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WATER MELON SEEDS AS A POTENTIAL COAGULANT IN WASTEWATER PURIFICATION

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Abstract

Now-a-days due to the increase of population, the demand of water has increased considerably resulting in the generation of scarcity of lake water. This research project investigates the potential of watermelon seed as a natural coagulant for water treatment. This is aimed at identifying watermelon seed as a possible replacement for alum and other synthetic polyelectrolytes in treating water. It was aimed at identifying watermelon seed as a possible replacement for alum and other synthetic polyelectrolytes in treating water. Results obtained showed that at dosage of 0.05g/L, pH of 7.0, the optimum time duration is 24 hours and the optimum removal of turbidity is obtained. The reduction in turbidity was below the world health organizations (WHO) recommended value of 5NTU, however the best colour removal was not up to the WHO recommendation value of 40NTU. The residue of the crushed watermelon seed is used as the coagulant which can be obtained using soxhlet extraction apparatus with n-hexane as the solvent. Several test were conducted to investigate the concentrations present in the water sample before and after the addition of coagulant into the water sample. Laboratory scale studies using jar test experiments were performed on medium turbid water to determine the effect of dosage, pH stirring time and speed on coagulation. This paper reports the potential of watermelon seed as a natural coagulant for water treatment. The results obtained show watermelon seed can be used as a natural coagulant for water treatment.

Keywords: Water treatment, Water melon, Ecofriendly, Natural method

1. Introduction

Due to fast industrial development and the growth of population, the availability of water decreases day to day. Long before now, plants have been used for different reasons including treatment of various ailments. Plants can also be used for treatment of impure surface water such as rivers and streams (via coagulation and disinfection). The uses of water cannot be over emphasized as it serves domestic, industrial and public importance. In fact water is necessary for sustenance of plant and animal life. Even though water is an essential commodity for humans, it can also do harm to human health if consumed (especially for drinking) without purification. The level of purity of water varies according to the purpose of its use. The common method of water treatment involves the use of aluminium sulphate and calcium hypochlorite as water coagulants. These synthetic coagulants are actually expensive to purchase and are chemicals that when used for water purification may have negative effects on health if not properly administered during the water treatment process. In recent years there has been considerable interest in the use of natural coagulants in place of commercial ones. Some studies on natural coagulants have been carried out and various natural coagulants have been produced or extracted from plants such as Moringa oleifera, Prosopis juliflora etc. Among plant materials that have been tested over the years, the seeds of water melon has been shown to be the most effective natural plant coagulant for water purification, hence it can be used in place of aluminium sulphate (alum) which is commonly used around the world. The growth of towns, cities, and development of industries by 19th century leads to problem of decreasing of groundwater, drinking water or lake water which encouraged the treatment of drinking water. Due to fast industrial development and the growth of population, the availability of water decreases day to day. Long before now, plants have been used for different reasons including treatment of various 2 ailments. Plants can also be used for treatment of impure surface water such as rivers and streams (via coagulation and disinfection). The water melon seed powder feature antimicrobial properties accordant that a recombinant protein in the powder is able to flocculate gram-positive and gramnegative bacterial cells. In this case, the microorganisms can be removed by settling in the same manner as the removal of mixture in properly coagulated and flocculated water. The treatment gave a range of 7.2 to 7.9 which falls within the decreased as the concentrations of the dosing solutions were increased. The backward

was observed with the water melon seed powder treatment. Among all the plant materials that have been tested over the years, powder refined from the seeds from water melon powder has been shown to be one of the most effective as a primary coagulant for water treatment and can be compared to that of alum accepted chemical coagulant.

1.1 Study area

The water samples are collected from two different lakes, the first sample is taken from Nandhivaram lake which is located at the interior of Guduvanchery and the other sample is taken from the Aadhanur lake which is located at Aadhanur. These two lakes are selected for analysis because both the lakes not used by the people living around the place because it is polluted. That's why the samples are collected from those lakes to analyse and to treat the water sample. The map

view of the sample location is shown in below figures (Figure 1 and 2). The DMS latitude and longitude of the lakes is shown in the Table 1.

