iJRASET
International Journal For Research in Applied Science and Engineering Technology

# INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

**Volume:** 6 **Issue:** IV **Month of publication:** April 2018

**DOI:** http://doi.org/10.22214/ijraset.2018.4577

www.ijraset.com

Call: 08813907089 | E-mail ID: ijraset@gmail.com

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
*ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 6.887*
*Volume 6 Issue IV, April 2018- Available at www.ijraset.com*

# Comparison Study between PAC & Combination of (PAC+Aloevera) as a Coagulant for Wastewater Treatment

Mr. Sainand Khot[1], Mr. Bhushan Kalantre[2], Shubham Turalkar[3], Rahul Ghodake[4], Dattatray Kolekar[5], Ganesh Chaudhari[6], Ranjit Bhosale[7], Dhanaji Gherade[8].

[1]*Assistant Professor Civil Engineering Department, Dr. D Y Patil Institute of Engineering Management and Research Akurdi Pune (MH) INDIA*

[2]*Managing Director at Priora water solutions pvt.ltd .office no.101, G-wing 6th floor ,K K market, Bibvewadi, Pune (MH) INDIA*

***Abstract:*** ***It is very important to treat the waste water to avoid a bad impact on human being and surrounding environment. This study gives a focus on the efficient treatment process of sewage by using the coagulation process. Coagulation is the process of converting the liquid coherent mass to the solid coherent mass. Coagulation is generally used in water treatment process for turbidity removal. In this study, we have used poly-aluminium chloride and combination of (poly-aluminium chloride+aloevera) as a coagulant. The waste water sample were collected from Sewage Treatment Plant (STP) situated in Akurdi area. The optimum dose which is used for the treatment is obtained by the jar test, and we have applied the three dosages of PAC of 40 mg/L , 60 mg/L , 80 mg/L respectively and dosages of aloevera are 1ml/L , 1.5ml/L and 2ml/L respectively . We have determined the physical and chemical properties ( pH, BOD, COD, TSS, TDS ) of wastewater before and after the application of PAC and (PAC+ALOEVERA) dosing. For the optimal dose of 60 mg/L the 91 % of BOD removal efficiency is achieved, which is good as compared to other two dosages of PAC combination with ALOEVERA. According to tests and results we have concluded that the use of PAC as a coagulant can be a good alternative for effective treatment of wastewater.***

***Keywords: Wastewater, Poly aluminium chloride (PAC), Coagulation, Aeration, AloeVera***

## I. INTRODUCTION

Water is precious and natural resource unevenly distributed on our planet. Drinkable water is available in less quantity on the earth. About 71% of Earth's surface is covered with water, but only 2.5% of it is fresh and out of that only 1% of water is drinkable. The fresh water is used for irrigation purpose and as a part of sanitation system and for industry. The fresh water is also used by the human being for domestic, commercial and industrial use. This study is only related to the domestic waste water. As per the CPHEEO (central public health environment and engineering organization) the consumption of fresh water per day per person is between 135 to 150 litres. Waste water contains all the dissolved impurities like proteins, carbohydrates, oil and fats. These contaminants are degradable and oxygen is used for degradation process. This oxygen is measured in terms of their demand of oxygen called as Bio-chemical oxygen demand. In this project we have used coagulation process to remove BOD contents in the waste water. Poly-aluminium chloride (PAC) and Aloevera (A. Barbadensis Mill ) is used as coagulant. The study on aloevera is found that it is oldest medicinal plant ever known and the most applied medicinal plant throughout the world. This plant grows in tropical region and can be cultivated in drought area. This plant requires less water for its growth and it contains 98% of water in its leaves. It contains around 75 nutrients and 200 active compounds with minerals, amino acids, enzymes and vitamins. Recently, a number of aluminium based coagulants have been developed for water treatment applications. PAC's are more soluble and have a higher pH of minimum solubility than alum which makes the preferred coagulant now a day. We have analysed different physical and chemical properties(pH, BOD, COD, TDS, TSS, Turbidity etc.) of waste water by applying only PAC dosing and the combination of PAC and Aloevera. The optimal dose of this coagulant is found out by jar test and then the BOD removal efficiency is found out for that optimum dose.

