EUROPEAN JOURNAL OF BIOMEDICAL AND PHARMACEUTICAL SCIENCES
http://www.ejbps.com

ISSN 2349-8870
Volume: 3
Issue: 9
381-387
Year: 2016

EFFECT OF NATURAL AND SYNTHETIC COAGULANT ON SYNTHETIC AND LAKE WATER TREATMENT

J. K. Desai[1*] and S. D. Patel[2]

[1]Research scholar in Bhagwant University, Ajmer, Rajasthan,
[2]Associate Professor, Department of Chemistry, J & J College of Science, Nadiad.

***Corresponding Author: Prof. J. K. Desai**
Research scholar in Bhagwant University, Ajmer, Rajasthan.

Article Received on 29/06/2016 **Article Revised on 20/07/2016** **Article Accepted on 11/08/2016**

ABSTRACT
Access to safe drinking and irrigation water is important as a health and development issue at national, regional, and local levels. About one billion people do not have healthy drinking water. More than six million people (about two million children) die because of diarrhea which is caused by polluted water. Developing countries pay a high cost to import costly chemicals for water treatment. This is the reason why these countries need low-cost and natural chemicals and methods requiring low maintenance and skill. The present study was aimed to investigate the effects of natural, Synthetic and different combination of Natural + synthetic coagulants on synthetic water. Data also compare with the Turbidity data of lakes of Gandhinagar district of Gujarat state for two different seasons results shows that, Synthetic coagulant quite better on lakes water compare to synthetic water, natural coagulant quite better on lakes water compare to synthetic water and combination of synthetic + natural coagulant gives best results on synthetic water compare to lakes water.

KEYWORDS: Synthetic water, lake water, Natural coagulant, Synthetic coagulant, Turbidity.

INTRODUCTION
Indiscriminate disposal of water with suspended solids have lead to higher amount of pollution to the natural water bodies. With the increase in polluted water by domestic and industrial usage of water in enormous amount, the current scenario of water coagulation does not cope up with it. When surface water is used for drinking water production, turbidity removal is an essential part in the treatment process. It is generally achieved by coagulation process with metal salts followed by aggregation of particles through flocculation and separation through sedimentation and filtration.[1-5]

For our present study, we had selected two lakes named Kolavada and Randheja lakes, which are situated near Gandhinagar. In present study also compare with synthetic water which is prepared in laboratory by known method.[6]

There is a variety of natural coagulants used around the world, like *Moringa oleifera*, *Strychnos potatorum* and fava beans.[7-10]

Observations
Fresh sample of two lakes situated near Gandhinagar district of Gujarat state for first season (July-2013 to December-2013) was taken, initial turbidity of sample were analyzed and results shows as per below table.

Table 1.1 Turbidity results of two lakes

Sr. No.	Lake	Initial turbidity	After 24 hours Turbidity
1	Kolavada	148	55
2	Randheja	131	38

Now, samples of two lake water was analyzed for various sixteen physico chemical analysis and the results of analysis were given below,

Table 1.2 Various physico-chemical data of two lakes water

Sr. No.	Lake	pH	EC	Alkalinity	Ca-Hard	Mg-Hard	TH
1	Kolavada	8.42	1.04	859.5	38.48	3.89	112
2	Randheja	7.32	1.02	937.6	44.89	3.89	128
		TDS	**Sulphate**	**Floride**	**Phosphate**	**Nitrate**	**Nitrite**
1	Kolavada	1127	576.39	0.333	0.09	0.5	ND
2	Randheja	1046	672.46	0.333	0.206	ND	ND

		DO	COD	BOD	Chloride		
1	Kolavada	4.8	305	80	159.04		
2	Randheja	4.5	382	110	122.12		

Fresh sample of two lakes situated near Gandhinagar district of Gujarat state for second season (January-2014 to June-2014) was taken, initial turbidity of sample were analyzed and results shows as per below table, Initial Turbidity and after 24 hours settled turbidity Results of both lakes

Table 1.3 Turbidity results of two lakes

Sr. No.	Lake	Initial turbidity	After 24 hours Turbidity
1	Kolavada	125	35
2	Randheja	118	31

Hence, 24 hours settling procedure improve turbidity both lakes water. But, water is not suitable for drinking and domestic purpose but maybe it is useful for irrigation purpose.

