Evaluation of wastewater treatment using Lemon peels and tulsi leaf powders as Natural coagulants

[1]Pavan Kalyan.M
UG student, Department of Civil Engineering
Alliance university, Bangalore-562106

[2]Shylendra R
UG student, Department of Civil Engineering
Alliance university, Bangalore-562106

[3]Asha Rani.N.R
Assistant professor
Department of Civil Engineering
Alliance university, Bangalore-562106

Abstract- Water is not only required for the survival of life, but it is also essential as it contributes to the survival of living life. As time passes people started to over-utilize the water for their survival. Many research work carried out on water quality testing parameters mentioned that excessive use of chemicals in water treatment causes cancers, tumors, and allergic disorders. Hence to overcome these problems use of natural coagulants is like such as banana peels and tulsi leaf were used to treat wastewater followed by the coagulation and flocculation process. Various dosages of lemon and tulsi powders were added to treat wastewater. This research work shows that it can remove pollutants present. The optimum dosage for lemon peel and tulsi leaf powder was found to be 5g/L of water with a contact time of 30 minutes.

Keywords – Natural coagulant, wastewater, lemon peel, tulsi leaf, turbidity

I. INTRODUCTION

All living organisms require water for their survival as it is very essential for their life. Water is used for various purposes which include drinking, irrigation, preparation of food, and industrial activities at the manufacturing unit. Earth is covered with 70% of water and has a lesser amount of 1% of fresh water and the distribution of freshwater is also uneven due to which people are lacking in availability of freshwater mainly in developing countries. Other than water scarcity problems the major problems faced by these countries are scarcity of adequate, reliable, and safe supply of water. There are various technologies such as the use of natural coagulants to remove contaminants. In this current work industrial wastewater is treated as discarded waste peels of lemon and tulsi leaf powder and there are various applications found significantly good in the removal of contaminants such as turbidity, hardness, chlorides, and residual chlorine. The peel and

Leaf powders used are non-toxic, low cost, and eco-friendly. The effect of dosages and contact time is considered in the removal of contaminants in the water is evaluated.

The industrial wastewater collected from hennagara lake which is having a high-level intensity of organic elements such as toxic, proteins, carbohydrates, and lipids. There are various methods to treat wastewater in this current study, and testing is carried out to check the applications of low-cost adsorbents such as lemon peels and tulsi leaf powder for treating industrial wastewater. The lemon peel acts as a low-cost natural coagulant material for coagulation procedure in wastewater treatment and it also acts as an eco-friendly coagulant. The possibility of lemon peels as a natural coagulant removes turbidity, hardness, chlorides, and residual chlorine in wastewater.

Tulsi leaf powder is a medicinal plant, even they cause waste controlling problems even though it has some compost and cosmetics potentiality. The material could be utilized for medication as well as individual care and it is also well-known for its anti-fungous and antibiotic properties. Likewise, that tulsi leaf powder also has adsorbent and coagulant

properties. It is very beneficial in purification and treatment processes. It also has adsorption capabilities to eliminate heavy metals such as chromium from wastewater, copper, and several toxic dyes

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II. MATERIALS AND METHOD

2.1 Coagulant used:

The coagulant used in this work is lemon peel and tulsi leaf powder where good characteristic lemon peel and tulsi leaf were preferred and accumulated from the regional marketplace at Chandapura in Bangalore. The lemon peels were cleaned thoroughly to eliminate dust and dirt from the peels gathered and then dried. The fine powder was produced with food processor, the hand-crafted powder achieved was utilized as a coagulant to treat wastewater. lemon peel and tulsi leaf powder were added directly to treat the wastewater samples and tests were carried out both pre-treatment and post-treatment. Industrial wastewater was collected for this experimental work. Tests such as turbidity, hardness, chlorides, and residual chlorine were carried out by the addition coagulant at different dosages i.e., 5, 10, 15, 20, 25, and 30gm/L of lemon peel powder and 2.5g, 5g, 7.5g, 10g, 12.5g, and 15g of tulsi leaf powder.

Figure 1: Raw Lemon peels and Dried Lemon peel powder

Figure 2: Raw tulsi leaf and Dried Tulsi leaf powder

2.2 Collection of the industrial wastewater sample.

Samples were collected from hennagara lake. Hennagara Lake is a lake in the suburb of Jigani in the southeast of the city of Bengaluru, the lake which was highly polluted by sewage and waste. In this analysis, the initial turbidity for the sample collected from hennagara lake water was found to be 141 NTU. Tests were conducted before and after adding both coagulants.

