wastewater purification systems for urban community but, none has ever thought of developing affordable water treatment systems that can be operated even by unskilled people. Rural communities in remote areas without such systems keep suffering (Sharma, *et al.,* 2008).

MATERIALS AND METHODS

A traditional slow anthracite filter arrangement was followed by a unit of natural coagulants such as *Azadiraachta indica* (neem), *Ocimum sanctum* (tulsi), *Citrus limon* (lemon) and adsorption reactor for the physical adsorption process using various horticultural wastes as adsorbent such as mango seed shells (MSS), coconut jute (CCJ), almond seed shells (ASS), etc. Finally treated water was collected in the third transparent glass container, keeping other two as stand by for night collection so as to be disinfected by the next day. The filter was operated in the presence of solar radiations so as to disinfect the water without using any chemical disinfectant. The sample was kept open from top so as to aerate the water naturally but covered by fine plastic net to avoid contamination.

A synthetically chromium contaminated surface water sample collected from Barkachha, Mirzapur, UP, India was treated using different horticultural wastes as adsorbents. The peels of various fruits and their seed shells were first sun dried followed by drying in the oven. The dry material was finely grounded and alternatively washed with 0.01 N NaOH and 0.01N H_2SO_4.

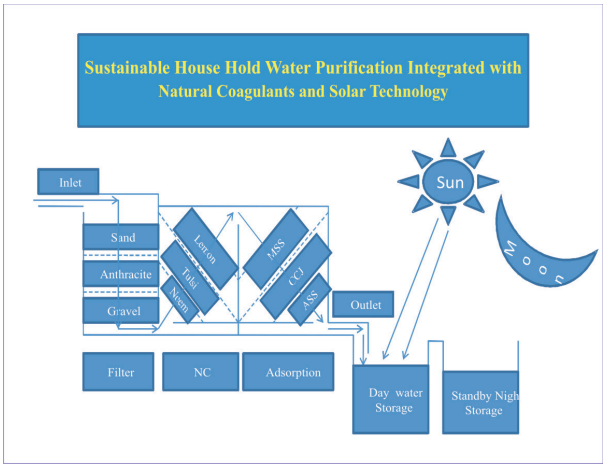
The pH, contact time, heavy metal concentrations, size of adsorbent grains and other parameters were fixed as per optimized values from existing relevant research (Sharma, *et al*., 2015, 2016, 2017). The surface water sample with mentioned characteristics was contaminated by AAS standard solution of chromium.

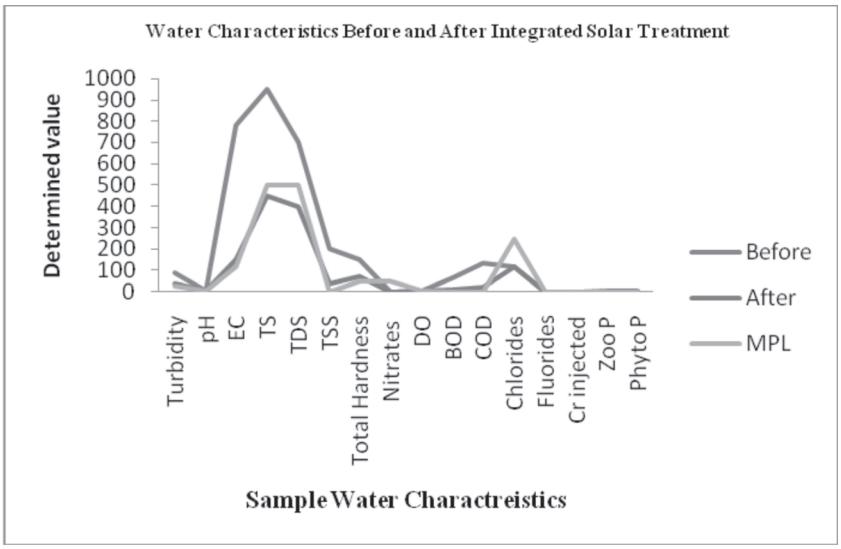
RESULTS AND DISCUSSION

Turbidity reduction from 90 mg /L to 40 mg/L shows that natural coagulants worked efficiently. The pH was within permissible range both before and after treatment; though it was marginally reduced. Electrical conductivity was reduced from 780 to 150 mg/L showing motivational results. TDS reduced from 700 to 400 mg/L which is within

S.No.	Characteristics	Parameter	Before	After	MPL
1	Physical	Color	Mudy	Clear	NIL
2		Temerature	23	20 C	
3		Turbidity	90	40	30
4		Odor	NIL		NIL
5	Chemical	pH	7.1	6.8	7.5
6		EC	780	150	120
7		TS	950	450	500
8		TDS	700	400	500
9		TSS	200	40	0
10		T Hardness	150	75	50
11		Nitrates	0.02	0.02	50
12		DO	7.5	8	4
13		BOD	70	10	0
14		COD	135	22	0
15		Chlorides	120	120	250
16		Fluorides	1.8	1.5	1.5
17		Cr (inj.)	0.1	0.04	0.01
18	Biological	Zoo P	3	1	
19		Phyto P	5	2	0

Note: EC in ìs/cm and rest in mg/L, Temp. in degree celcious.





permissible range and likewise TSS from 200 to 40 mg/L; this is not as per expectation for which there is scope for modification in the treatment system. Total hardness was also removed 50% rendering the water soft. DO was found to increase 7.5 to 8 mg/L and that is due to phyto planktons activated during solar disinfection though it was a good symptom for the purification of water. Reduction in BOD from 70 to 10 mg/L was also found satisfactory, but leaves the scope for further modification in system or increase in retention/ contact time for processing. Likewise COD was also reduced from 135 to 22 mg/L. Nitrates, chlorides and fluoride contents were not much affected but all were within permissible limits. Though there was not any pathogen, but zoo planktons were also reduced to a satisfactory level.

CONCLUSION

The lab scale batch experiment results are very exciting and motivating - removing 60-85% contaminations on an average. However, there is a considerable scope to modify this technique to design a continuous prototype flow system integrated with natural coagulants and solar technology.

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