Now, samples of two lake water was analyzed for various sixteen physico chemical analysis and the results of analysis were given below,

Table 1.4 Various physico-chemical data of two lakes water

Sr. No.	Lake	pH	EC	Alkalinity	Ca-Hard	Mg-Hard	TH
1	Kolavada	8.42	1.10	584	24.05	16.54	128
2	Randheja	7.32	1.08	585	27.27	14.59	144
		TDS	**Sulphate**	**Floride**	**Phosphate**	**Nitrate**	**Nitrite**
1	Kolavada	1141	960.66	0.666	0.122	ND	ND
2	Randheja	1085	768.52	0.333	0.228	ND	ND
		DO	**COD**	**BOD**	**Chloride**		
1	Kolavada	4.0	128	92	241.4		
2	Randheja	3.6	169	122	163.3		

All this various physico-chemical results are considered as initial or blank results for both lakes water. These results are useful to make comparison with data of treated water.

Hence, we put various sets with parallel to neat 24 hours settled sample, in which we add various synthetic [PAC (Poly Aluminium chloride)], natural [i.e. ***Citrus lemonum*** (Lemon juice)] and various combinations of natural + Synthetic coagulants to check improvement of quality of Lake Sample. All the results are presented in below tables.

➢ **Kolavada lake water. (July-2013 to Dec-2013)**

Table 1.5 Various physico-chemical data after treatment of synthetic and natural coagulant

Coagulant	ppm	Clear zone	Turbidity	pH	EC	Alkalinity	Ca-Hard	Mg- Hard	TH	TDS
PAC	10	85	6.0	8.38	0.98	485	19.24	1.95	96	584
	20	86	6.0	8.38	0.98	483	19.24	1.95	96	584
	30	89	4.0	8.39	0.98	483	19.24	1.95	96	584
	40	89	4.0	8.39	0.99	482	19.24	2.91	100	585
	50	92	2.0	8.39	0.99	482	19.24	2.91	104	585
(Lemon) ***Citrus lemonum***	10	87	5.0	8.40	0.92	492	20.84	1.95	104	579
	20	87	5.0	8.40	0.92	492	20.84	1.95	104	579
	30	89	4.0	8.40	0.92	490	20.84	2.91	104	579
	40	90	4.0	8.41	0.93	490	22.44	1.95	108	579
	50	92	2.0	8.41	0.93	488	22.44	1.95	108	580
PAC+ ***Citrus lemonum*** (Lemon)	10+10	86	5.0	8.36	0.95	487	22.44	0.97	100	590
	10+20	87	5.0	8.36	0.95	487	22.44	0.97	100	590
	10+30	88	4.0	8.36	0.95	486.5	20.84	1.95	100	590
	10+40	88	4.0	8.37	0.95	486	20.84	1.95	100	590
	10+50	90	3.0	8.37	0.96	485	20.84	0.97	100	592

Table 1.6 Various physico-chemical data after treatment of synthetic and natural coagulant

Coagulant	ppm	Sulphate	Floride	Phosphate	Nitrate	Nitrite	DO	COD	BOD	Chloride
PAC	10	576.4	0.333	0.098	0.383	ND	5.7	75	37	149.10
	20	576.4	0.333	0.098	0.383	ND	5.7	73	37	151.94
	30	576.4	0.333	0.098	0.383	ND	5.4	68	34	151.94
	40	576.4	0.333	0.098	0.383	ND	5.6	71.5	33	151.94
	50	672.5	0.333	0.098	0.383	ND	5.7	56	27	153.36
Citrus lemonum (Lemon)	10	480.33	0.333	0.098	0.383	ND	5.9	57	27	147.68
	20	480.33	0.333	0.098	0.383	ND	5.9	52	25	146.26
	30	480.33	0.333	0.098	0.383	ND	5.7	54	23	146.26
	40	480.33	0.333	0.098	0.500	ND	6.0	44.30	20	144.84
	50	576.40	0.333	0.104	0.383	ND	4.9	87	41	144.84
PAC+ ***Citrus lemonum*** (Lemon)	10+10	576.40	0.333	0.028	0.383	ND	5.0	75	38	146.26
	10+20	576.40	0.333	0.028	0.383	ND	5.0	78	39	146.26
	10+30	576.40	0.333	0.028	0.500	ND	4.9	79.50	37	149.10
	10+40	576.40	0.333	0.02	0.383	ND	4.9	80.20	37	149.10
	10+50	576.40	0.333	0.02	0.383	ND	5.0	84	39	149.10