Table1: Locationofthesample

S.No	Latitude and Logitude	Name of the Lake	Located at
1	12*52'04.1"N 80*02'51.0"E	Aadhanurlake	Aadhanur
2	12*50'05.6"N, 80*04'39.2"E	Nandhivaramlake	Nandhivaram

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Figure 1: Locationofthesample (NandhivaramLake)

Figure 2: Locationofthesample (AadhanurLake)

2. Materials and Methods

2.1 Powdered watermelon seed

Citrullus Lanathus is a plant species in the family Cucurbitaceae, the watermelonis a large annual plant with long, weak, trailing or climbing stems which are five-angled(five-sided)andupto3mlong.Theleavesarelarge,coarse,hairypinnately-lobed and alternate; they get stiff and rough when old. The plant has branchingtendrils. The white to yellow flowers grow singly in the leaf axils and the corolla iswhiteoryellowinsideand greenish-yellow on the outside. The flowersareunisexual,withmaleandfemaleflowersoccurringonthesameplant.Themaleflowers predominate at the beginning of the season; the female flowers, whichdeveloplater,haveinferiorovaries.Thestyles areunitedintoa singlecolumn.

Watermelon seed oil is extracted using Soxhlet Extraction Apparatus from theseedsoftheCitrullusLanathus (watermelon).Itisparticularlycommon.Traditionally,theseedsareextractedfromtheseedcasing,anddriedinthesun.Oncedried,the seeds arepressedtoextract the oil.

2.2 ExtractionProcess

WatermelonseedoilisextractedusingSoxhletExtractionapparatus fromtheseedsofthe Citrulluslanathus (watermelon).ASoxhletextractorisinvented in 1879 by Franz von Soxhlet. It was originally designed for the extractionof a lipid from a solid material. Typically, a Soxhlet extraction is used when thedesiredcompoundhasalimitedsolubilityinasolvent,andtheimpurityisinsolublein the solvent. It allows for unmonitored and unmanaged operation while efficiencyrecyclinga smallamountofsolventtodissolvea largeramountofmaterial.A Soxhlet extractor has three main sections, a percolator (boiler and reflux)which circulates the solvent, a thimble (usually made of thick filter paper) whichretains the solid to be laved, and a siphon mechanism, which periodically emptiesthethimble.The source material containing the compound to be extracted is placed insidethe thimble. The thimble is loaded into the main chamber of the Soxhlet extractor.Theextractionsolventtobeusedisplacedinadistillationflask.Theflaskisplacedon the heating element. The Soxhlet extractor is placed atop the flask. A refluxcondenserisplacedatop

theextractor.The solvent is heated to reflux. The solvent vapour travels up a distillation arm,and floods into the chamber housing the thimble of solid. The condenser ensuresthat any solvent vapour cools, and drips back down into the chamber housing thesolid material. The chamber containing the solid material slowly fills with warmsolvent. Some of the desired compound dissolves in the warm solvent. When theSoxhlet chamber is almost full, the chamber is emptied by the siphon. The solventis returned to the distillation flask. The thimble ensures is returned to the

rapidmotionofthesolventdoesnottransportanysolidmaterialtothespillpot.Thiscyclemaybeallowed torepeatmanytimes,over hours ordays.During each cycle, a portion of the non-volatile compound dissolves in thesolvent. After many cycles the desired compound is concentrated in the distillationflask. The advantage of this system is that instead of many portions of the warmsolventbeingpassedthroughthesample,justonebatchofsolventisrecycled.

Afterextractionthesolventisremoved,typicallybymeansofarotaryevaporator,yieldingtheextractedcompound.Thenon-solubleportionoftheextractedsolid remainsin the thimble,andusuallydiscarded. The seeds were washed severally with water, sun-dried for a week, sorted toremovebadones,shelledandgroundwithahigh-speedlaboratoryelectricblender,packed in an air tight container. 150g of the crushed seeds were then packed in athimble and placed in a soxhlet extraction apparatus. 500ml of the n-Hexane wasused to extract oil from the crushed seed in the column. The apparatus was leftrunningforabout6hoursandstoppedwhentheextractionwascomplete.Thecakewasthenwashedwithdistilledwatertoremoveresidualn-Hexane,driedinanoventill constant weight and then sieved. The finer particles were then used as thecoagulant. Figure 3 shows the powdered watermelon seeds.