## II. LITERATURE REVIEW

Following are the research papers which are studied to assess the comparative evaluation and analysis of different PAC and Aloe vera dosing. This research study was beneficial for us to find out the optimum dose of Coagulant.

Effect of poly aluminium chloride water treatment sludge on effluent quality of domestic wastewater treatment Vol.7 (4), pp. 145-152, April 2013 Irene Nansubuga[1,3], Noble Banadda[2*], Mohammed Babu[3], Willy Verstraete[1] and Tom Van de Wiele[1]

In this study, the reuse of poly aluminium water treatment sludge (PA-WTS) as a flocculent aid to improve the effluent quality of wastewater during primary sedimentation is evaluated and presented. PA-WTS was collected from Gabba water treatment plant (Gabba WTP) Uganda, after the coagulation-flocculation process that makes use of aluminium chlorohydrate (ACH). The average aluminium residue concentration in PA-WTS was 3.4 mg/L. During this study, batch laboratory experiments were conducted in a jar-test apparatus in which different doses of PA-WTS were added. Removal efficiencies of the analyzed parameters at different doses of PA-WTS were then compared to get the optimal sludge dose. There was an increased removal of TSS, TP, TAN and COD in the Bugolobi STP wastewater supernatant after mixing it for 5 min at a rate of 25 rpm and allowing it to settle for 30 min. To select the optimal dose, the removal efficiency of different parameters at varying PA-WTS doses was compared. The pH has been found to affect coagulation and flocculation.

Use of Aloe Vera as Coagulant aid in Turbidity Removal ISSN 0974-3154 Volume 10, Number 1 (2017) GulmireAmruta[1] G.R. Munavalli[2] In this study Aloe Vera gel is used as coagulant aid with alum for turbidity removal. Use of Aloe Vera gel as coagulant aid with can effectively reduce the amount of alum required. Also it was found that Aloe Vera has less effect on other water quality parameters like pH, EC, hardness. In results it was found that for 10mg/l of alum dose and 40ml/l of Aloe Vera dose maximum turbidity removal efficiency was achieved. For high turbid water it varied between range of 76-81% and low turbid water it varies between 60-65%.

## III. METHODOLOGY

Development of any treatment system depends upon the characteristics of wastewater and the contaminants that are to be removed. Thus it was necessary to carry out certain test to determine the characteristics of wastewater in order to decide the effective treatment process. Hence we have analysed various physical and chemical properties ( pH, BOD, COD, TSS, TDS, Turbidity ) of the wastewater. The raw wastewater sample was collected from the Sewage Treatment Plant situated in Akurdi Pradhikaran area. Initially we have analysed the parameters of raw wastewater sample then we applied different PAC dosages of 4% , 6% ,8% concentration i.e. 40 mg/L , 60 mg/L , 80 mg/L ( 4% Dose = 4mg in 100 ml hence 40mg for 1000ml ) to the raw sample and then same parameters are analysed.

For this analysis we have conducted a jar test which is most widely used experimental method for coagulation and flocculation. Before operating jar test the sample is mixed homogeneously by adding PAC dose in it and kept it for stirring at 25 rpm for 20 minutes, then it is kept for 30 minutes for the settlement of sludge. After settlement of sludge the parameters of supernatant water are experimented. For the same waste water we applied the dose of the combination of PAC and aloevera. The leaves of aloevera were washed under the tap water to remove the dirt. Thick green cover or epidermis was carefully separated from the gel part. Then the gel part was blended in mixer to form liquid and preserved in glass bottle in refrigerator. 1% of dilution of aloevera was made by using 1 ml aloevera gel in 100 ml distilled water similarly different percentage of aloevera solutions was made.

