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Evaluation of stabilize contaminants in biological sludge wastewater

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Abstract : In this study, the performance of activated sludge to remove organic contaminants from industrial wastewater has been investigated. A solution of 8 g glacial acetic acid, 8 g poly-ethylene glycol and6 g P-xylene in water were prepared. This solutions was mixed with ratio of 80/100, 90/100, and 100/100 for activated sludgefrom wastewater sludge. The parameters such as pH, temperature, mix speed and the mixing ratio of sewage sludge were investigated. The mixing ratio of sludge was observed to be reducing the COD in the effluent 90/100at pH 7.5, temperature 37 ^{o}C and mix speed 180rpm.
Key word: activated sludge**,** kit COD**,** reduce Organic matter.

1. Introduction

Modern wastewater treatment is dominated by the activated sludge process, which was developed over 100 years ago [1]. Organic compounds are biologically oxidized in an aerated tank. Then, the sludge is typically separated from the treated effluent in sedimentation tanks, partly returned to the inlet of the aerated tank, and partly wasted as excess sludge (or waste activated sludge, WAS) [2]. Alternatively, membrane filtration can be used to separate the activated sludge from the treated water [3].

In many existing and emerging activated sludge process configurations, rapid sorption of organic compounds from the wastewater onto the sludge plays an important role for the removal. Existing process configurations that rely on sorption as a major removal mechanism include contact-stabilization [4] and adsorption-bio oxidation (AB) [5, 6]. In the contact-stabilization process, the influent wastewater is mixed with activated sludge in a contact tank having a short hydraulic retention time (HRT) of e.g. 15 min. Organic compounds are assumed to rapidly sorb onto the sludge, which is separated from the treated water in a sedimentation tank. The settled sludge is then aerated in a stabilization tank to oxidize the sorbed organics, before being recycled back to the contact tank. The AB process is a two-sludge system consisting of a high-rate activated sludge process (the A-stage) operated with a short solids retention time (SRT) of 3–12 hours. In the A-stage, organics are removed mainly by sorption onto the sludge. The low-loaded B-stage is then used e.g. for nutrient removal and oxidation of the organic compounds remaining in the wastewater after the A-stage [7,8].

Directing WAS to the primary settlers to be mixed with the primary sludge in a wastewater treatment plant is another quite common practice to utilize the sorptive capacity of the WAS and improve the dewatering properties of secondary sludge [10- 21]. However, scientific studies on the effect of activated sludge addition on organics removal in primary sedimentation are scarce. Yetis and Tarlan [9] found that addition of WAS improved sedimentation of suspended solids in raw wastewater under certain conditions. Tests were carried out with sludge cultivated at different solids retention times and generally concentrations above 1600 mg total suspended solids (TSS)/L gave the best results. However, no information was provided about dissolved substances. Ross and Crawford [22] carried out full-scale tests comparing primary settlers that either received or did not receive WAS. However, they did not see any significant differences in the organics content in the effluent from the settlers.

New activated sludge processes based on sorption as the major mechanism for organics removal are also emerging. As energy-efficiency and carbon footprint are becoming more and more important for wastewater treatment plants [23], high-rate activated sludge processes similar to the A-stage of an AB process are being investigated [24,25]. A high-rate activated sludge process with short solids retention time (SRT) is potentially more energy-efficient than a low-rate process with long SRT because less oxygen is needed per mass of organic material removed and more excess sludge is produced, which can be converted to biogas in an anaerobic digester. Thus, a high-rate process could both cut electricity consumption because of lower aeration requirements and increase energy output (in the form of produced biogas) for a wastewater treatment plant [26].

Sorption-based processes have also been investigated as an enhanced form of primary treatment. Huang and Li [27] recycled primary sludge and mixed it with the raw wastewater before primary sedimentation. Enhanced organics removal could only be obtained after the primary sludge had been aerated in a stabilization tank. A COD removal efficiency of 40% could be obtained which was 35% higher than with primary sedimentation alone. Zhao et al. [28] investigated a bioflocculation-adsorption, sedimentation and stabilization process for enhanced primary treatment. They obtained total COD removal efficiencies of 70–80%. Both of the processes referred to here are very similar to the contact-stabilization process.

To design and predict the performance of sorption-based activated sludge processes for enhanced primary treatment or for more energy-efficient wastewater treatment, studies investigating the sorption capacity of sludge are needed. The goal of this study is to quantify the sorption of particulate and dissolved organic compounds onto different types of sludge available at wastewater treatment.

2. Experimental

2.1. Materials

All solutions were prepared with ultra pure water (obtained from HAMILTON, England) Laboratory glass was kept overnight in a 10% (V/V) HNO_3 solution and then rinsed with deionized water. All reagents were made from Merck. All chemicals were potassium Hydrogen Phetalate(KHP), Ag_2SO_4, $K_2Cr_2O_7H_2O$, $HgSO_4$, activated sludge, glacial acetic acid, poly-ethylene glycol and P-xylene, COD barcode standard kits.

2.2 Instrumentation

A HACH spectrophotometer (model DR-5000), Thermal reactor, an electronic analytical balance (220LA, ADAM), A WTW photometer (model Photolab S12) were used.

2.3. Solutions Instruction needed to build COD kits

2.3.1. Catalyst solution

Hour Glass washed with distilled water and placed in an oven at 100 ^oC to dry. After removing it, be placed in a desiccators containing silica gel to cool. Then the hour glass is placed on a digital balance and the balance becomes zero. 10 g silver sulfate salt is placed on the hour glass weight. The amount of silver sulfate salts was added to1000 mL sulfuric acid and a small bar magnet put in which magnetic stirrer is placed on the device. Stirrer speed is 300 rpm set at room temperature until complete dissolution is done. This procedure time may be at least 5 hours.

2.3.2. Oxidizing solutions in the high and low range

50 g of potassium dichromate salt was weighed and placed in the oven 100 ^oC, to complete loss of water and salts into anhydrous potassium dichromate, is ready for use. 5.24 g potassium dichromate dried salt and 33. 3 g of sulfate salt of mercury were mixed in glass hours and added to the flask containing 700 mL distilled water. The contents are stirred up balloons rotation salts are dissolved in water. 140 mL concentrated

sulfuric acid is added slowly to the flask and diluted with distilled water. COD reagent solution for concentration range 900-5200 mg / L was prepared. For COD preparation of reagent solution in the concentration range 50-1200 mg L^{-1}, who called on a low-oxidizing solution, the same method of preparation of the solution, was in lower amount of potassium dichromate (10.2 g).

2.3.3. Instructions COD kits

For making COD kit the vials with 10 cm length and 1 cm diameter was used. Potassium dichromate solution ready in two concentration ranges above and below each catalyst solution added in a container and to act quickly, on each measurement range volume a digital Pipette0.5-5 mL is installed. For Catalyst solution, the volume of digital pipette set on the number 3.5mL and for the solution of potassium dichromate, based on the number 1.5mL. To build a high concentration of potassium dichromate kit within the thick 1.5 mL and for making kit in the range of lower concentrations also 1.5 mL diluted dichromate solution is added to separate vials. Each of the vials, 3.5 mL Catalyst solution is added.

3. Results and discussion

In doing of laboratory work, the main purpose is to remove organic contaminants sludge and pursuits of COD tests have been performed. To achieve this purpose many devices and chemicals are needed to build a simple aerobic reactor in the laboratory. Two programs for COD unknown results on the DR-5000 spectrophotometer are defined, one for concentrations ranging of50-1200 mg / L and other concentrations in the range of900-5200 mg / L. Kits for measuring COD was unknown and in parallel HACH barcode kits for photometer WTW device was used. When the reactor was built and activated sludge, started its activities at the same time, one or two ml (depending on the concentration of COD) of the mixture, handmade sets and the same amount, was added to the standard kit. whereas both were in the thermo reactor, after cooling, handmade kits were introduced to a spectrophotometer by using a calibration curve obtained from unknown amount of COD photometer kit devices, was introduced and the results were compared with results of the kit. This action was repeated and the results were recorded every four hours once.An aerobic reactor which contains a container one liter, pH meter, stirrer and heater and eight mixed were formed to investigate the circumstances. This reactor does not include all aerobic microorganisms, so you need to stop the poisoning and death of these microorganisms.

3.1. Conclusions about the concentration of suspended solids

Four mixtures were prepared with different ratios of sludge and wastewater. By controlling the pH and temperature and air flow and adequate complementary food to the bacteria, educe of the COD process was followed.

As mentioned in the previous section, the sludge to waste four of 80/100, 90/100, 100/100 and 110/100 was chosen and the results showed that effluent mixing ratio of 90/100 is the best performer for removal organic materials.For ratio 80/100,67.7%, for ratio90/100, 72.8%,for ratio 100/100 64.8% and the ratio of 110/100, reduce Organic matter content the 57.3% was observed. This calculation is simply the best ratio of activated sludge wastewater treatment is 90/100 to remove organic matter in the terms used in this research. In two series of experiments to test with a longer kit (kit barcode photometer machine WTW). The results showed that there is little difference between the two methods. This lack of difference must also be demonstrated with statistical calculations.

The COD results of two series experiments including both methods, is shown in table 1.

Table 1. COD reduction results with two different concentrations of suspended solids by two methods

COD with standard kit (mg/L) TSS=4845	COD with kit (mg/L) TSS=4845	COD with standard kit (mg/L) TSS=3811	COD with kit (mg/L) TSS=3811	number
3138	3156	3342	3355	1
2500	2519	2445	2516	2
1897	2012	1990	2012	3
1425	1418	1605	1603	4
1199	1215	1188	1217	5
1108	1112	1063	1082	6

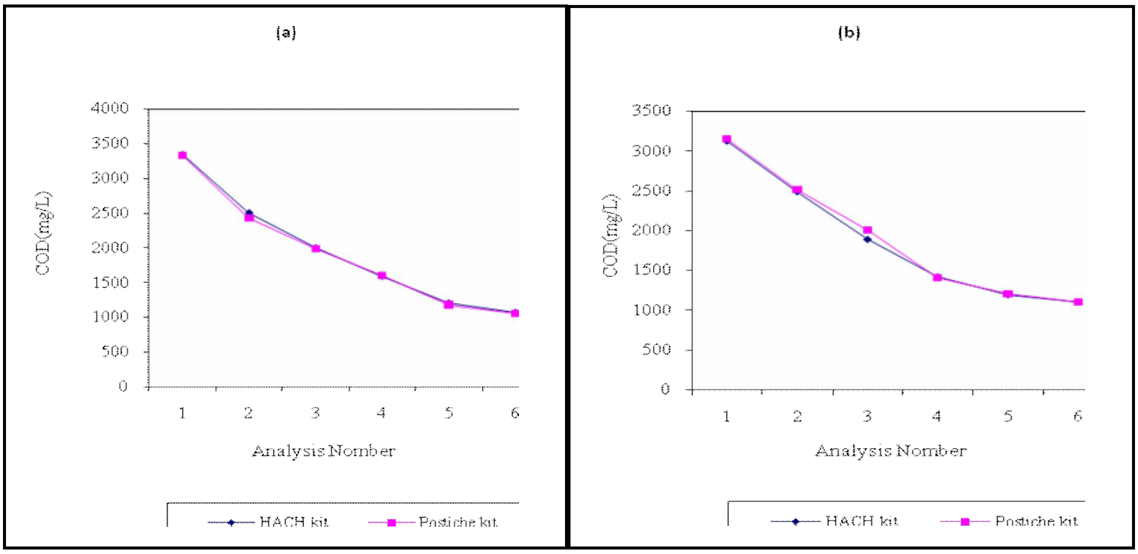

Figure: 1 compare the results of the a) TSS=3811 mgL^{-1},b) TSS=4845 mgL^{-1}

Concordance of the result from two graphs can be easily observed. Nonconformity just one point of each figure is visible. Thus large number of experiments is admittedly inevitable.

3.2. T test for significance of differences between means

It is necessary to draw a calibration curve. For this purpose standard solution of potassium hydrogen phethalate (KHP) was used. Solution with a suitable concentration for calibration in both upper and lower concentration range was built with dilution of the standard solution. In the presence of oxidizing such as potassium hydrogen phthalate, potassium dichromate orange to green and oxidation and reduction of the number change. For the spectrophotometer DR-5000 program were defined as COD-Lowang up Range, 620 nm wavelengths are appropriate. The calibration curve was plotted versus concentration.

(a) (b)

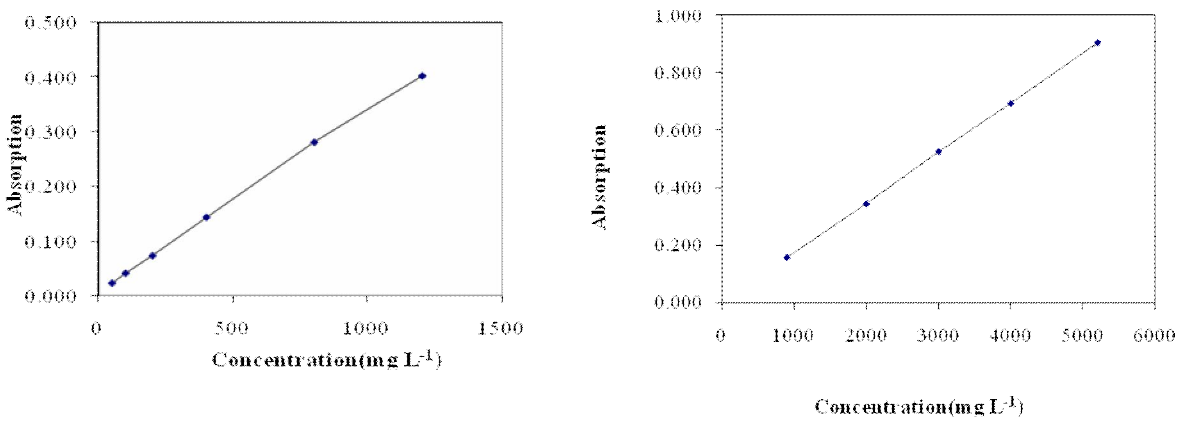

Figure 2: The calibration curve for low and high concentration range of COD

3.4. Conclusions about the speed of stirring the mixture

To check the speed of stirring the mixture well, in four different speed COD reduction process with activated sludge checked out. Result check shown to speed stirrer, equal to 60 rpm, 55.1%, to speed 240 rpm, 72.4%, for speed 420 rpm, 42.2% and to speed 540 rpm, 35.4% was from organic matter decomposition. By examining results and rate of decline, it can be concluded that eating quickly mixed together, is the best about 240 rpm. The speed of microorganisms in contact with food and colloidal solution is very effective and they are able to get enough food and oxygen. Also like previous experiments in two series of standard tests HACH with handmade kit was used simultaneously. The measurement result is shown in table 2.

Figure 3 a clear statement of the table 2, shown the measurement results of two methods are very different from each other.

Table 2. Results COD reduce the time in two different speed mixer and two separate methods

COD with standard kit 240 rpm (mg/L)	COD with kit240 rpm (mg/L)	COD with standard kit 60 rpm (mg/L)	CODwith kit 60 rpm (mg/L)	number
3239	3250	3233	3249	1
3000	3011	2882	2895	2
2720	2729	2520	2508	3
2380	2386	1995	2015	4
2005	2018	1770	1785	5
1765	1878	1450	1458	6

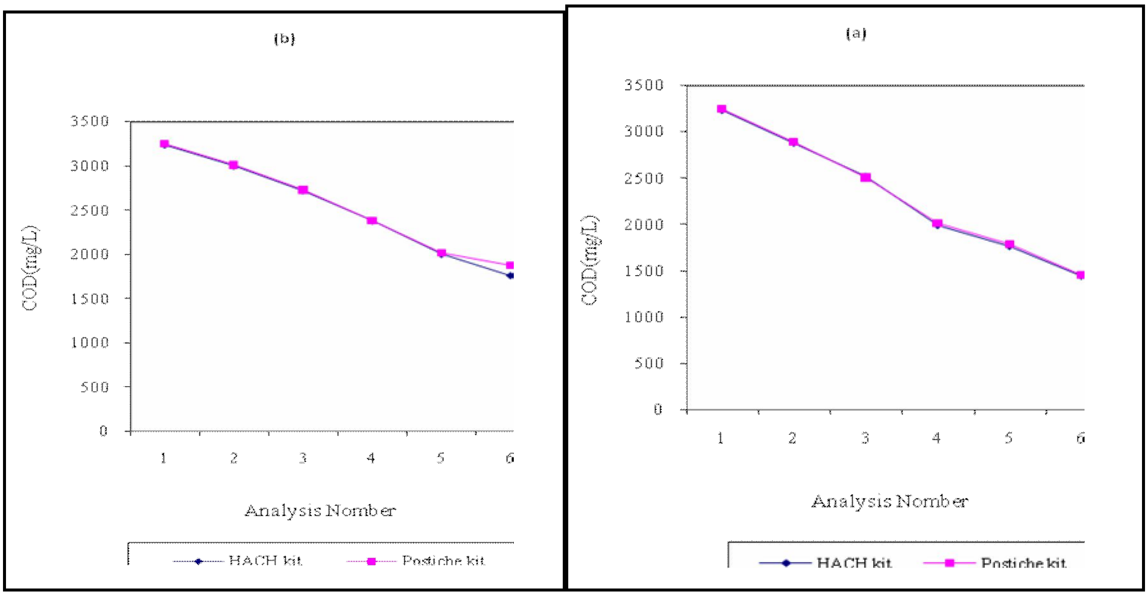

Figure 3: Compare the two techniques in a): 60 rpm and b): 420 rpm

In this study, with a pH of 7.5, temperature 37°C, constant air flow with speed 180 rpm, the best mixing ratio of activated sludge wastewater treatment, 90/100, also with a pH of 7.5, temperature 37°C and ratio 90/100 for the sludge to waste, the stirring speed 240 rpm, was obtained respectively.

4. Conclusion

The best conditions for improving efficiency, performance monitoring process is done by sending samples entry, middle and end to the lab. Intermediate and final laboratory and testing on these samples is different depending on the conditions, especially the COD test is the most important indicator of wastewater contamination. The optimum conditions obtained in research laboratories by researchers.

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