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THE EFFECTIVENESS OF RETURN SLUDGE IN REMOVING UNDESIRABLE MATERIALS FROM CLARIFLOCCULATOR BASINS

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Abstract: To assess the use of returned sludge in water reatment, samples were brought from the Tigris River water during the summer and fall of 2002. A chemical treatment was carried out on it using alum as a coagulant, and after adding different percentages of sludge deposited at the bottom of the clarification ponds, it was found that returning 50% of the sludge improves the removal efficiency by an amount that can reach 14%. This applies to models with low and medium turbidity; otherwise, the reduction in removal efficiency is due again. The aluminium sulphate and hydroxides deposited at the bottom of the pond and recycled with the reflux sludge contributed to the improvement of the removal efficiency.

Keywords: *Chemical Treatment; Water; Recycle; Sludge; Alum;*

1. Introduction

Moving forward with the development in various fields of work and society, water has become suffering from two types of pollution. It can be asserted that the first type is organic pollution and the second is inorganic pollution. Organic and inorganic substances are present in water in different states, as they may be suspended, colloidal, or dissolved.

Alum $(SO_4)_3.14H_2O$, a compound common in America [1-3] and many other countries, has been used to improve the removal efficiency and reduce the amount of this substance, polyelectrolyte was produced. The difficulty of importing these materials and their pure form, in addition to the problems that occurred in the water supply networks due to the aluminium compounds [4] and the health risks that accompanied the presence of the remaining aluminium ion in the water after the treatment [5], became a major cause Researchers have to find ways and means to solve or mitigate this problem [6-8].

Coagulation mechanism of aluminium salts and found that achieving this mechanism depends on the positively charged aluminium hydroxide deposition on negatively charged colloidal particles [9-11].

Bratby as well as (James and O'Melia) [5 and 6] have indicated that several factors play a major role in the removal of impurities to judge the success of this or that substance. These factors include the ability of the material to achieve the treatment process, its cost, sedimentation basins, and the amount of sludge produced. Dempsey et al. [7] used polymerized aluminium chloride (PACI) with alum. (Kawamura) [8] Confirmed

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that low brownish water has difficultyin achieving the treatment process, and on this basis and to improve the sintering process, some water treatment plants recycle part of the sludge.

Processing determinants and parameters have been studied by many researchers, and concluded that the specific characteristics of sludge resulting from the coagulation process using alum are as follows [9-15]:

Bio-oxygen requirement (BOD) 150 - 40 mg / L., Chemical oxygen requirement (COD) 340 - 5,000 mg / L., Suspended Solids (TSS) 1100 - 14000 mg Liters., Volatile Substances (VSS) 600 - 4000 mg / L., The pH is neutral. Also, (Cornwell and Lee) (16) showed that the level of Cryptosporidium could range between 2900 and 47000 cells/ml, for the return water from the sedimentation and filtration basins after some concentration of it.

2. Methodology

2.1 Work methodology

The practical side is summarized by bringing natural samples of the water of the Tigris River (Tigris River) north of Baghdad during the summer and fall of 2002 and inside the water treatment plant of one of the industrial sites of the Industrial Ministry. These samples were mixed with samples from flocculation tanks. A set of laboratory analyzes (physical and chemical) (AWWA, APHA and WEF) [17] were conducted on these models to know the nature of these models and to take them as a basic reference in judging the success or failure of the experiments.

2.2 Samples preparation

Natural samples are taken and a Jar-Test Technique is examined using cylindrical glass flasks of one-litre capacity under the influence of a group of factors and by two attempts for each model, to find out the optimum dose of coagulant (alum, 1% concentration) required to achieve the best removal of cloudiness and non-material Desirable from the water. Then the same test is performed with the addition of different quantities of sediments in the clarification ponds, known as sludge, and then analyzes are carried out on the treated samples and the treatment efficiency is known, noting that the dimensions of the paddle in the device are 7.5 x 2.5 cm^2.

3. Results

1- The recycling of the dairy liquid waste sludge improves the treatment efficiency.
2- Experience has shown that recycling 50% will effectively improve removal efficiency.