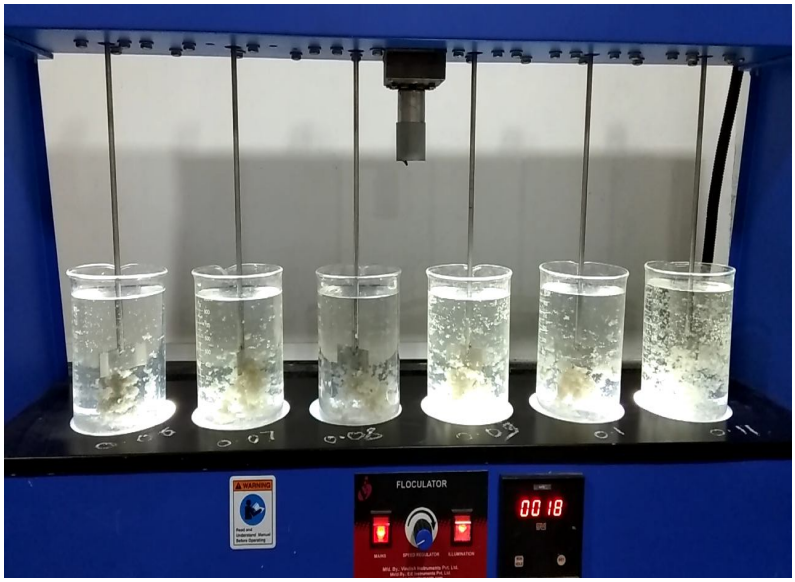



Fig. 1 Jar Test setup

Fig. 2 Aloe Vera Plant

Fig.3 Poly Aluminium Chloride

## IV. RESULTS AND DISCUSSION

### *A. PAC as a Coagulant*

The analysis of the wastewater with PAC as coagulant with dosages of 40 mg/L, 60 mg/ L & 80 mg/L was done.

From the Table.1 the results shows that for the different PAC dosing the BOD & COD removal efficiency was found to be around 90% for 60mg/L dosage. The Turbidity was found to be 93% efficient for 60mg/L dosage as compared to other two dosages. Snapped observations shows that listed parameters lies within the permissible limits of CPCB norms. Thus the optimum dosage was 60mg/l of PAC.

| Parameters | Dosage ( PAC ) | | | |
|---|---|---|---|---|
| | Raw Sample | 0.04 | 0.06 | 0.08 |
| pH | 7.45 | 7.18 | 6.99 | 6.27 |
| BOD (mg/L) | 140 | 15.6 | 14.7 | 15.7 |
| COD (mg/L) | 504 | 81 | 86 | 79 |
| TSS (mg/L) | 170 | 110 | 62 | 90 |
| TDS (mg/L) | 360 | 535 | 430 | 493 |
| TURBIDITY (NTU) | 44.6 | 15.5 | 3.2 | 4.3 |

Table.1 Analysis of PAC dosing on wastewater

### *B. PAC+ALOEVERA as a Coagulant*

The analysis of the wastewater with combination of (PAC+Aloevera) as coagulant with dosages as PAC – 40mg/L,60mg/L & 80mg/L and Aloevera – 1ml/L, 1.5ml/L & 2ml/L was done.

From Table.2 it is observed that for the different (PAC+Aloevera) combination dosing the BOD & COD removal efficiency was found to be around 90% for 40mg/L (PAC)+1ml/L(AloeVera) dosage . The Turbidity was found to be 84% efficient for the same dosage as compared to other dosages. Snapped observations shows that listed parameters lies within the permissible limits of CPCB norms (Table no.3). Thus the optimum dosage was 40mg/L of (PAC )+ 1ml/L of (Aloevera) combination, which is one of the least quantity dosage.