Figure 3: Powdered watermelon seed

3. Resultsand Discussion

3.1 Analysis of water sample

The water samples are collected from two different lakes (Aadhanur Lake and Nandhivaram Lake). The collected water samples is analyzed and treated by adding the watermelon seed as the coagulant.

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Table 2:Testresultsforrawwatersample(NandhivaramLake)

S.no	Parameter	Unit	Result	AsperIS1050–2012	
				Acceptable Limit	Permissible Limit
1.	Appearance	-	Turbid	-	-
2.	Colour	Hazen	Pale yellow	5	15
3.	Odour	-	Agreeable	Agreeable	Agreeable
4.	pHvalue	-	7.9	6.5-8.5	NoRelaxation
5.	Turbidity	NTU	6.8	1	5
6.	Taste	-	Agreeable	Agreeable	Agreeable
7.	TotalHardnessas CaCO3	mg/L	331	200	600
8.	E-Coli	MPN/ 100ml	<12	-	-
9.	Coliform	MPN/ 100ml	<12	-	-
10.	Conductivity@ 25^{o}C	µmhos/ cm	463	-	-
11.	TotalDissolved Solids@180°C	mg/L	597	500	2000
12.	CarbonateHardnessas CaCO3	mg/L	76.2	-	-
13.	NonCarbonateHardnessas CaCO3	mg/L	13.2	-	-
14.	CalciumasCa	mg/L	28.2	75	200

15.	MethylOrangeAlkalinityas CaCO3	mg/L	73.8	200	600
16.	Phenolphthalein Alkalinity asCaCO3	mg/L	Nil	-	-
17.	Magnesiumas Mg	mg/L	4.6	-	-
18.	Chlorideas Cl	mg/L	57.98	-	-
19.	Sulphateas SO4	mg/L	23.6	500	2000
20.	IronasFe	mg/L	0.8	0.3	NoRelaxation
21.	TotalSilica as SiO2	mg/L	1.7	-	-

Table 3: Testresultsof thewater sampleafter theadditionofcoagulant (6hours)

S.no	Parameter	Unit	Result	AsperIS1050–2012	
				Acceptable Limit	Permissible Limit
1.	Appearance	-	Turbid	-	-
2.	Colour	Hazen	8	5	15
3.	Odour	-	Agreeable	Agreeable	Agreeable
4.	pHvalue	-	7.8	6.5-8.5	NoRelaxation
5.	Turbidity	NTU	6.1	1	5
6.	Taste	-	Agreeable	Agreeable	Agreeable

7.	TotalHardnessas CaCO3	mg/L	331	200	600
8.	E-Coli	MPN /100ml	<12	-	-
9.	Coliform	MPN/ 100ml	<12	-	-
10.	Conductivity@25^{o}C	µmhos/ cm	487	-	-
11.	TotalDissolvedSolids@180°C	mg/L	632	500	2000
12.	CarbonateHardness asCaCO3	mg/L	79.8	-	-
13.	NonCarbonateHardness asCaCO3	mg/L	12.2	-	-
14.	CalciumasCa	mg/L	28.82	75	200
15.	MethylOrangeAlkalinity asCaCO3	mg/L	79.8	200	600
16.	Phenolphthalein Alkalinity asCaCO3	mg/L	Nil	-	-
17.	Magnesium asMg	mg/L	4.86	30	100
18.	Chlorideas Cl	mg/L	59.98	250	1000
19.	Sulphate asSO4	mg/L	23.6	200	400

20.	IronasFe	mg/L	0.7	0.3	NoRelaxation
21.	Total Silica asSiO2	mg/L	1.8	-	-

Table 4: Test results of the water sample after the addition of coagulant(12 hours)

S.no	Parameter	Unit	Result	AsperIS1050–2012	
				Acceptable Limit	Permissible Limit
1.	Appearance	-	Turbid	-	-
2.	Colour	Hazen	8	5	15
3.	Odour	-	Agreeable	Agreeable	Agreeable
4.	pHvalue	-	7.1	6.5-8.5	NoRelaxation
5.	Turbidity	NTU	5.1	1	5
6.	Taste	-	Agreeable	Agreeable	Agreeable
7.	Total Hardness asCaCO3	mg/L	428	200	600
8.	E-Coli	MPN/100ml	<12	-	-
9.	Coliform	MPN/100ml	<12	-	-
10.	Conductivity@ $25^{o}C$	µmhos/cm	437	-	-

11.	Total DissolvedSolids @180°C	mg/L	582	500	2000
12.	Carbonate Hardnessas CaCO3	mg/L	77.8	-	-
13.	NonCarbonate Hardnessas CaCO3	mg/L	12.2	-	-
14.	CalciumasCa	mg/L	29.82	75	200
15.	MethylOrangeAlkalinityas CaCO3	mg/L	79.1	200	600
16.	Phenolphthalein Alkalinity asCaCO3	mg/L	Nil	-	-
17.	Magnesiumas Mg	mg/L	3.96	30	100
18.	Chlorideas Cl	mg/L	59.18	250	1000
19.	Sulphateas SO4	mg/L	23.6	200	400
20.	IronasFe	mg/L	0.9	0.3	Norelaxation
21.	TotalSilica as SiO2	mg/L	1.9	-	-

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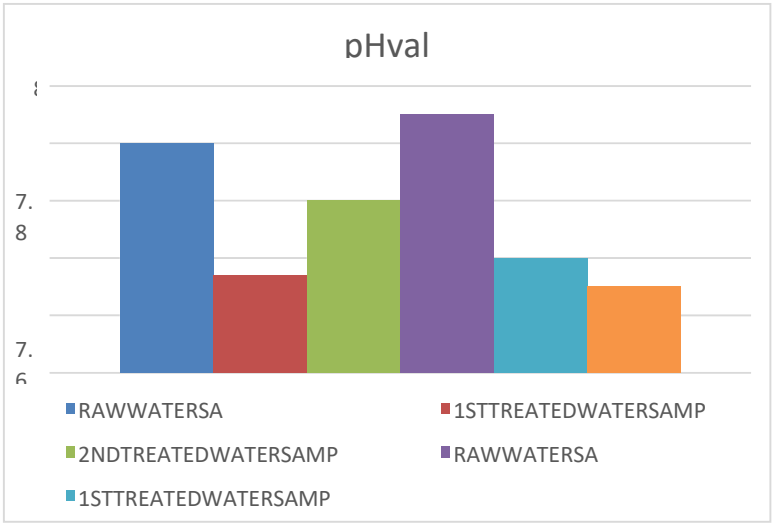

Figure 4:pHvalueofthesampleoftheNandhivaram *L*ake

Theabovechart(Figure 4)showsthatthepHvalueofthesampleofthe Nandhivaram Lakewhichgivesgoodresults.

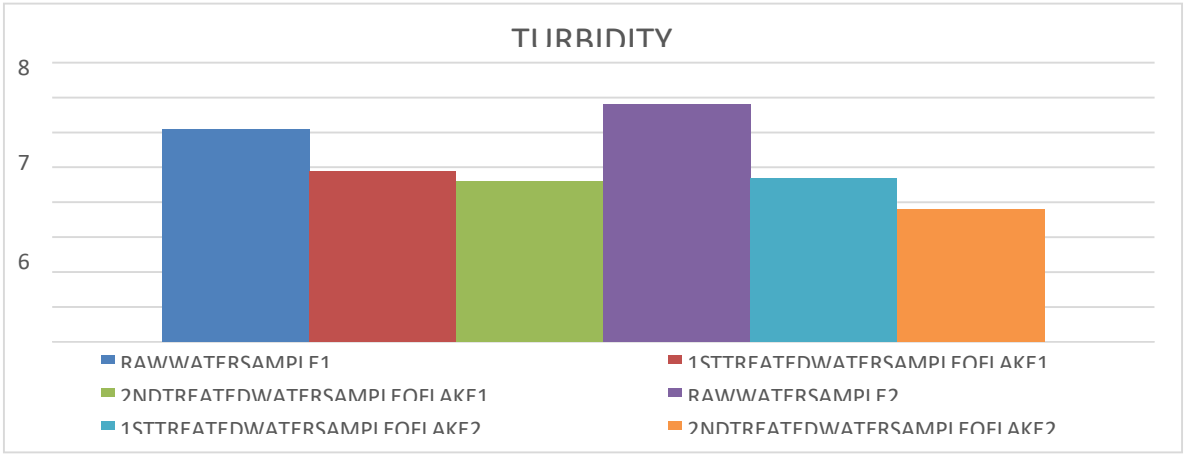

Figure 5:TurbidityvalueofthesampleoftheNandhivaram *L*ake

Theabovechart(Figure 5)showsthatturbidityvalueofthesampleofthe Nandhivaram Lakewhichgivesgoodresults.

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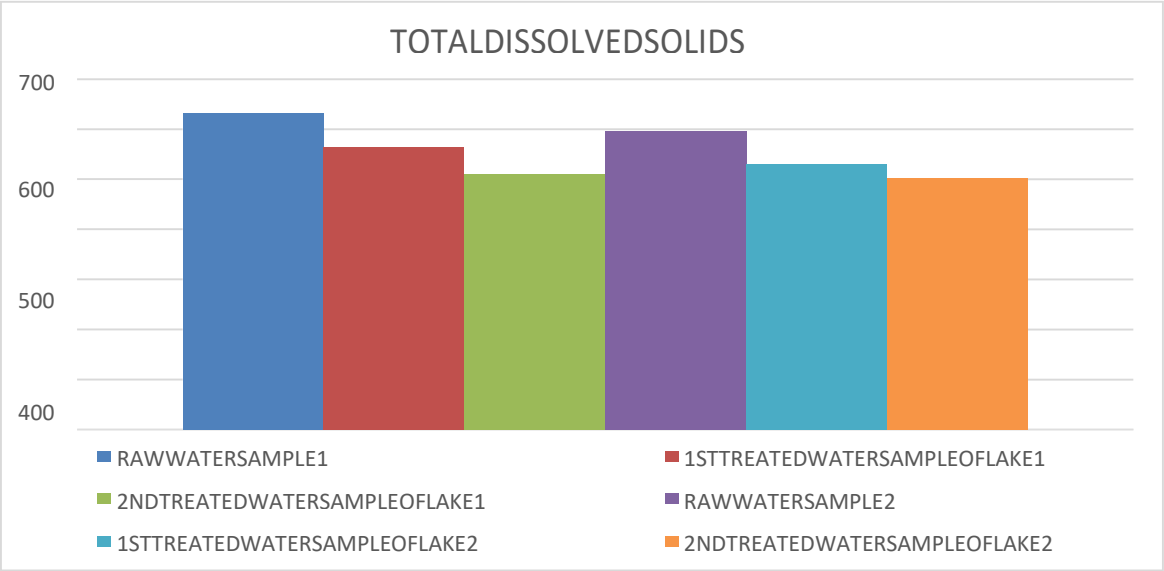

Figure 6:Total dissolved solids valuesofthesampleoftheAadhanur *L*ake

Theabovechart(Figure 6)showsthatthetotaldissolvedsolidsofthesampleof the Aadhanur Lakewhich showsgoodresults compared totheothersamples.

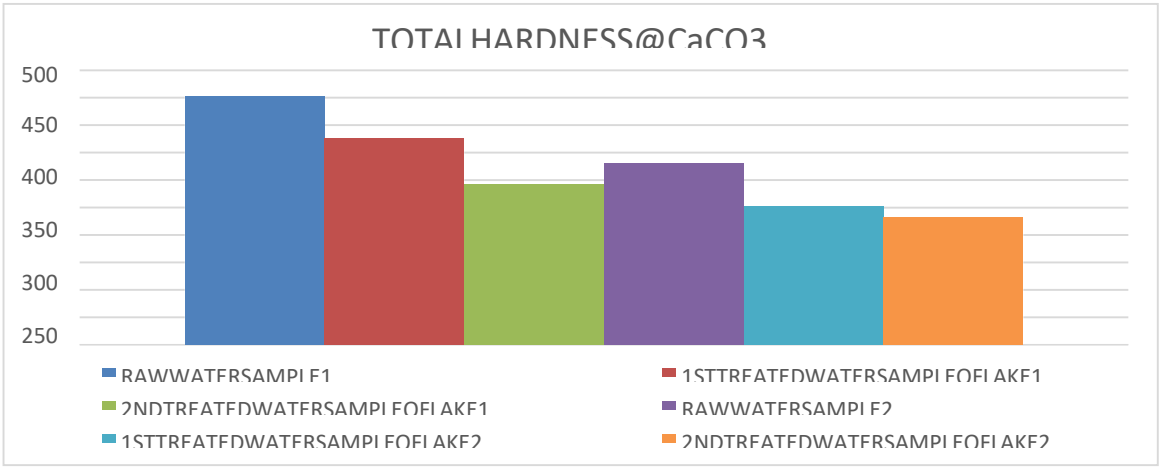

Figure 7:Hardness valuesofthesampleoftheNandhivaram *L*ake

Theabovechart(Figure 7)showsthatthetotalhardnessofthesampletheNandhivaramwhich showsgoodresultscompared totheothersamples