Figure 3: View of Hennagara lake and Collection of water sample

2.3 Experimental setup design:

Treatment setup includes the entrance of raw water into jar test apparatus where flocculation, followed by sedimentation. Manual screening is carried out then to treat silt, suspended material in water coagulants is added then rapid mixing is done so that it clumps together and forms floc, flocs settle down in the bottom of the jar test apparatus. A jar testing unit was set up where different concentrations of coagulant dosages were measured and added into a jar test beaker. The solutions were rapidly mixed for 2 minutes, trailed by gentle mixing for 30 minutes. The suspensions could stand with no interruption for an hour and then water is accumulated for sedimentation.

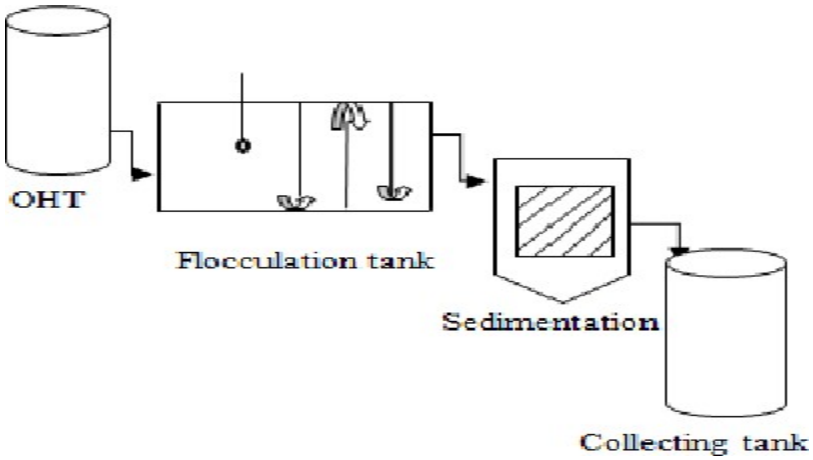


Figure 4: Diagram of Treatment Plant

2.4 Jar test

To check the optimum coagulant dosage for the taken sample by using lemon peel and tulsi leaf powder as a natural coagulant. This is a very easy method to check the optimum dosage of coagulant. The device contains six stirrers providing paddles. The paddles are mounted on a motor and regulator which rotates at varying speeds. Samples will be taken in beakers of 1000ML capacity and coagulants with different dosages will be added instantaneously to all six

jars. Paddles will be rotated at 100-150rpm for about 5-10 minutes and at 40-60rpm for about 30-40minutes, equivalent to the flash mixing and slow mixing in the flocculator, then allow for settling around 30minutes, samples will be taken carefully to measure turbidity by which least turbidity value gives the optimum dosage of coagulant.

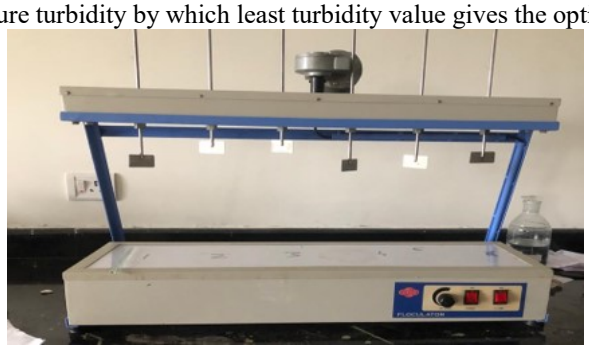


Figure 5: Jar test apparatus

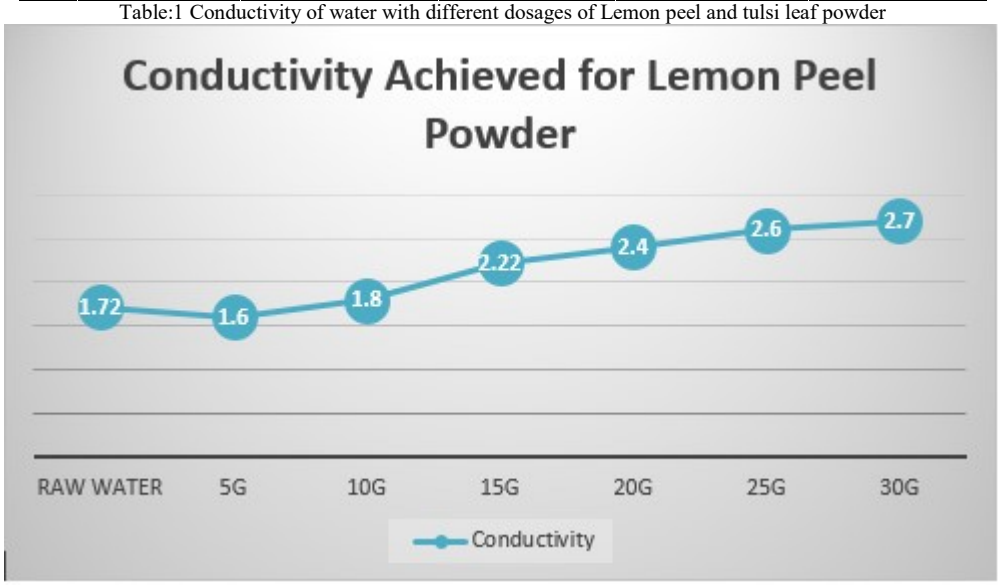
III. RESULTS AND DISCUSSION

3.1 Conductivity measurement

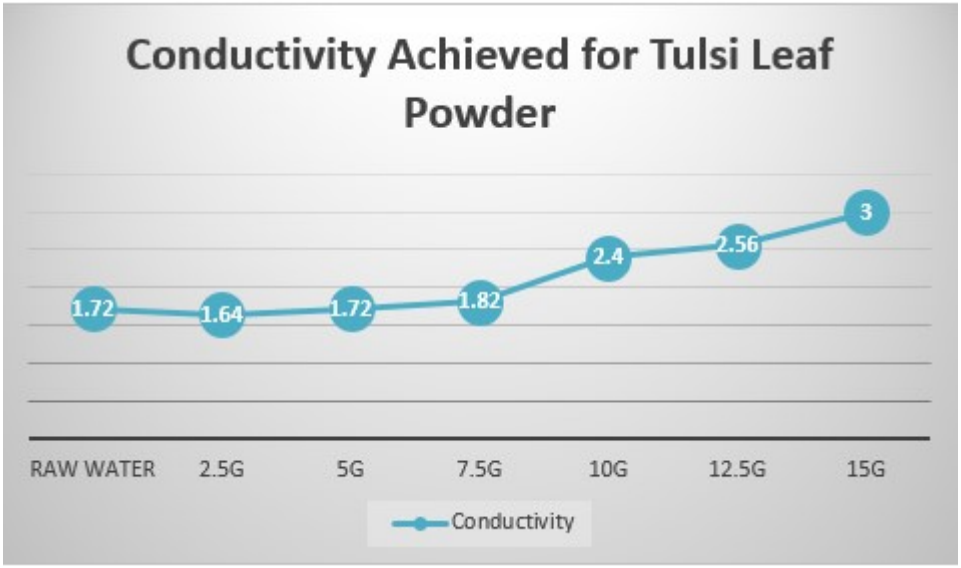
The testing samples used for pH measurements were used to check conductivity. A conductivity meter with an electrode with a probe was used to measure conductivity. Once reading becomes constant in LCD concerned results can be noted down.

Sl no	SAMPLE	Coagulant dosage	Conductivity (mmhos)	Coagulant dosage	Conductivity (mmhos)
1	Per-testing	-----	1.72	-----	1.72
2	Post-testing of water	5gm/L Lemon peel powder.	1.6	2.5gm/L tulsi leaf powder	1.64
3	Post-testing of water	10gm/L Lemon peel powder.	1.8	5gm/L tulsi leaf powder	1.73
4	Post-testing of water	15gm/L Lemon peel powder.	2.22	7.5gm/L tulsi leaf powder	1.82
5	Post-testing of water	20gm/L Lemon peel powder.	2.4	10gm/L tulsi leaf powder	2.4
6	Post-testing of water	25gm/L Lemon peel powder.	2.6	12.5gm/L tulsi leaf powder	2.56
7	Post-testing of water	30gm/L Lemon peel powder.	2.7	15gm/L tulsi leaf powder	3

Table:1 Conductivity of water with different dosages of Lemon peel and tulsi leaf powder



Graph:1 Conductivity of water with different dosages of Lemon peel



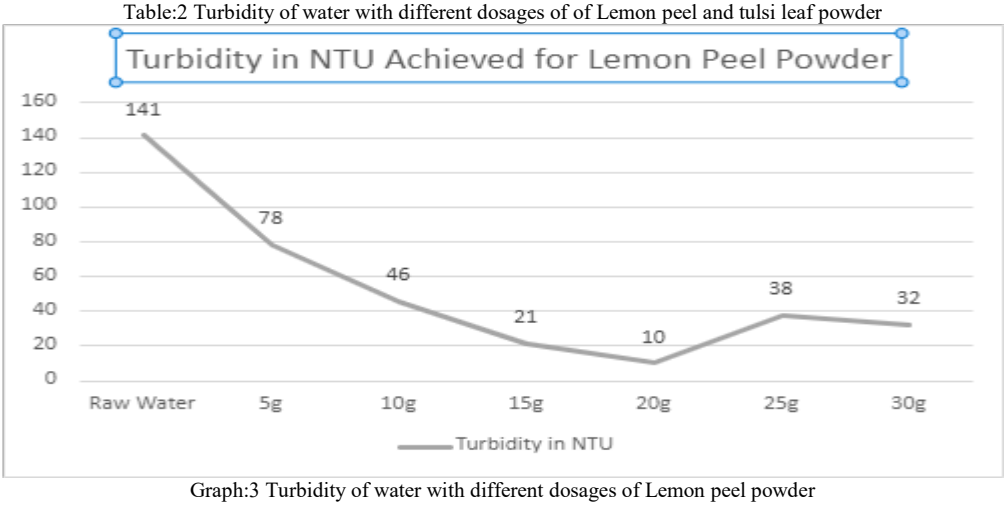
Graph:2 Conductivity of water with different dosages of Tulsi leaf powder

3.2 Turbidity measurement

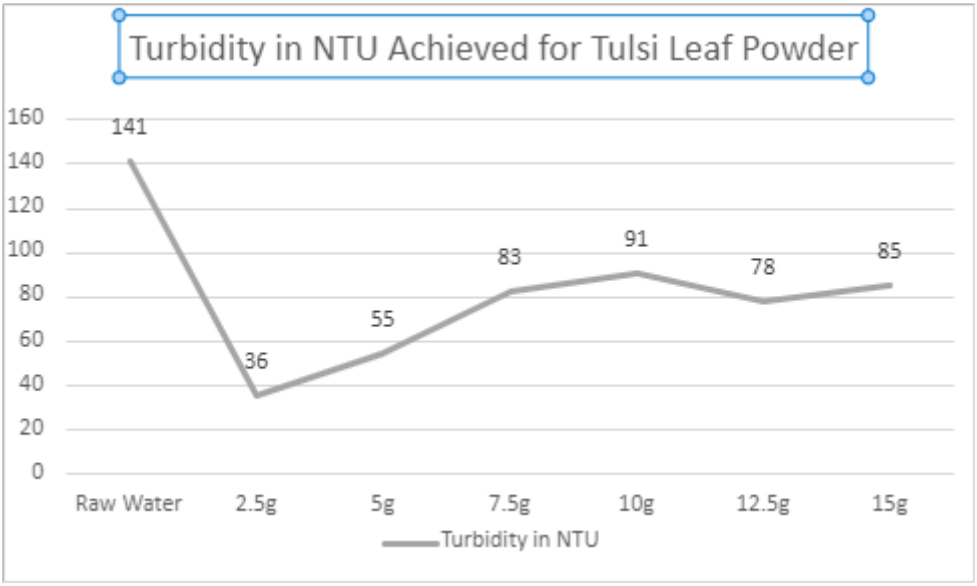
This test was carried out to measure colloidal particles present in the collected water samples from Bellandur and Suryacity lake. Samples were poured into the nephelometer tube and read the turbidity reading directly from the LCD panel display of the nephelometer instrument.

Sl no	**SAMPLE**	**Coagulant dosage**	**Turbidity in NTU**	**Coagulant dosage**	**Turbidity in NTU**
1	Per-testing	-----	141	-----	141
2	Post-testing of water	5gm/L Lemon peel powder.	78	2.5gm/L tulsi leaf powder	36
3	Post-testing of water	10gm/L Lemon peel powder.	46	5gm/L tulsi leaf powder	55
4	Post-testing of water	15gm/L Lemon peel powder.	21	7.5gm/L tulsi leaf powder	83
5	Post-testing of water	20gm/L Lemon peel powder.	10	10gm/L tulsi leaf powder	91
6	Post-testing of water	25gm/L Lemon peel powder.	38	12.5gm/L tulsi leaf powder	78
7	Post-testing of water	30gm/L Lemon peel powder.	32	15gm/L tulsi leaf powder	85

Table:2 Turbidity of water with different dosages of of Lemon peel and tulsi leaf powder



Graph:3 Turbidity of water with different dosages of Lemon peel powder



Graph:4 Turbidity of water with different dosages of Tulsi leaf powder

3.3 Total hardness

Hardness of the sample was carried out with various dosages of natural coagulants; the removal of magnesium hardness and calcium hardness of the sample was also tested.

Sl no	SAMPLE	Coagulant dosage	Total Hardness in mg/L	Coagulant dosage	Total Hardness in mg/L
1	Per-testing	-----	292	-----	292
2	Post-testing of water	5gm/L Lemon peel powder.	162	2.5gm/L tulsi leaf powder	468
3	Post-testing of water	10gm/L Lemon peel powder.	168	5gm/L tulsi leaf powder	432
4	Post-testing of water	15gm/L Lemon peel powder.	172	7.5gm/L tulsi leaf powder	456
5	Post-testing of water	20gm/L Lemon peel powder.	174	10gm/L tulsi leaf powder	484
6	Post-testing of water	25gm/L Lemon peel powder.	176	12.5gm/L tulsi leaf powder	468
7	Post-testing of water	30gm/L Lemon peel powder.	182	15gm/L tulsi leaf powder	472

Table:3 Total Hardness of water with different dosages of Lemon peel and tulsi leaf powder

Sl no	SAMPLE	Coagulant dosage	Calcium Hardness in mg/L	Coagulant dosage	Calcium Hardness in mg/L
1	Per-testing	-----	192	-----	192
2	Post-testing of water	5gm/L Lemon peel powder.	114	2.5gm/L tulsi leaf powder	360
3	Post-testing of water	10gm/L Lemon peel powder.	108	5gm/L tulsi leaf powder	372
4	Post-testing of water	15gm/L Lemon peel powder.	98	7.5gm/L tulsi leaf powder	344
5	Post-testing of water	20gm/L Lemon peel powder.	64	10gm/L tulsi leaf powder	322
6	Post-testing of water	25gm/L Lemon peel powder.	54	12.5gm/L tulsi leaf powder	298

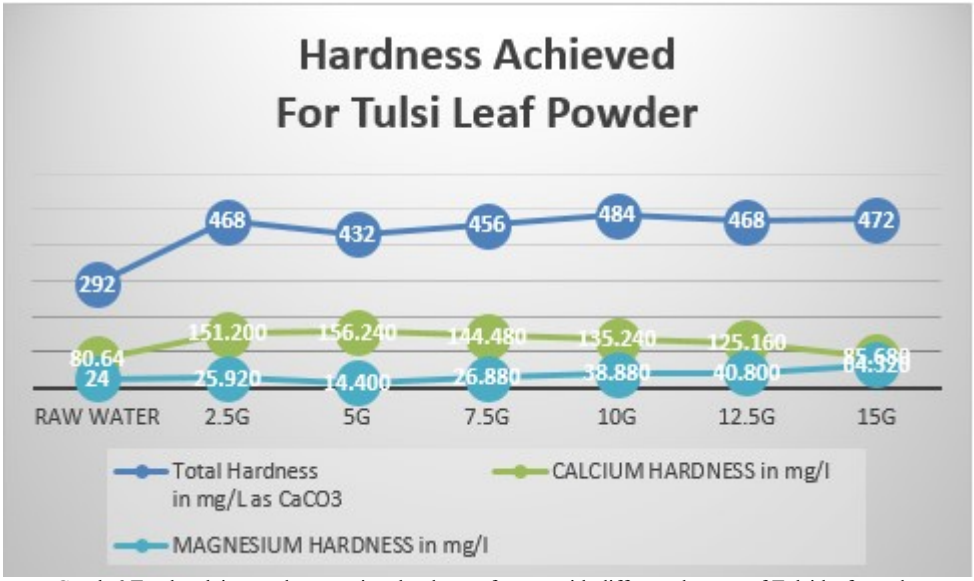
7	Post-testing of water	30gm/L Lemon peel powder.	48	15gm/L tulsi leaf powder	204

Table:4 Calcium Hardness of water with different dosages of Lemon peel and tulsi leaf powder

Sl no	SAMPLE	Coagulant dosage	Magnesium Hardness in mg/L	Coagulant dosage	Magnesium Hardness in mg/L
1	Per-testing	-----	100	-----	100
2	Post-testing of water	5gm/L Lemon peel powder.	48	2.5gm/L tulsi leaf powder	108
3	Post-testing of water	10gm/L Lemon peel powder.	60	5gm/L tulsi leaf powder	60
4	Post-testing of water	15gm/L Lemon peel powder.	74	7.5gm/L tulsi leaf powder	112
5	Post-testing of water	20gm/L Lemon peel powder.	110	10gm/L tulsi leaf powder	162
6	Post-testing of water	25gm/L Lemon peel powder.	122	12.5gm/L tulsi leaf powder	170
7	Post-testing of water	30gm/L Lemon peel powder.	134	15gm/L tulsi leaf powder	268

Table:5 Magnesium Hardness of water, Lemon peel and tulsi leaf powder with different dosages

Graph:5 Total, calcium and magnesium hardness of water with different dosages of Lemon peel powder



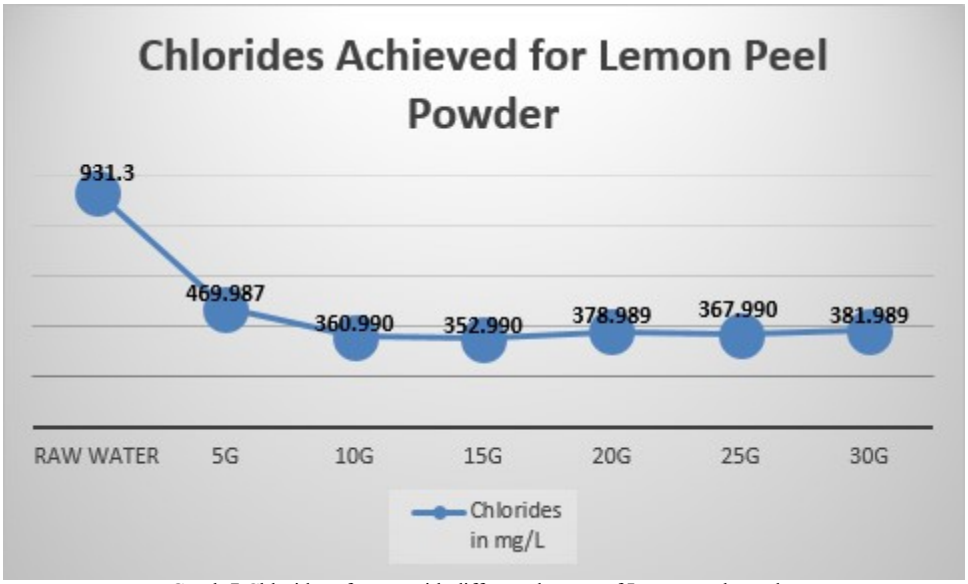
Graph:6 Total, calcium and magnesium hardness of water with different dosages of Tulsi leaf powder

3.4Chlorides

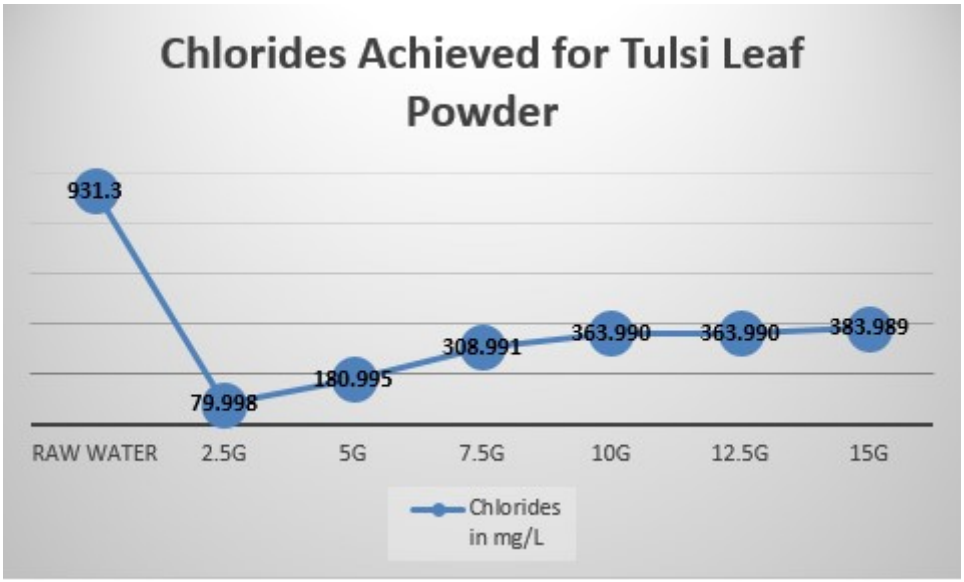
Chlorides present within allowable limits will not cause a dangerous impact on individuals. Water tastes salty once it reaches 39.99mg/L. The chloride concentration present in water used for the cultivation of crops is normally under control along with the total saltiness of the water. Evapotranspiration increases the salinity in the root zone of the cultivated plant, which leads to complexity intake of water due to osmotic pressure variations among the water out of the plants and inside the plant cells.

Sl no	**SAMPLE**	**Coagulant dosage**	**CHLORIDES in mg/L**	**Coagulant dosage**	**CHLORIDES in mg/L**
1	Per-testing	-----	931.31	-----	931.31
2	Post-testing of water	5gm/L Lemon peel powder.	469.987	2.5gm/L tulsi leaf powder	79.998
3	Post-testing of water	10gm/L Lemon peel powder.	360.990	5gm/L tulsi leaf powder	180.995
4	Post-testing of water	15gm/L Lemon peel powder.	352.990	7.5gm/L tulsi leaf powder	308.991
5	Post-testing of water	20gm/L Lemon peel powder.	378.989	10gm/L tulsi leaf powder	363.990
6	Post-testing of water	25gm/L Lemon peel powder.	367.990	12.5gm/L tulsi leaf powder	363.990
7	Post-testing of water	30gm/L Lemon peel powder.	381.989	15gm/L tulsi leaf powder	383.989

Table:6 Chlorides of water with different dosages of Lemon peel and tulsi leaf powder



Graph:7 Chlorides of water with different dosages of Lemon peel powder



Graph:8 Chlorides of water with different dosages of Tulsi leaf powder

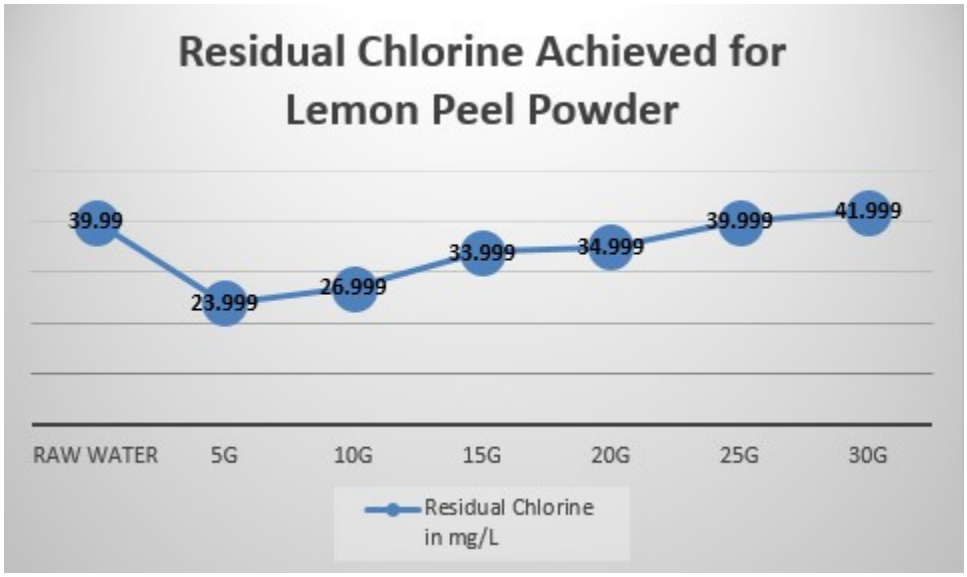
3.5 Residual Chlorine

Available chlorine is due to presence of free chlorine in water if it is present within the limits it inactivates bacteria and viruses which gives protection to water but if it is present in excess it may leads to ill effects on health such as cancer in bladder.

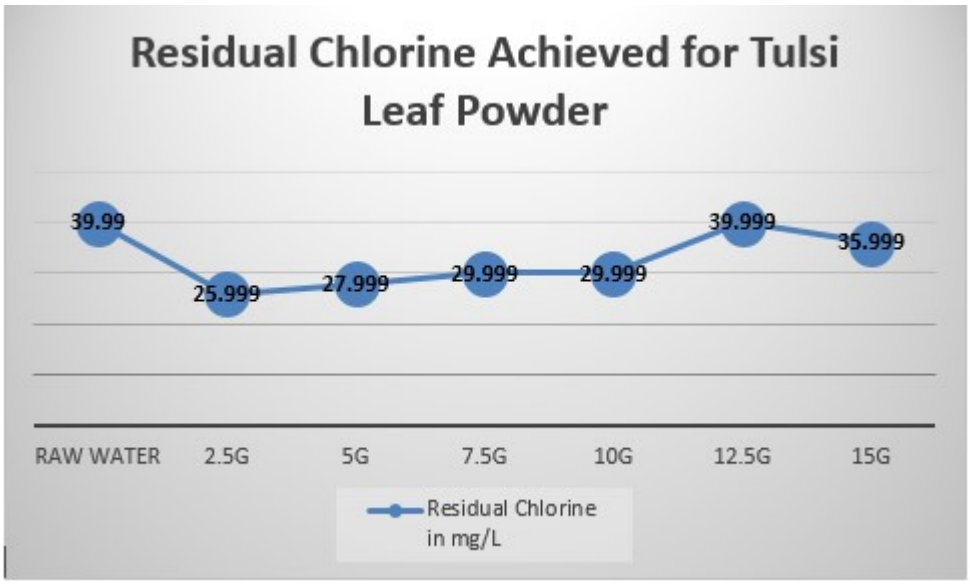
Sl no	SAMPLE	Coagulant dosage	Residual chlorine in mg/L	Coagulant dosage	Residual chlorine in mg/L
1	Per-testing	-----	39.999	-----	39.999
2	Post-testing of water	5gm/L Lemon peel powder.	25.999	2.5gm/L tulsi leaf powder	25.999
3	Post-testing of water	10gm/L Lemon peel powder.	27.999	5gm/L tulsi leaf powder	27.999
4	Post-testing of water	15gm/L Lemon peel powder.	29.999	7.5gm/L tulsi leaf powder	29.999

5	Post-testing of water	20gm/L Lemon peel powder.	29.999	10gm/L tulsi leaf powder	29.999
6	Post-testing of water	25gm/L Lemon peel powder.	39.999	12.5gm/L tulsi leaf powder	39.999
7	Post-testing of water	30gm/L Lemon peel powder.	35.999	15gm/L tulsi leaf powder	35.999

Table:6 Chlorides of water with different dosages of Lemon peel and tulsi leaf powder



Graph:9 Residual Chlorine of water with different dosages of Lemon peel powder



Graph:10 Residual Chlorine of water with different dosages of Tulsi leaf powder

IV.CONCLUSION

- From the above results, it is been determined that natural coagulant like lemon peel and Tulsi leaf powder can be used to check the effectiveness in wastewater treatment.

- Generally, the ability of clean water is little tough especially in rural areas. The technique is inexpensive, conventional, simple to execute and reduces mortality and mobility due to water borne diseases and this will improve public health in rural areas.
- The turbidity removal efficiency was found to be 45% for lemon peel powder and the turbidity removal efficiency was found to be 61% for tulsi leaf powder.
- The removal efficiency of total hardness was found to be 45%, removal efficiency of magnesium hardness was found to be 52% and removal efficiency of calcium hardness was found to be 2% for lemon peel powder and removal efficiency of total hardness was found to be 48%, removal efficiency of magnesium hardness was found to be 40% and removal efficiency of calcium hardness was found to be 9% for tulsi leaf powder
- The removal efficiency of chlorides was found to be 50% for lemon peel powder and removal efficiency of chlorides was found to be 81%.
- The removal efficiency of residual chlorine was found to be 30% for lemon peel powder and removal efficiency of residual chlorine was found to be 31%.
- The optimum dosage of Lemon peel powder was found be 5gm/L and 5gm/L for Tulsi leaf powder.

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