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Application of the Optimum Coagulant for Cost Effective Waste Water Treatment

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Abstract
This paper discusses the possible use of the sludge produced in the raw water treatment plant in the wastewater treatment process. The sludge contains some amount of the aluminum ions required for coagulation. If the BOD of the waste water is reduced considerably in the primary treatment plant through coagulation and sedimentation, then it will be possible to reduce the operation cost of the waste water treatment plants by the reduction of the power consumption. The application of the raw water sludge also helps in reduction of the phosphate content. This will in turn help in reducing the eutrophication of the receiving surface water bodies. In this paper, the effect of increasing the dose of alum sludge on the BOD reduction of the waste water is the primary sedimentation tank is studied. The experiments were carried out using coagulant alum solution and Chemical sludge simultaneously and the results obtained were found to be effective in treatment of waste water.
Keywords: ***wastewater, treatment, BOD, Raw water Sludge, phosphate***

I. Introduction

The waste water produced through the various domestic activities is collected through sewerage system in the pumping station and is further carried to the waste water treatment plant for treatment and the effluent or the treated waste water is then discharged into nearby receiving surface water bodies. The waste water contains organic and inorganic matter in both the soluble and insoluble form. The water that is being discharged into the surface water body has to confirm to the Indian standards for the parameters like BOD, COD, nutrient content, suspended solid etc. in order to ensure the quality of the receiving water bodies is not depleted. In the wastewater treatment plants, the waste water passes through series of physical, chemical and biological treatment processes.

Most of the municipal waste water treatment plant use aerobic treatment process. This requires the supply of oxygen through aerators or any other facility which require power supply. The objective of the study is to reduce the BOD of the waste water in the primary treatment plant this in turn reduces the oxygen that is required for the biological treatment and in turn the power consumption.

II. Methodology:

For experimental purposes the wastewater was collected from the primary health center at Mysore. The experiments were conducted for about two months in order to confirm the results obtained. The waste water samples that were collected for the test for BOD, phosphate content and pH increased dosage by 1% . the coagulant alum solution was applied and subjected to rapid mixing for 1 minute and slow mixing for 20 minutes in the jar test apparatus to determine the optimum coagulant dosage required for the wastewater treatment. The sample was then allowed to settle for 2hours and the change in the parameters was also noted on application on increasing dose of raw water chemical sludge. The dosage of the sludge was applied volumetrically starting from 5ml,10ml, 15ml, 20ml,25ml, up to to 50ml in multiples of 5. The aluminum content and the total solids in the sludge were determined before the application of the dosage. The total solids were found to be 98000mg/l and aluminum content was 42.33mg/l.

Conventional Treatment and Application of the Raw Water Sludge:

Significant removal of nutrients is not possible in conventional treatment plant unless tertiary treatment process is applied. The construction and operation cost for the removal of BOD is very high and the application of biological treatment for the removal of nutrients is not possible for the municipal waste water treatment plant. In the experimental work done, it was observed that significant removal of phosphate is possible by the application of the optimum quantity of coagulant before the wastewater enters

the primary sedimentation tank. The figure shows the modification that has to be done in the conventional wastewater treatment plant in order to reduce the operation cost as well as the remove the nutrients inthe primary treatment process.

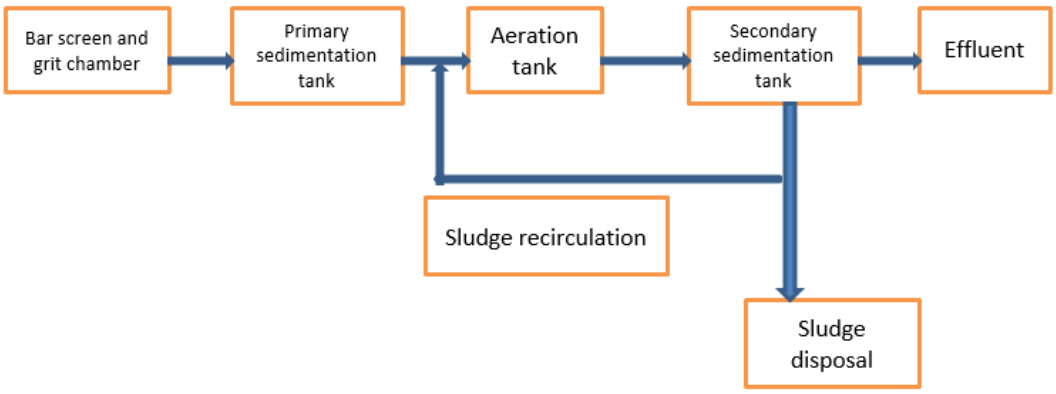

Fig. 1: Activated sludge process

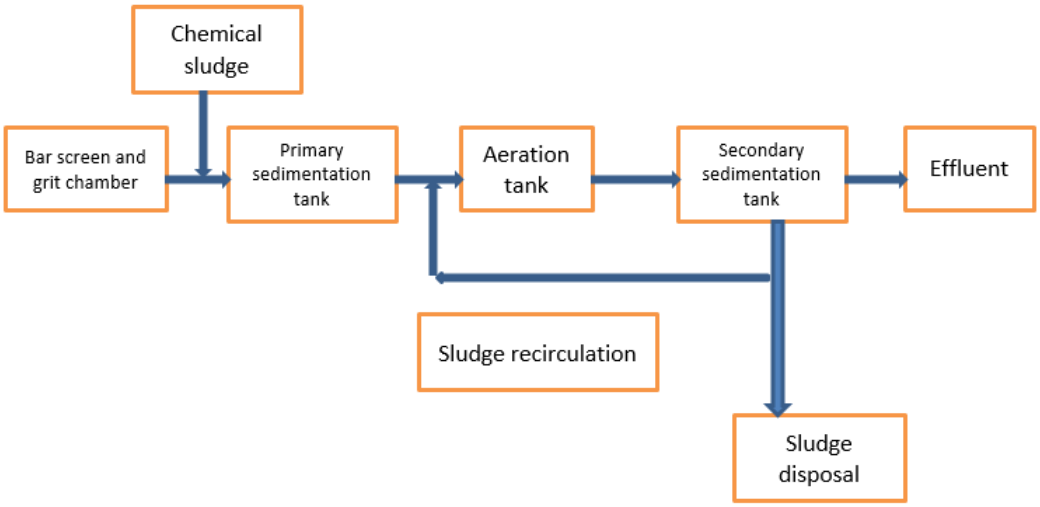

Fig. 2: Modified in activated sludge process.

It is observed that by application of the raw water Chemical sludge, the BOD of the wastewater and phosphate content reduced significantly in the primary sedimentation tank. The dosages and the results obtained from the experiment studies are as discussed below:

III. Observations:

The results obtained by application of alum dosage are as given below:

Dosage	Aluminium content (mg/l)	pH	BOD (mg/l)	% reduction	Phosphate reduction	% reduction
Raw sample	NA	7	242.06	0	0.12	0
Raw settled sample	NA	7	224.5	7.3	0.083	31.1
10mg/l	1.13	7	200	17.4	0.069	43.0
20mg/l	2.27	7	181.92	25	0.056	53.6

30mg/l	3.41	7	167.71	30.7	0.045	62.7
40mg/l	4.55	7.1	157.65	35.2	0.035	70.6
50mg/l	5.69	7	148.41	38.7	0.028	76.7
60mg/l	6.83	6.9	137.84	43.1	0.023	80.6

The results obtained by application of raw water chemical sludge are as given below:

Dose	Al content (mg/l)	pH	BOD (mg/l)	% reduction	Phosphate reduction	% reduction
5ml	0.423	7.1	192.38	20.52	0.066	61.45
10ml	0.846	7	177.75	26.51	0.061	64.43
15ml	1.28	7.1	156.77	35.37	0,054	68.66
20ml	1.7	7.1	143.38	40.83	0.051	70.15
25ml	2.12	7	1129	46.53	0.05	72.52
30ml	2.54	7.1	120.1	50.45	0.04	76.77
35ml	3.0	7	120.06	50.43	0.021	87.45
40ml	3.38	6.8	120	50.41	0.015	91.28
45ml	3.81	7	119.5	50.64	0.007	96.00
50ml	4.23	7.04	119.1	50.80	0.002	99.1

The percentage BOD reduction in the wastewater of the sample through the application of the aluminum ions in the form of the pure alum solution as well as the raw water sludge was determined. It is observed that the significant reduction takes place in the BOD of the sample collected through the application of the sludge in the dosage of 30ml per 500ml of the sample. With further increase in the dosage of the sludge the increase in the BOD reduction was not significant. It is observed that the BOD reduction through the application of sludge is better compared to that through the alum solution. The pH of the sample before and after the application of aluminum ion dosage in either form was found to be within the range of 6.8 to 7.2.

The percentage reduction in the phosphate content with the increasing dosage of aluminum through the alum solution as well as raw water chemical sludge. The reduction of the phosphate content goes on increasing gradually with the increasing dose of aluminum. In this case it is also observed that results obtained through the application of the raw water sludge are better than the alum solution.

IV. Results and Discussion:

The observation indicates that significant reduction in the BOD of wastewater takes place through the application of the raw water sludge. There is also reduction in the phosphate content in the sample after the application of the sludge.

The raw water chemical sludge contains a flocs formed in the sedimentation tank of the raw water treatment plant. This contains some amount of the aluminum ions along with the settable solids. The particle size of the sludge being large, coagulation along with the adsorption takes place during floc formation in the flocculator. This results in the greater amount of the settlement of the suspended and settable matter in the wastewater in the primary treatment plant. The supernatant liquid is clearer and has lower BOD and phosphate content

The study indicates that it is possible to

reduce the BOD up to 50% in primary treatment plant by optimum coagulant dosage for, flocculation and sedimentation. For a wastewater treatment plant that is already setup, this can be achieved by pumping the raw water sludge into the sewage before it enters primary sedimentation tank. This will reduce the power consumption to great extent without any significant addition on cost.

In the conventional treatment process the supernatant liquid from primary sedimentation tank flows into aeration tank or any other unit of secondary treatment plant. Aerobic treatment is generally used in municipal waste water treatment plant. The volume of the aeration tank and the oxygen required for the waste water treatment is calculated depending upon the BOD of the influent. For the conventional activated sludge process 1.2 Kg of oxygen is required per Kg of BOD removal. With about 50% reduction in the BOD in the primary treatment process the oxygen required in aeration tank is reduced.

The power consumption of the aerator increases with increase in the amount of oxygen requirement. The reduction in the oxygen requirement reduces the power consumption. Phosphate content is also reduced considerably in the primary sedimentation tank. Thus the tertiary treatment for the removal of the nutrients can be eliminated to some extent. The pH value of the sample before and after application of the sludge is about 7 which imply that the water is almost neutral. As the pH of the water is not affected by the dosing of the sludge, the tertiary treatment process will not be affected.

V. Conclusion:

It is found that 50% reduction in BOD is possible in the primary sedimentation tank through optimum quantity of coagulation dosage and sedimentation, this will also reduce about 40% of the daily power consumption of the aerator in the treatment plant. Hence the operation cost of the plant will be reduced significantly. With the suggested modification in the conventional waste water treatment plant , it is possible to setup and operate the treatment plant for treating waste water for the places which are facing power supply problems. Removal of nutrients helps in the reduction of eutrophication of the surface water bodies receiving treated effluents. It will also reduce the cost of the treatment of the water effluent downstream where it is used as source of fresh water for the domestic purposes.

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