| Parameters | Dosage [( PAC mg/L) + (AloeVera ml/L)] | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Raw Sample | 0.04+1 | 0.04+1.5 | 0.04+2 | 0.06+1 | 0.06+1.5 | 0.06+2 | 0.08+1 | 0.08+1.5 | 0.08+2 |
| pH | 7.45 | 7.2 | 7.4 | 7.5 | 7.1 | 7.4 | 7.4 | 7.2 | 7.3 | 7.5 |
| BOD (mg/L) | 140 | 15.3 | 14.4 | 12.6 | 10.8 | 14.4 | 17.1 | 14.4 | 14.7 | 15.2 |
| COD (mg/L) | 504 | 120 | 116 | 112 | 136 | 116 | 96 | 118 | 111 | 108 |
| TSS (mg/L) | 170 | 72 | 68 | 40 | 24 | 36 | 28 | 21 | 24 | 16 |
| TDS (mg/L) | 360 | 350 | 350 | 300 | 300 | 350 | 350 | 300 | 350 | 300 |
| TURBIDITY (NTU) | 44.6 | 7.3 | 7.7 | 8.1 | 3.2 | 3.7 | 4.1 | 4.4 | 4.5 | 4.9 |

Table.2 Analysis of PAC+ALOEVERA dosing on wastewater

| Parameters | pH | BOD (mg/L) | COD (mg/L) | TSS (mg/L) |
|---|---|---|---|---|
| Values | 5.5-9.0 | 30 | 250 | 100 |

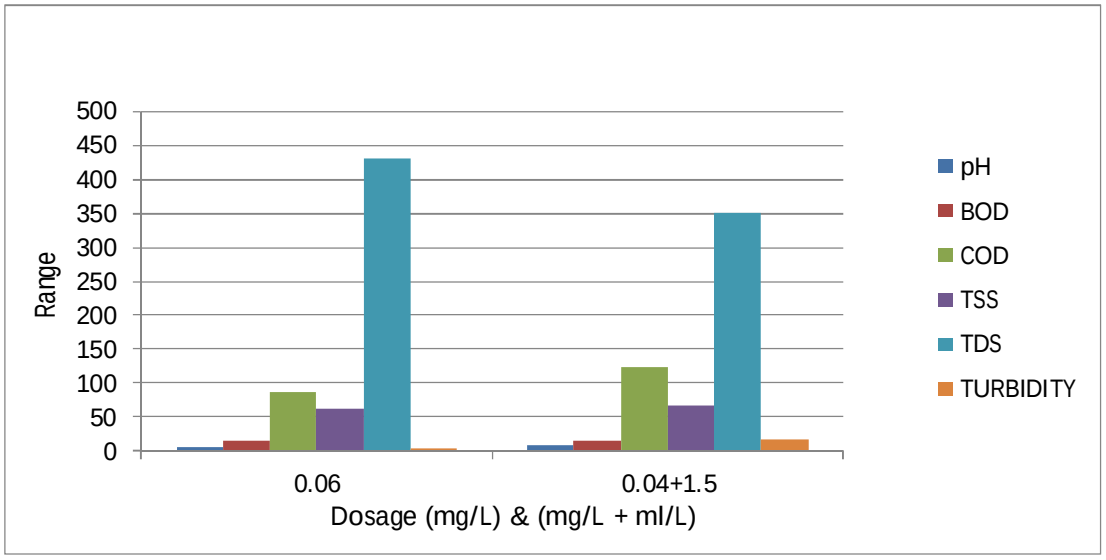
Table.3 CPCB effluent discharge standards for inland surface water

*C. Comparison between PAC and PAC+ALOEVERA As A Coagulant*

According to CPCB norms permissible limits fixed for inland surface water remains within the permissible limits for considered parameters. Out of all considered parameters it's observed that turbidity is increased by 56.16%. Drawn cost estimation laid down after study shows that PAC without Aloevera is cheaper than PAC+ Aloevera by 40% for a capacity of 10 kld of waste water.