➢ **Randheja lake water (July-2013 to Dec-2013)**

Table 1.7 Various physico-chemical data after treatment of synthetic and natural coagulant

Coagulant	ppm	Clear zone	Turbidity	pH	EC	Alkalinity	Ca-Hard	Mg- Hard	TH	TDS
PAC	10	93	4.0	7.15	0.9	796.5	35.27	2.92	100	584
	20	93	4.0	7.14	0.9	796.5	35.27	2.92	100	584
	30	93	4.0	7.16	0.9	795.5	35.27	2.92	100	582
	40	94	3.0	7.15	0.92	796	36.87	0.97	96	580
	50	95	3.0	7.16	0.92	796	35.27	1.95	96	580
Citrus lemonum (Lemon)	10	95	7.0	7.16	0.91	794.5	38.48	1.95	104	589
	20	95	7.0	7.18	0.91	794.5	38.48	2.92	108	589
	30	95	6.0	7.18	0.92	793	38.48	2.92	108	592
	40	96	6.0	7.15	0.92	793	38.48	2.92	108	592
	50	96	6.0	7.16	0.89	792.5	40.08	1.95	108	593
PAC+ ***Citrus lemonum*** (Lemon)	10+10	91	9.0	7.16	0.89	792	32.07	3.89	96	587
	10+20	91	9.0	7.15	0.89	790.5	32.07	3.89	96	588
	10+30	91	9.0	7.18	0.90	789	32.07	3.89	96	588
	10+40	91	9.0	7.18	0.90	788	32.07	3.89	96	588
	10+50	91	9.0	7.18	0.90	787	35.27	2.92	100	589

Table 1.8 Various physico-chemical data after treatment of synthetic and natural coagulant

Coagulant	ppm	Sulphate	Floride	Phosphate	Nitrite	DO	COD	BOD	Chloride
PAC	10	480.33	ND	0.122	ND	6.4	67	42	116.44
	20	480.33	ND	0.122	ND	6.5	74	42	116.44
	30	480.33	ND	0.122	ND	6.2	64	41	116.44
	40	484.26	ND	0.122	ND	6.4	69	42	115.02
	50	384.26	ND	0.114	ND	6.4	66	41	115.02
Citrus lemonum (Lemon)	10	480.33	ND	0.114	ND	6.5	82	45	112.18
	20	576.40	ND	0.114	ND	6.4	79	44	112.18
	30	480.33	ND	0.114	ND	6.6	91	45	110.76
	40	480.33	0.333	0.114	ND	6.6	89	45	110.76
	50	480.33	ND	0.104	ND	6.5	87.5	46	112.18
PAC+ ***Citrus lemonum*** (Lemon)	10+10	576.40	ND	0.114	ND	6.4	74.8	43	115.02
	10+20	576.40	ND	0.114	ND	6.3	67	43	113.60
	10+30	576.40	0.333	0.122	ND	6.3	69	42	113.60
	10+40	576.40	ND	0.122	ND	6.3	68	43	113.60
	10+50	576.40	ND	0.122	ND	6.4	72	40	113.60

Hence, 24 hours settling procedure improve turbidity of both lakes water. But, These water not suitable for irrigation purpose.

Water samples with various synthetic (PAC), natural (***Citrus lemonum*** i.e. Lemon juice) and various combinations of natural + Synthetic coagulants use to

check improvement of quality of Sample. All the results are presented in below tables.

➢ **Kolavada lake water.(Jan-2014 to June-2014)**

Table 1.9 Various physico-chemical data after treatment of synthetic and natural coagulant.

Coagulant	ppm	Clear zone	Turbidity	pH	EC	Alkalinity	Ca-Hard	Mg- Hard	TH	TDS
PAC	10	85	6.0	8.38	0.98	485	19.24	11.67	96	584
	20	86	6.0	8.38	0.98	483	19.24	11.67	96	584
	30	89	4.0	8.39	0.98	483	19.24	11.67	96	584
	40	89	4.0	8.39	0.99	482	19.24	12.65	100	585
	50	92	2.0	8.39	0.99	482	20.84	12.65	104	585
Citrus lemonum (Lemon)	10	87	5.0	8.4	0.92	492	20.84	12.65	104	579
	20	87	5.0	8.4	0.92	492	20.84	12.65	104	579
	30	89	4.0	8.4	0.92	490	20.84	12.65	104	579
	40	90	4.0	8.41	0.93	490	22.44	12.65	108	579
	50	92	2.0	8.41	0.93	488	22.44	12.65	108	580
PAC+ ***Citrus lemonum*** (Lemon)	10+10	86	5.0	8.36	0.95	487	22.44	10.7	100	590
	10+20	87	5.0	8.36	0.95	487	22.44	10.7	100	590
	10+30	88	4.0	8.36	0.95	486.5	20.84	10.7	100	590
	10+40	88	4.0	8.37	0.95	486	20.84	10.7	100	590
	10+50	90	3.0	8.37	0.96	485	20.84	11.67	100	592

Table 1.10 Various physico-chemical data after treatment of synthetic and natural coagulant.

Coagulant	ppm	Sulphate	Floride	Phosphate	Nitrite	DO	COD	BOD	Chloride
PAC	10	576.4	0.333	0.098	ND	4.3	68	42	215.8
	20	576.4	0.333	0.098	ND	4.3	68	42	215.8
	30	576.4	0.333	0.098	ND	4.3	64	40	215.8
	40	576.4	0.333	0.098	ND	4.4	64	40	217.3
	50	672.5	0.333	0.098	ND	4.4	65	39	217.3
Citrus lemonum (Lemon)	10	480.33	0.333	0.098	ND	4.2	64	35	208.7
	20	480.33	0.333	0.098	ND	4.2	64	35	208.7
	30	480.33	0.333	0.098	ND	4.2	63	35	208.7
	40	480.33	0.333	0.098	ND	4.2	63	35	211.6
	50	576.4	0.333	0.104	ND	4.3	67	37	204.5
PAC+ ***Citrus lemonum*** (Lemon)	10+10	576.4	0.333	0.104	ND	4.3	70	48	204.5
	10+20	576.4	0.333	0.104	ND	4.3	70	48	204.5
	10+30	576.4	0.333	0.104	ND	4.3	72	48	207.3
	10+40	576.4	0.333	0.104	ND	4.3	68	46	207.3
	10+50	672.5	0.333	0.114	ND	4.4	68	46	210.2

➢ **Study on Randheja lake water. (Jan-2014 to Jun-2014)**

Table 1.11 Various physico-chemical data after treatment of synthetic and natural coagulant.

Coagulant	ppm	Clear zone	Turbidity	pH	EC	Alkalinity	Ca-Hard	Mg- Hard	TH	TDS
PAC	10	90	4.0	8.35	0.58	393	14.4	20.43	120	622
	20	90	4.0	8.35	0.58	393	14.4	20.43	120	622
	30	92	4.0	8.35	0.58	392	14.4	20.43	120	622
	40	92	3.0	8.37	0.59	392	14.4	20.43	120	624
	50	93	3.0	8.37	0.59	390	16.03	21.4	128	624
Citrus lemonum (Lemon	10	88	5.0	8.39	0.61	397	11.22	19.46	108	627
	20	88	5.0	8.39	0.61	397	11.22	19.46	108	627
	30	89	5.0	8.4	0.61	397	11.22	19.46	108	628
	40	90	4.0	8.4	0.62	395	11.22	19.46	108	628
	50	90	4.0	8.4	0.62	395	12.83	20.43	116	630
PAC+ ***Citrus lemonum*** (Lemon	10+10	90	4.0	8.32	0.59	394	14.4	20.43	120	625
	10+20	90	4.0	8.32	0.59	394	14.4	20.43	120	625
	10+30	91	4.0	8.33	0.59	394	14.4	20.43	120	627
	10+40	92	3.0	8.33	0.59	392	14.4	21.4	124	627
	10+50	92	3.0	8.33	0.60	392	16.03	21.4	128	628

Table 1.12 Various physico-chemical data after treatment of synthetic and natural coagulant.