4. Discussion

Physical and chemical laboratory analyzes were conducted on river water for different periods, as shown in “Table 1”, by the way-all tables put at appendix “A”. At the same time, the same experiments were conducted on sludge water taken from the coagulation and sintering basin, as shown in “Table 2”. The river water models were tested using the pitcher test method to find the best parameters involved in the treatment process.

Concerning the optimum dose of alum coagulant, it was found for the samples taken and it is shown in “Fig. 1”. The sedimentation period was also fixed (20 minutes).

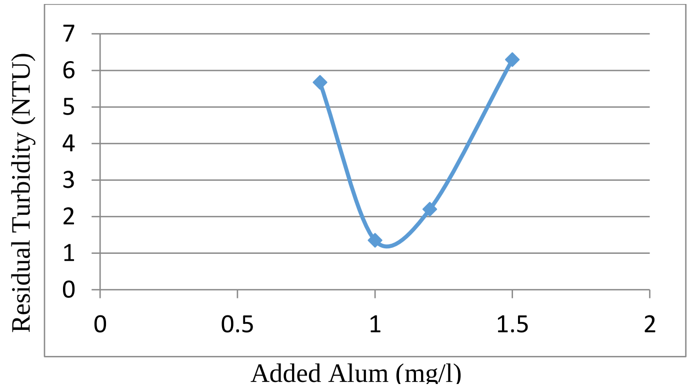

Figure 1. Relationship between added Alum and Residual Turbidity.

From “Fig. 2”, the relationship between the number of rotations of the paddle in the jar checker and the velocity gradient value can be observed, and from the same figure, the value of the gradient of velocity (G) can be found. Some of the factors involved in the treatment process have been approved according to the scientific references (Letterman et al.; Kawamura) [8, 12] and (Eckenfelder) [13], namely:

• The rapid mixing period is three minutes

• The velocity gradient value for the rapid mixing is between (122.79 sec^{-1}) and (205.7 sec^{1}) According to (Letterman et al.) [12] and (Eckenfelder) [13] the conditions of treatment are:

• The rapid mixing period is three minutes

• The velocity gradient value for rapid mixing is between (122.79 sec^{-1}) and (205.7 sec^{-1}) according to the two degrees (10) and (30) degrees Celsius respectively, in which the models were confined between these two degrees approximately.

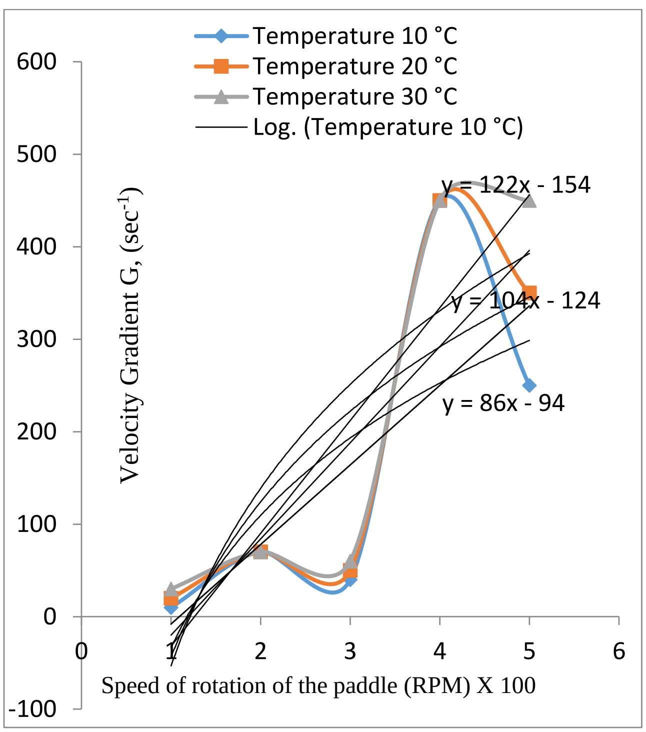

Figure 2. Relationship between the rotation of the paddle per minute and velocity gradient at different temperatures.

It can also be deduced from “Fig. 2” the optimal limits of the velocity gradient (G) value for slow mixing after reaching the appropriate sintering period to achieve the best removal (30 minutes). It can be seen from “Table 3” that it is a value between (31.5 sec^{-1}) and (38.4 sec^{-1}). It can also be inferred after observing “Fig. 2” It can infer the optimal limits of the velocity gradient (G) value of the slow mixing after the appropriate sintering period has been reached to achieve the best removal (30 minutes). It can be noted from “Table 3” that it is a value that is between (31.5 sec^{-1}) and (38.4 sec^{-1}).

The sludge was circulated with the river water at different rates (75%, 50%, 25%) of the volume of the treated sample. It is noticed from “Fig. 3” that the behaviour of the sludge when added is similar in many of the properties of aluminium to achieving stabilization and restabilization again(Ahmad, T., et al. (2016); Wang, Liu et al. 2020; [14, 15] which occurs when adding small or more than necessary quantities of coagulants. This gives the impression that raw water that contains high sludge can lead to a reduction in the removal efficiency when using the same amount of added alum, and this is a natural issue as it is not in the area to continue adding brownish that can lead to getting rid of the brownish As the return or non-return of sludge, which depends on the sludge entering the station, is a very important issue, which was mentioned by (Gilani 2001); Gilani 2001) [16, 17]. Also, from “Fig. 3”, it is clear that the treatment efficiency improves when 50% of sludge is added to a ratio limited between (9%) and (14%). The suspended materials present in the sludge water can work to create a kind of bonding between the small and fine particles present in the raw water. In other words, they can be in the form of bonding bridges similar to the bridges made by polyelectrolytes [18-20]. At the same time, these bridges may be broken or not formed if they exceed certain limits, and this may be due to the long or short mixing period. Another reason that can lead to an increase in the effectiveness of removing the brownish in the river water when adding sludge is the concentrations of the excess aluminium ion added in the treatment plants, which exceeds the saturation limit, which causes it to precipitate in the form of aluminium sulphate ($Al_2 (SO_4)_3$, which can reach its percentage Between (20%) and (30%) or that precipitates in the form of aluminium hydroxides ($Al (OH)_3$), ($Al (OH)^{2+}$) and ($Al (OH)^{++}$), etc. from different forms and bodies, which can be Its percentage reaches between (70%) and (80%) [21-25], and this is confirmed by the results of the analyzes in "Table 1" aforementioned, and this, of course, indicates that the efficiency of the treatment plant on which the research was conducted is operating at a limited rate of (70%) and (80%).

"Fig. 3" gives an accurate picture of the concentrations of the added and remaining aluminum ion in the case of using alum with dairy sludge wastewater and with samples of (50%) sludge and the improvement in the removal efficiency of the pollutants in treated wastewater. Samples were taken at different time periods of the year and over two samples each week for completion and completion of physical and chemical analyzes. Here the work was done on this basis. Whereas, the amount of water used for production varies according to the quality of the administration and other factors that were previously mentioned. Also, climatic factors play an important role in the amount of consumption, and therefore the amount of consumption may increase in some seasons, followed by an increase in the amount of waste disposed. That the treatment process discharges when adding dairy water sludge is also different depending on these factors, note Figure 3

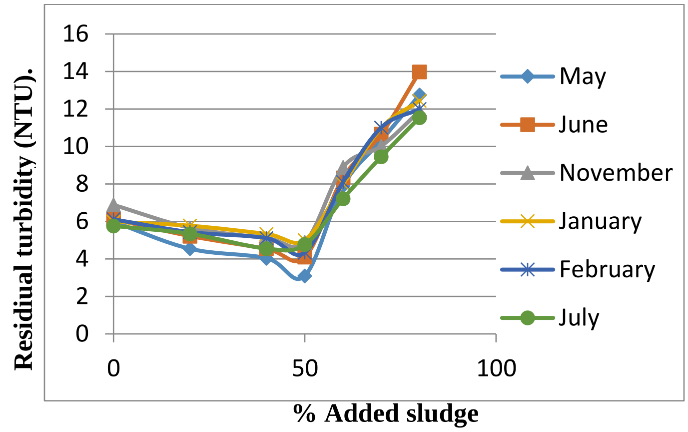

Figure 3. Relationship between added sludge and residual turbidity.

5. Conclusions

1. Recycling of sludge with (50%) of the incoming discharge improves the treatment efficiency. The deviation from this percentage works to create additional brownishness, and this is what happened at (25%) and (75%).
2. The presence of excess aluminium ion in the sediment sludge, the precipitate in the form of aluminium sulphate, which forms a ratio between (20%) and (30%), and the gelatinous aluminium hydroxides and others, which constitute a ratio between (70%) and (80%), contributes to improving processing efficiency When return sludge is used in the treatment process.
3. The returned particles work with the sludge, bridges and felts work, which increases the removal efficiency at rates that can reach (14%), and this, of course, reduces the amount of aluminium used to achieve the treatment process and can be in the same proportion.
4. In the event of high disturbance, it is expected that there will be no improvement in removal efficiency due

to the occurrence of the proofreading mechanism.

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Conflict of interest

The authors declare no conflict of interest in publication of this research.

Table 1. Chemical and physical analyzes of river water for different time periods during 2020.*

Date	Temperature (°C)	pH	Turbidity (NTU)	SO_4^{2-} *	Al^{3+} *	TSS *	TDS *
5 / 7	19.4	7.7	201	258.25	94.6	4625	399.5
6 / 6	21	7.6	221	252.99	90.0	2755	484
7 / 16	22.2	7.6	187	253.65	92.5	3465	624.6
11 / 20	18.1	7.5	166	244.8	89.1	2150	498
11 / 25	17.6	7.8	370	278.2	130.6	15516	450
12 / 2	18.8	7.6	323	236.24	111.5	11252	621.5
12 / 8	16.3	7.5	320	254.52	120.6	13240	466

* Measured unit is mg/l

Table 2. Chemical and physical analyzes of sludge water deposited in the refining basins during 2020. *

Date	Temperature (°C)	pH	Turbidity (NTU)	SO_4^{2-} *	Al^{3+} *	TSS *	TDS *
5 / 7	20	7.9	16	206.6	0.59	670	528
6 / 6	24	7.9	14	199.2	0.61	590	658
7 / 16	25	7.9	14	207.4	0.63	610	849.1
11 / 20	18.1	7.8	17	163.9	0.46	730	578
11 / 25	16.9	8	15	197.1	0.53	633	640
12 / 2	18	7.85	18	194.4	0.56	760	744.1
12 / 8	15	7.8	21	201.2	0.62	892	591.5

* Measured unit is mg/l

Table 3. Temperature values with velocity gradient (G sec-1) for optimum turbidity removal for synthetic water models (50% raw water + 50% sludge). *

Date	Temperature (◦C)	Value of velocity gradient (G sec^{-1})	Temperature of Rapid mixing part (◦C)	Temperature of sludge (◦C)	Turbidity (NTU)
5 / 7	20	38.4	19.7	19.4	3.45
6 / 6	24	35.2	22.5	21	4
7 / 16	25	35.3	23.6	22.2	3.6
11 / 20	18.1	31.7	18.1	18.1	4.5
11 / 25	16.9	31.5	17.25	17.6	3.5
12 / 2	18	38	18.4	18.8	5
12 / 8	15	37.5	16.15	16.3	3.6

* Measured unit is mg/l

Table 4. Added and residual aluminum ion concentration at best process values in raw water and synthetic water models (50% raw water + 50% sludge). *

Date	pH	Al $^{3+}$ residual (mg / l) for raw water when best treated	The percentage of improvement in the removal efficiency of browning when using %(samples (50% sludge	Residual Al^{3+} ** mg/ l) for raw water at best treatment	Al^{3+}, added (mg /l) to raw water when best treated
5 / 7	7.45	0.08	13.75	0.09	4.28
6 / 6	7.7	0.08	11.11	0.09	4.28
7 / 16	7.5	0.088	10.0	0.1	4.28
11 / 20	7.6	0.08	10.0	0.09	4.28
11 / 25	7.8	0.076	12.5	0.085	4.28
12 / 2	7.6	0.09	9.10	0.1	4.28
12 / 8	7.6	0.11	10.0	0.13	6.00

*Measured unit is mg/l.

****The aluminum ion concentration originally present in the raw water model is subtracted.**

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