| Parameters | Optimum Dosage ( PAC ) & (PAC+ALOEVERA) | | |
|---|---|---|---|
| | Raw Sample | 0.06 | 0.04+1 |
| pH | 7.45 | 6.99 | 7.2 |
| BOD (mg/L) | 140 | 14.7 | 15.3 |
| COD (mg/L) | 504 | 86 | 120 |
| TSS (mg/L) | 170 | 62 | 72 |
| TDS (mg/L) | 360 | 430 | 350 |
| TURBIDITY (NTU) | 44.6 | 3.2 | 7.3 |

Table.4 Optimum Dosages of PAC & PAC+AloeVera




Graph.1 Comparison between optimum dosages

## V. CONCLUSION

Detailed analysis of physical and chemical parameters of the pre and post treatment of waste water of the akurdi sewage treatment plant has been carried out. A few of the significant conclusions drawn are as follows.

In general the optimum dosage of coagulant of PAC was 60 mg /L and combination of PAC + Aloevera was 40 mg/L + 1ml/L. The increasing trend of Turbidity was found from pre to post addition of Aloevera. Drawn estimation laid down after study shows that PAC without Aloevera is cheaper than PAC+ Aloevera by 40% for a capacity of 10 kld of waste water.

Finally we conclude that PAC is preferable coagulant over the combination of PAC + Aloevera in all variants.

## REFERENCES

[1] A JAR TEST STUDY ON THE USE OF ALUM FOR TURBIDITY AND NUTRIENT REMOVAL IN CANYON LAKE, CA James A. Noblet Department of Chemistry and Biochemistry California State University-San Bernardino December 6, 2012

[2] A.I. Zouboulis ⁎, N. Tzoupanos Received 15 November 2007 Accepted 3 May 2008 Available online 8 October 2009 Alternative cost-effective preparation method of polyaluminium chloride (PAC) coagulant agent: Characterization and comparative application for water/wastewater treatment☆

[3] General standards CPCB The Environment (Protection) Rules, 1986

[4] GulmireAmruta[1] G.R. Munavalli[2] Use of Aloe Vera as Coagulant aid in Turbidity Removal ISSN 0974-3154 Volume 10, Number 1 (2017)

[5] Hery Dwiputranto1 ,Hermanto Siregar2 , Hendro Sasongko3 Volume 6, Issue 11, November 2016 Financial Feasibility Study for Poly Aluminum Chloride Plant.