Coagulant	ppm	Sulphate	Floride	Phosphate	Nitrite	DO	COD	BOD	Chloride
PAC	10	480.33	0.333	0.06	ND	3.7	97	72	184.6
	20	480.33	0.333	0.06	ND	3.7	97	72	184.6
	30	480.33	0.333	0.06	ND	3.7	95	72	184.6
	40	480.33	0	0.06	ND	3.7	95	70	184
	50	480.33	0	0.068	ND	3.8	95	70	184
Citrus lemonum (Lemon)	10	288.2	0	0.036	ND	3.9	91	65	181.8
	20	288.2	0	0.036	ND	3.9	91	65	181.8
	30	288.2	0	0.036	ND	3.9	90	65	181.8
	40	384.26	0	0.044	ND	3.9	90	63.5	181.8
	50	384.26	0	0.044	ND	4.0	88	63	183.2
PAC+ ***Citrus lemonum*** (Lemon)	10+10	384.26	0.333	0.044	ND	3.6	96	75	184.6
	10+20	384.26	0.333	0.044	ND	3.6	96	75	184.6
	10+30	384.26	0	0.044	ND	3.6	96	75	186
	10+40	480.33	0	0.052	ND	3.6	93	73	186
	10+50	480.33	0	0.052	ND	3.7	93	73	186

Preparation of Synthetic water: Synthetic water were prepared by mixing 125 ppm $CaCO_3$ (Calcium carbonate) and 125 ppm Kaolin in 1litre Tap water. Here, 20 liter of stock solution prepared for experiment by adding 2.5 gm $CaCO_3$ and 2.5 gm Kaolin in 20 liter of tap water.

Initial turbidity of synthetic water is 87.3 NTU and after 24 hours turbidity is 9.4 NTU.

Coagulant solution was prepared in distilled water by adding 1000 mg in 1 liter distilled water. It means 1mg = 1ppm = 1ml. every time used fresh sample.

Table 1.13 Initial Turbidity and after 24 hours settled turbidity Results of synthetic water

Sr. No.	Sample	Initial turbidity	After 24 hours Turbidity
1	Synthetic water	87.3	9.4

Hence, 24 hours settling procedure improve physico chemical data of synthetic water. But, still results are not suitable to use for irrigation purpose.

Hence, we put various sets with parallel to neat 24 hours settle sample, in which we add various synthetic and natural coagulants as well we had also plan to check combination of natural and synthetic coagulants on lake sample. All the results are presented in below tables.

Table 1.14 :Turbidity data after treatment of synthetic and natural and combination of coagulant.

Sr. No.	Coagulant	ppm	Clear zone	Turbidity
1	Poly aluminum chloride(PAC)	10	62	1.0
2		20	63	1.0
3		30	67	0.7
4		40	69	0.7
5		50	81	0.4
6	***Citrus lemonum*** (Lemon)	10	49	6.2
7		20	52	5.9
8		30	59	5.4
9		40	63	5.1
10		50	69	4.8
11	PAC+ ***Citrus lemonum*** (Lemon)	10+10	99	0.3
12		10+20	99	0.1
13		10+30	99	0.1
14		10+40	99	0.0
15		10+50	99	0.0
Sr. No.	**Coagulant**	**ppm**	**Clear zone**	**Turbidity**
1	Poly aluminum chloride(PAC)	10	62	1.0
2		20	63	1.0
3		30	67	0.7
4		40	69	0.7

5		50	81	0.4
6	***Citrus lemonum*** (Lemon)	10	49	6.2
7		20	52	5.9
8		30	59	5.4
9		40	63	5.1
10		50	69	4.8
11	PAC+ ***Citrus lemonum*** (Lemon)	10+10	99	0.3
12		10+20	99	0.1
13		10+30	99	0.1
14		10+40	99	0.0
15		10+50	99	0.0

RESULTS AND DISCUSSION

For Lake water: After compilation all data of study of lake water collected in season-01 and season-02, Following results came out and such a result is tabulated in following table

Turbidity	Synthetic coagulant gives best results and reduces turbidity at a low level.
pH	Synthetic and natural coagulants work equally to reduce pH to neutral level.
Electrical conductivity [EC]	Synthetic and natural coagulants work equally to reduce electrical conductivity.
Alkalinity	Natural coagulants and combination of natural + synthetic coagulant reduce Alkalinity of lake Water.
Calcium Hardness	Natural coagulants , synthetic coagulant and combination of Natural + synthetic coagulant work reduces calcium hardness of lake water
Magnesium Hardness	Synthetic coagulant gives best result to reduce magnesium hardness, while combination and natural coagulant gives moderate result.
Total hardness [TH]	All types of coagulants gives moderate result to reduce total hardness of lake Water.
Total Dissolved solid [TDS]	All types of coagulants gives moderate result to reduce Total dissolved solid [TDS] of lake Water.
Sulphate	All types of coagulants give moderate result to reduce sulphate of lake water
Floride	All types of coagulants give no improvement to reduce Floride of lake water.
Phosphate	All types of coagulants give best result to reduce Phosphate content of lake Water.
Nitrate	All types of coagulants give moderate result for nitrate content of lake Water, PAC and PAC + Onion combination gives good results.
Nitrite	Initial lake water does not contain nitrite elements. So, there is no need to study Synthetic and natural coagulants.
Dissolved Oxygen	All types of coagulants have no effect on dissolved oxygen content of lake Water.
Chemical Oxygen demand	All types of coagulants have good effect on chemical oxygen demand content of Lake water.
Biological Oxygen demand	All types of coagulants have good effect on Biological oxygen demand content of Lake water.
Chlorides	All types of coagulants have good effect on chloride content of Lake Water.

For Synthetic water

- Synthetic coagulants reduce turbidity at a low level and synthetic + Natural coagulants combination removes turbidity completely.

Treatment	**Results**
Initial	87.3
After 24 hrs Settling	9.4
After application of Poly aluminium chloride (PAC) synthetic coagulant	Between 0.4 to 1.0
After application of ***Citrus lemonum*** (Lemon) natural coagulant	Between 4.8 to 6.2
After application of PAC + ***Citrus lemonum*** (Lemon)	Between 0 to 0.3

CONCLUSION

- **Initial Turbidity**: Initial turbidity data were similar in synthetic water and lakes water.

- **After 24 hours as such settling**: As such settling for 24 hours is quite efficient for synthetic water compare to lakes water.

- **Synthetic coagulant**: The effect of poly aluminium chloride(PAC) synthetic coagulant quite better on lakes water compare to synthetic water.

- **Natural coagulant**: The effect of ***Citrus lemonum*** (Lemon juice) as a natural coagulant quite better on lakes water compare to synthetic water.

➢ **Synthetic + natural coagulant**: The effect of combination of synthetic + natural coagulant gives best results on synthetic water compare to lakes water.

ACKNOWLEDGEMENTS

Authors are thankful to Dr.B.K.Jain, Principal, M.G.Institute of Science Ahmedabad, Gujarat for valuable support.

REFERENCES

1. M. Senthil kumar, G. V. T. Gopala Krishna and V. Sivashankar, ARPN J. of Engg. And Applied Sciences, 2015; 10(6): 2714.
2. Sonal Choubey, S. K. Rajput and K. N. Bapat, Int. J. of Engg. Tech and Adv. Engg., October 2012; 2(10): 429.
3. Saritha Vara, Int. J. of Energy and Environ. Engg., 2012; 3: 29.
4. Renuka A. Ninayke, M. V. Jadav, Int. J. of Adv. Tech. in Civil Engg., 2013; 2(1): 118.
5. G. Vijayaraghavan, T. Sivakumar and A. Vimal kumar, Int. J. of Adv. Engg. Res. and studies, Dec. 2011; 1(1): 88.
6. Sunita Singh Thakur, Soanal choubey, Archives of Applied Science Research, 2014; 6(2): 24.
7. http://akvopedia.org/wiki/Natural_coagulation_/_Flocculation
8. M. D. Asrafuzzaman, A. N. M. Fakhruddin, ISRN Microbiology, Article ID 2011; 6: 632189.
9. A. H. Birima, H. A. Hammad, 4th international conference on Energy and Environment, 16, 012065 (2013).
10. T. Phani Madhavi, R. Raj kumar, Int. J. of Chem. Tech Res., Apr.-June 2013; 5(3): 1119.