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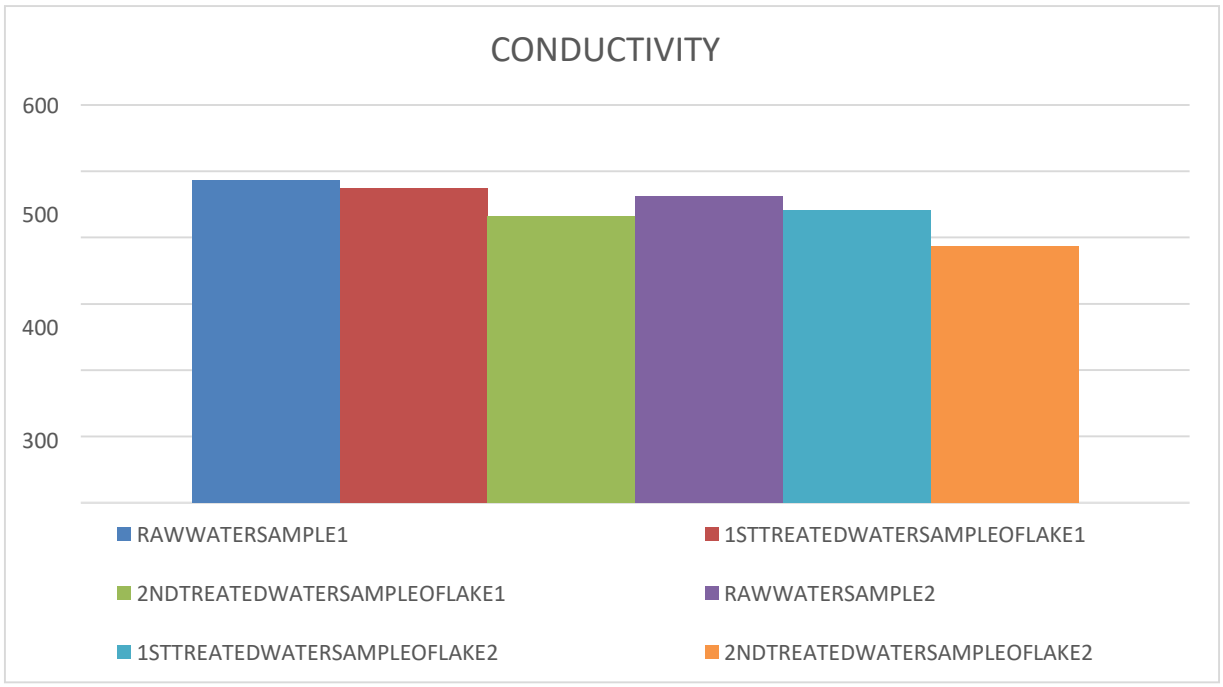

Figure 8:Conductivity valuesofthesampleoftheNandhivaram *L*ake

Theabovechart(Figure8)showsthattheconductivityofthesampleoftheNandhivaram lakewhich showsgood resultscompared totheothersamples.

4. Conclusion

In this research, the water sample is treated using natural material like watermelonseedpowder.It can be used for the reduction in the high concentration of the physical andchemicalparameters in the lakewater.From the result it is observed that the concentration has been reduced topermissiblelimits.The optimum dosage used in the water sample is 50 gms per litre and theoptimum time durationfor thecoagulant toreact is24 hours.Henceit isconcludedthat byusingalow costmaterialandanaturalabsorbentlikewatermelonseeds,thelakewatercanbepurifiedtoaconsiderable extent.When the watermelon seeds cake can be used in combination with alum toremovethe

higher turbidityand colour.Howevertherecommendationsratioforthecombinedcoagulantdoseshouldbearound80% ofwatermelon seedpowder and20%ofalum.

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