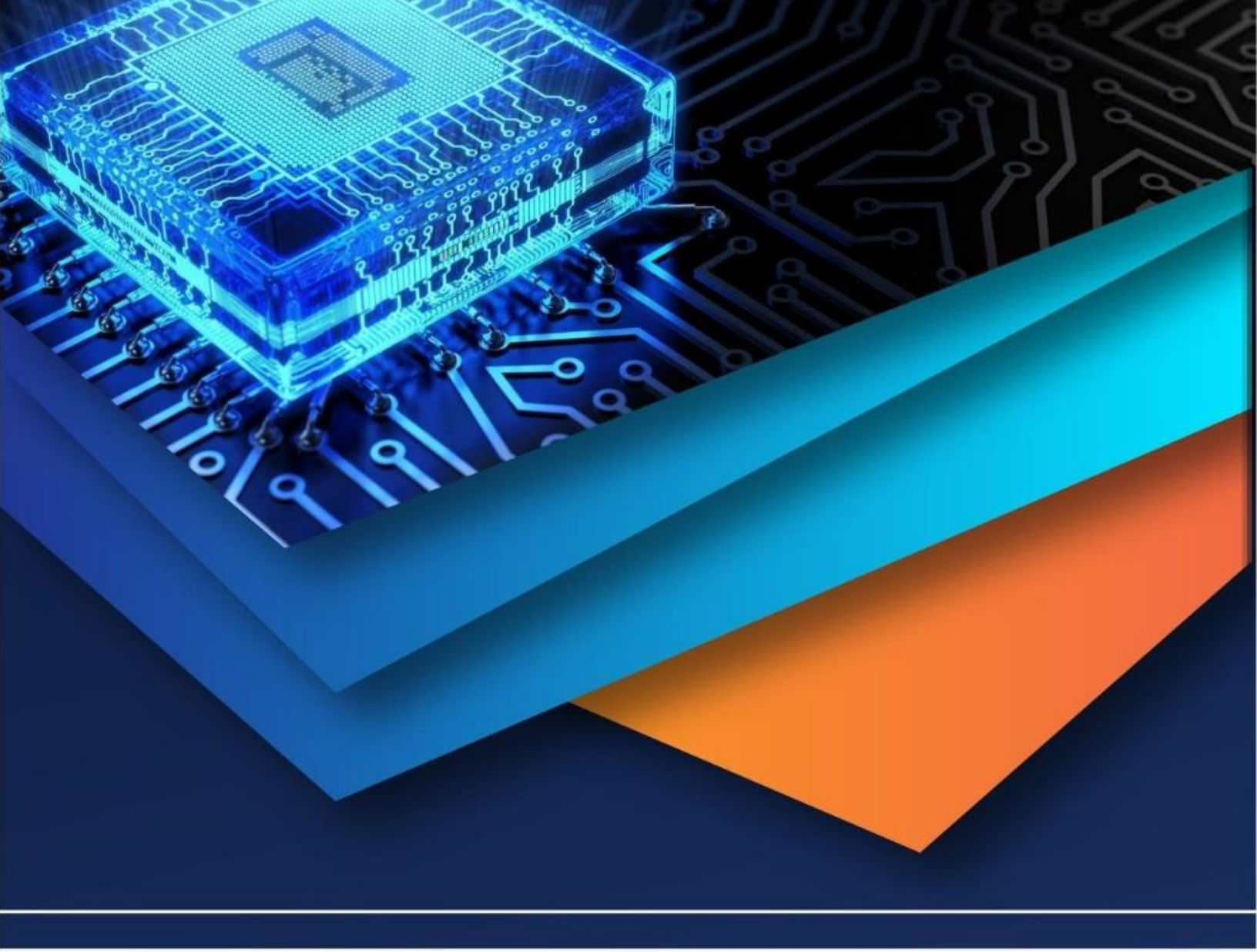
[6] Irene Nansubuga[1,3], Noble Banadda[2*] Effect of poly aluminium chloride water treatment sludge on effluent quality of domestic wastewater treatment Vol.7 (4), pp. 145-152, April 2013

[7] IS 10500 : 2012 Indian Standard DRINKING WATER — SPECIFICATION ( Second Revision ) ICS 13.060.20

[8] Khai Ern Leea *, Marlia Mohd Hanafiahb , Azhar Abdul Halimb , Mohd Hafiyyan Mahmudb Procedia Environmental Sciences 30 ( 2015 ) 56 – 61 Primary treatment of dye wastewater using aloe vera-aided aluminium and magnesium hybrid coagulants.

[9] Research Journal of Recent Sciences ISSN 2277-2502 Vol. 5(1), 9-15, January (2016) Evaluation of Aloe vera leaf gel as a Natural Flocculant: Phytochemical Screening and Turbidity removal Trials of water by Coagulation flocculation Sessou Philippe[2], Alassane Abdoukarim[1]

[10] Zimbabwe Journal of Science & Technology pp 101-108 Vol.10 [2015] e-ISSN 2409-0360 Treatment of Low Turbidity Water Using Poly-Aluminium Chloride (PAC) and Recycled Sludge: Case study Chinhoyi a Taurai Jowa and b Liberty L Mguni*



10.22214/IJRASET

45.98

IMPACT FACTOR: 7.129

IMPACT FACTOR: 7.429

# INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY