Design and manufacture of a membrane bioreactor to synthetic wastewater treatment

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Abstract: Application of membrane bioreactors (MBRs) for treatment of organic wastewaters is increasing rapidly, as a result of their high efficiency of removing and solving problems which conventional biological systems have like oxygen dispersing and suspended solid concentrated. In this research, it was tried to analyse the results of organic waste water treatment with ceramic and polymeric membranes MBRs. For this propose, using a MBR was designed. All experiments were performed synthetic waste waters and Tehran refinery activated sludge was used as biological unit. Glucose was used as carbon source in the synthetic waste water and it was replaced with phenol during the experiments. Mixed liquor suspended solid (MLSS) was determined as the biological system growth. Chemical oxygen demand (COD) removal was analyzed as ability of the MBR in removing organic pollutants and also fouling behavior of the membranes were investigated. The ceramic membrane was replaced with hollow fiber membrane module, and glucose was replaced with phenol as the carbon source. Phenol concentration was increased slowly for studying the biological system behavior and phenol concentration effect on ammonium removal was olso studied. Effects of solid retention time and carbon, nitrogen ratio in feed were investigated and finally hollow fiber membrane fouling behavior was studied. The results showed that more than 96% COD and more than 99% phenol removals could be acheived when phenol was used as carbon source. Studying membrane bioreactor behavior in different phenol concentrations and different carbon to nitrogen ratios showed that increasing phenol concentration, ammonium removal. COD to N ratio of 20 was the optimum ratio when glucose was used as carbon source and also when phenol concentration was below 400 mgl^{-1} in the feed. For higher phenol concentrations of carbon to nitrogen ratio of was recommended. Solid retention time of 10 days was the best at which MLSS was stable in the MBR.

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1- Introduction

For the first time using ultra filtration membrane processes in treatment with activated sludge process has been reported by Smith in 1969. Other early reports of bioreactor aeration, Hardt and colleagues have reported a volume of 10 liters in 1970, where the closed end of the membrane system for separating biomass from water has been used. The amount of suspended solids in the system is from 23 to 30,000 mg which had higher concentrations than conventional systems. Water flow rate in the system Lit m-2h-1 7.5 and COD removal efficiency of 98% has been reported. In 1971 the first system developed membrane filtration processes was reported by Oliver. In a continuous flow bioreactor system and Ultra-filtration water through the membrane module was removed from the system. The membrane used was a plate type and the pressure inside and outside, respectively, 345 kNm^{-2}and 172 kNm^{-2} and the outlet flow rate equal to m-2h-1 9/16 have been reported. The system was commercially marketed in Japan under license Sanky Oliver and Company. By 1993, about 39 pieces of the outer membrane bioreactor has been reported in various industries. Nowadays, membrane Bioreactors of various systems in Japanese industry, particularly food and beverage industries with high COD effluent are used that are provided by different companies. At the same time the company Detford part of today's corporate environment xenon products including outer membrane Bioreactors for domestic wastewater treatment was provided with aeration. In late 1980 Zenon Environmental Inc. use of technology companies in the water treatment industry Oliver began the two of these successes were reported in 1993 and 1996. In 1989 the Japanese government asked the big companies to design processes for water production that can scale to produce high quality water. Problems such as the inability of the air distribution system to supply oxygen for biological and high concentrations of microorganisms, particularly bacteria, are found in most biological treatment methods. The effluent from these units usually is not good quality and the quantity of solids and contaminants have been removed, which necessitates the need for the complementary method for water purification. The ability of these systems to remove organic materials such as wastewater proven analysis and business units in the past few years there has been this purpose. But the possibility of refining wastewaters that contain toxic carbon compounds such as aromatic, or sources of excessive nitrogen and phosphorus compounds are the problem that needs further investigation. The aim of this study was to investigate the possibility of phenol as an organic compound is toxic in a membrane bioreactor. The effect of various concentrations of phenol and ammonia removal process has been investigated as a source of other pollutants. Solid retention time as an essential element in biological systems as well as operational and studied and stayed at different levels of phenol and COD has been investigated. And the growth of activated sludge was studied and changes in soluble solid mass of sludge have been studied as an indicator of changes in various detention times. The study materials were collected for this study based on the proposed project design and commissioning of a membrane bioreactor and its function during the 5 months was determined. To determine how changes in the samples were analyzed by standard methods and the results of these experiments were analyzed and compared with the results given in the references. All results are reported in accordance with those articles, resources and indicate the ability of a membrane bioreactor for the removal of toxic organic substances.

2- Review of Literature Membrane Bioreactors

Although the composition of biological systems with a single membrane was used about 30 years ago but the rate of publication in journals and magazines has been very low until mid-1990. More Articles related to Japan, USA, UK, France, China, South Korea and Canada for a total of more than 75% of the research in this field is included. Meanwhile, Japan and South Korea and France, the first study on this topic has been started, while almost all other countries after 2000 have been widely entered the field. Despite much progress in the past 20 years, the field of research has always been focused on a few specific and these are problems that are often called upon to challenge the system. These challenges can be summarized as the following.

1- Fouling membranes is an important issue in all fields of membrane technology, membrane fouling. Ability to solve this problem easily and decreased fouling in the membranes of the issues that has always been attended.
2- Stability of the membranes, due to the inevitable clogging of the membranes, the cleaning should always be considered. The use of membranes is considered the maximum resistance against physical and chemical cleaning is covered.
3- System costs, these costs include purchase costs and operating expenses, such as membranes and replacement costs of pumping and aeration.

2.1- Types of Membrane Bioreactor

Membrane Bioreactors can be divided into three groups: aerobic, extraction and separation of solid - liquid. Aeration system capable of mining through the membrane separating the phases and allows one component to another component parts, and improve the efficiency of wastewater treatment. Due to the low solubility of oxygen in water, wastewater treatment plants that require high levels of oxygen for biological treatment are usually always there are many problems in the conventional methods of chemical treatment are used rather than biological treatment. The study of these systems has shown that the mass transfer resistance and low concentrations of oxygen in the gas phase are important factors in the oxygen transport system [1]. One way to increase efficiency is the use of pure oxygen instead of normal air. Also, by reducing the size of the bubbles can be largely reduced the mass transfer resistance. However, the conventional method of injecting pure oxygen instead of air is not economically feasible. In addition, oxygen injection would be easily mixed with the biomass because many problems are caused by bubbles.

2.2 - Factors affecting membrane bioreactor

Issues have been studied mostly in the MBR systems can be divided into the following:

1- Operational conditions

   The most important operating conditions, solid retention time (SRT) and liquid (HRT) and their changes with time, the addition of temperature and aeration membrane within the system and how well are those that have been studied, SRT is the ratio of the solid mass in the bioreactor solids discharge outlet of the bioreactor is expressed in units of days. HRT ratio of liquid volume in the bioreactor effluent is to flow from the bioreactor, which is expressed in units of time.

2- Membrane

   Membrane fouling is most important during the startup of membrane bioreactor was studied. Type of obstruction (reversible or not), how to clean and reduce membrane fouling, its durability over time and the possibility of using membranes with different pollutants and microorganisms in the bioreactor, including topics that are studied.

3- Type of waste

   The main issue has always been the possibility of using membrane bioreactor wastewater treatment types are. Accordingly, the wastewater can be divided into two general categories of real and synthetic. The membrane bioreactor wastewater treatment real straight is as biological treatment units are used in the refining process. Synthetic wastewater effluent or sewage simulation is based on the specifications. The main advantage of this type of wastewater effluent flow and the ability to control entry scrutiny bioreactor performance in the removal of any particular be considered.

2.3- Phenol removal in a membrane bioreactor

UASB reactors phenol solution into the reactor containing anaerobic bacteria is placed with the help of bacteria to degrade phenol. In activated sludge systems for wastewater containing phenol mass, mass containing live microbes are in contact. In these systems after the purification procedure was performed at a certain time, the effluent is sent to another unit where other methods, such as sedimentation or filtration of water mass, masses, and is separated [2],. Figure (1) of phenol using microorganisms is given. More ways mentioned above are known as conventional methods, and classical. These methods are not efficient at high densities and high economic costs, and finally, the impossibility of using them for a long time, remove steady state are problems and limitations that each of them are having some previous methods. Membrane Bioreactors allow the removal of high concentrations of phenol has been reported continuously. In a laboratory, for example, the two reactors, each with a useful volume of 8/1 liter Pyrex glass was used. PVDF membrane using commercial membranes that have overall level cm214 / 0 and a hollow fiber are respectively. Of the activated sludge wastewater Treatment Company in Seoul has been used as a biological unit .An air pump to supply air flow lit / min 3 has been used. Membrane bioreactor for wastewater treatment is one of the two units with low levels of concentration and a high concentration of phenol used. Our results indicate that low concentrations of phenol removal were performed 8 days after the full amount, Figure (2) [3].

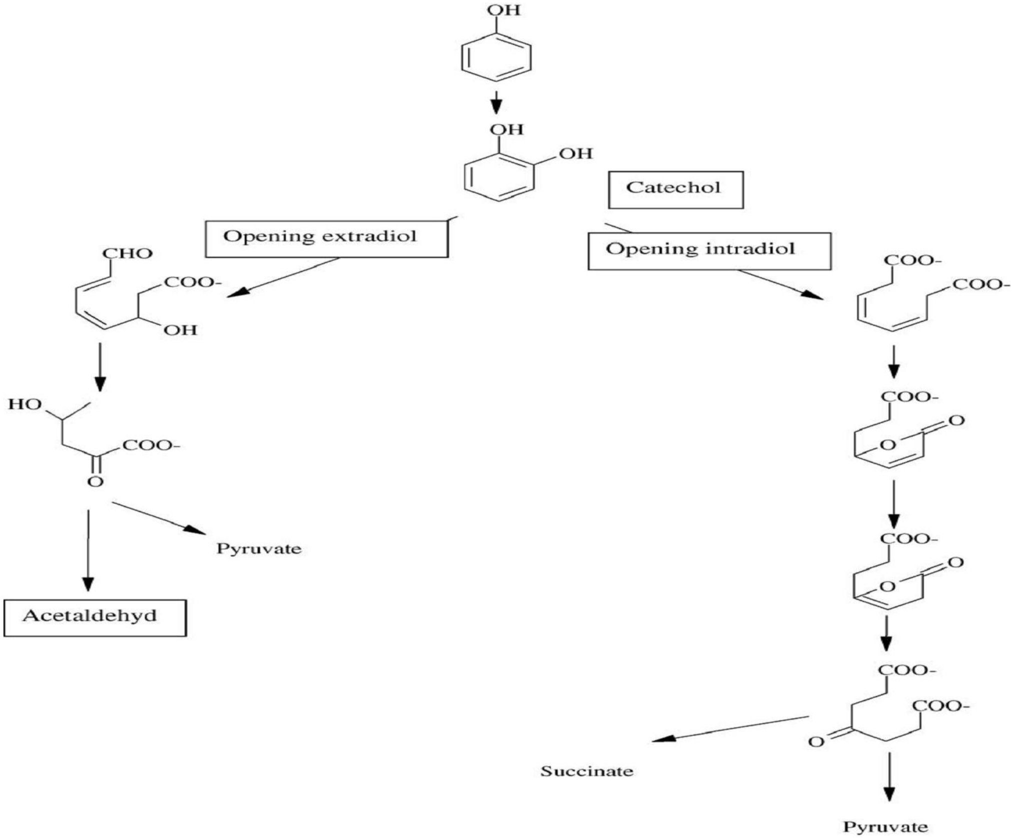

Figure (1) biological removal of phenol [4]

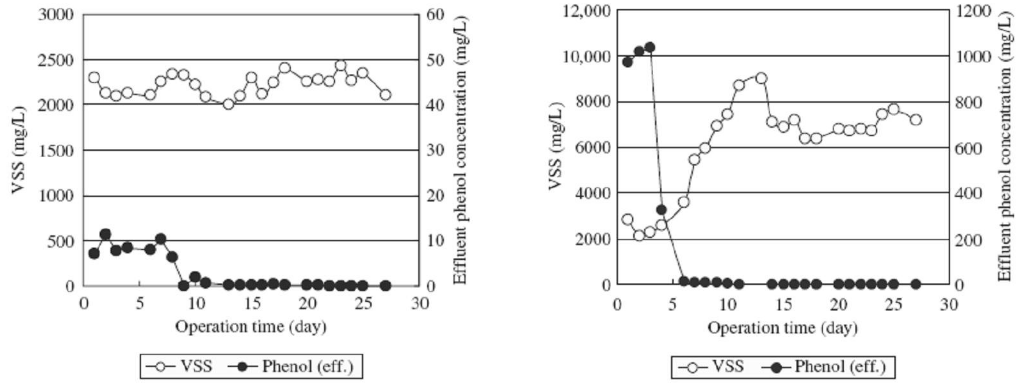

Figure (2) phenol with MBR - quantities of high concentrations of (R) - Low levels of concentration (left) [3]

3- Research Methodology

The main experiment was conducted to investigate the phenol removal in a membrane bioreactor. The study used multiple sources and evaluates bioreactor wastewater treatment, especially those that have been used for phenol removal. The nominal size of a membrane bioreactor and useful volume lit10 lit 14 was designed and built. Important design parameters and their values are listed below. Important factor in the design of the bioreactor can be expressed as follows

1- Type of membrane bioreactor (aerobic or anaerobic immersion or flow back system)
2- Liquid retention time (HRT)
3- Select the type of biological system
4- Select the type and size of the membrane surface
5- Determination of lateral components of membrane bioreactor includes a feed tank, the pumps and fittings

Each of these components is described in details below. Prepared feed containing phenol and ammonia and phosphorus compounds were kept in a stainless steel tank (1). Then use the pump with the discharge cc min-1 10 was sent into the reactor (2). Using membrane separates the water from the system (3). It is used to provide oxygen for aquarium rocks (4). Used to supply air from the air pump to provide the flow rate that would provide lmin-1 16-2 (5, 9). Vacuum pump to create suction in the Italian system (6) was used as the fluid passes through the membrane in a vacuum flask (7) were collected. The amount of vacuum pressure with a pressure gauge (8) was measured. Connections used (10) to allow oxidation of the steel was eliminated. The overview of membrane bioreactor is 1 - Tank Feed 2 - Feed Pump 3 - Module Lead 4 - Air diffusers 5 - Air Pump 6 - vacuum pump 7 - vacuum flask 8 - Pressure Controller 9 - Air flow meter 10 – Handles interface

3.1- Equipment used for the construction of a membrane bioreactor

As PVDF hollow fiber microfiltration membrane with a pore size of said mµ 0.2 m2 0.05 a useful cross-section and length 40 cm was used for testing. Glass container with dimensions of cm3 20 × 20 × 40 cubic shape of the glass thickness mm6 with an internal volume of about 14 l was used. A bioreactor has been used in order to create a vacuum filtration vacuum pump to create pressure for the Italian P2-S type used. Nominal characteristics of the pump m3hr-1 5/2, are respectively. To pump feed (including phenolic compounds, or glucose) into the bioreactor type of positive displacement pumps Watson - marlow used. The pump's ability to pump at least Lmin-11/0 and maximum fluid was Lmin-1 1. Due to the amount of discharge needed to set up the system so the return flow was used to adjust the feed flow rate. Aeration system to supply oxygen needed for bacterial growth and decrease membrane fouling are used. For this purpose, the ability to supply air flow rate of lmin-1 16-0 was used. DO give air to control the upper limit was set mgl-1 2. The pumps were produced in China by HAILEA Co and the ability to adjust the input pressure bar 2/1. System for the measurement of solid mass within the sample in 105 ml 20-10 hr 1 time placed. PRECISA M310 digital scale precision model 001/0 Manufacture ¬ Pryska to measure the sample weight used. Ordinary thermometers for temperature control in aquariums with a single Tetra HT150 model have been used. Given that these devices could be used for an aquarium system to adjust the temperature with an accuracy of 5/0. pH was measured by pH meter 900 series Priska. The instrument was calibrated daily using a buffer solution with pH value of 7 and 4. First, sensor devices for measuring the pH of distilled water is rinsed and dried. Then the sensor is placed inside the reactor or sample and the number of reads has been fixed. Photometer instrument to measure phenol (Palintest 7100 product series, England) is used due to its precision and ease of use. This device is capable of measuring 50 articles, including phenol, ammonia and COD. COD samples must be placed at 150 hr 2 days until the reaction is complete conversion of organic carbon to inorganic carbon. For this reason the COD reactor is used to regulate the temperature.

3.2- Methods of measurement

All materials used are of high purity. The method of measuring pH, dry weight of activated sludge and ammonia, phenol and COD concentration in the samples is described. For each device, solvents and reagents used are described and how the calibration of the model and method is described for preparing solutions and reagents.

3.2.1- Based Approach

Phenolic compounds in pH 1/0 ± 9/7 free potassium cyanide in the presence of 4 - Amino Anti Pirin reaction and form Amino Anti Pirin, a combination of color. The maximum absorption wavelength of the compound in aqueous solution in nm 500 occurs. Since this method is not very sensitive, the size of the sample does not influence the result, but to increase the accuracy and comparability of results is better matched to the size of all samples.

3.2.2- References

Distilled water was used for preparation of reagents. Phenol reagents for analysis include

1. Solution 5/0, normal ammonium hydroxide 35 ml of concentrated NH4OH and we believe it is diluted to a volume of one liter.
2. Phosphate buffer solution (at pH 8/6): 5/104 g K2HPO4 and 3/72 g of KH2PO4 in distilled water, and some believe the volume of one liter.
3. Reagent 4 - Amino Anti Pirin: 2 grams of this material and we believe in some distilled water to a volume of 100 ml.
4. Free potassium cyanide solution: 8 g of K3Fe (CN) 6 in 100 ml of distilled water, and we believe the volume. This solution should be stored in brown glass bottles.

Table (1) lists the chemicals used in the experiments

Uses	Chemical Name	Formula	Purity	Amount	Producing Factory
Cultivate Environment	Potassium hydrogen phosphate	K2HPO4	99		Merck
	Potassium dihydrogen phosphate	KH2PO4	98		Merck
	Calcium Chloride	CaCl2 • 2H2O			Merck
	Magnesium sulfate.	MgSO4	99		Merck
	Manganese sulfate	MnCl2 • 4H2O	98,5		Merck
	Iron sulfate (Π)	FeSO4 • 7H2O	99,5		Merck
	Sodium molybdate	Na2MoO4	99,5		Merck
	Ammonium chloride	NH4Cl	99,99	240	Merck
	Zinc	ZnSO4 • 7H2O	98		Merck
	Cobalt chloride	CoCl2 • 6H2O,	98		Merck
		EDTA	98		Merck
	BRIC acid	H3BO3	99		Merck
	Nickel chloride	NiCl2 • 6H2O	98.5		Merck
	Phenol	C6H5OH	99	1000	Merck
COD analysis	Silver sulfate	Ag2SO4	99	10	Merck
	Mercuric sulfate.	Hg2SO4	98.5		Merck
	Sulfuric acid	H2SO4	98		Merck
	Potassium dichromate	K2Cr2O7	98		Merck
Analysis of phenolic					Merck
	Ammonium hydroxide.	NH4OH	25	0.5	Merck
	Potassium hydrogen phosphate	K2HPO4	99	2/73	Merck
	Potassium dihydrogen phosphate	KH2PO4	98	104	Merck
	4-Amino Anti Pirin	C11H13N3O	99	20	Merck
	Free potassium cyanide	C6FeK3N6	99	80	Merck

3.3 - Sampling of the bioreactor

Samples for measurement of MLSS daily 2 ml 20 ml10 or systems were applied simultaneously. The sample size was dependent on the MLSS. In small amounts in ml 20 ml 10 are removed when the value was high MLSS. If the two samples were more than 10% by weight of the third sample was taken. Average of two or three samples is reported as the MLSS. Measurements of phenol or ammonia and COD effluent collected after vacuum flask 5 liters of water per day within a sample was taken for analysis. Ammonia was tested daily and many times, because the solution for up to 100-fold dilution was measured with a sample analysis was performed. Ml 10 sample was used for analysis of phenol guidelines. COD samples were analyzed daily for 2 ml 5/2 was removed and measured mean value.

3.4 - Design of Experiments

Due to the long duration of each experiment, the effect of the carbon source concentration and SRT was determined during testing. Experiments were conducted in four stages. The first phase of the sludge, which was reinforced with glucose, was performed using ceramic membranes. In the second phase and the third and fourth effects of glucose substituted phenol retention times were assessed. The hollow fiber membranes were used in the second stage to the next.

4 - Results

Membrane bioreactor which launched in four phases was enhanced compatibility with phenol sludge and ammonia compared to the effect of SRT and COD. In this chapter, each of these stages are described, respectively, and environmental conditions used and the removal of membrane behavior will be discussed at each stage.

4.1 - Strengthening activated sludge process

The experiment was arranged with ceramic membranes made in the laboratory and during the MLSS concentration increased from 25 days to close mgl-14000. At this stage of glucose as the carbon material, which can easily be used by bacteria was used in all experiments were taken into consideration during COD to nitrogen ratio equal to 20. The phenol concentration in mgl-1 1000 COD amount will be equal to 2380 N mgl-1 120 should be used. Changes in influent COD diagram (5-1) are given. Glucose concentration at the inlet of mgl-1 2000 was chosen during the experiment mgl-15000-4000 increasing to microorganisms increase is greater than the MLSS. Reactor temperature was kept close to the maximum value of ° C32. It operates at a maximum temperature of activated sludge ° C 35 is higher than the amount of pathogenic microorganisms is produced. Study the changes in COD indicate that micro-organisms have a few days to remove all the incoming glucose and consequently remove more than 95% is reached. COD of synthetic wastewater treatment routine about mgl-11000-300 and HRT is commonly hr 10-8. Due to the amount calculated in HRT use ceramic membranes hr 32 mgl-1 5000-2000 so the influent COD was assumed to be a constant loading. COD load is the amount of input per unit of time, ie, towards influent COD and MLSS on HRT for a certain amount of normal values for mgCOD / mgMLSS.hr 4/0-0.01 the ceramic membrane against mgCOD / mgMLSS.hr 03/0 and the maximum hollow fiber membrane 4/0.

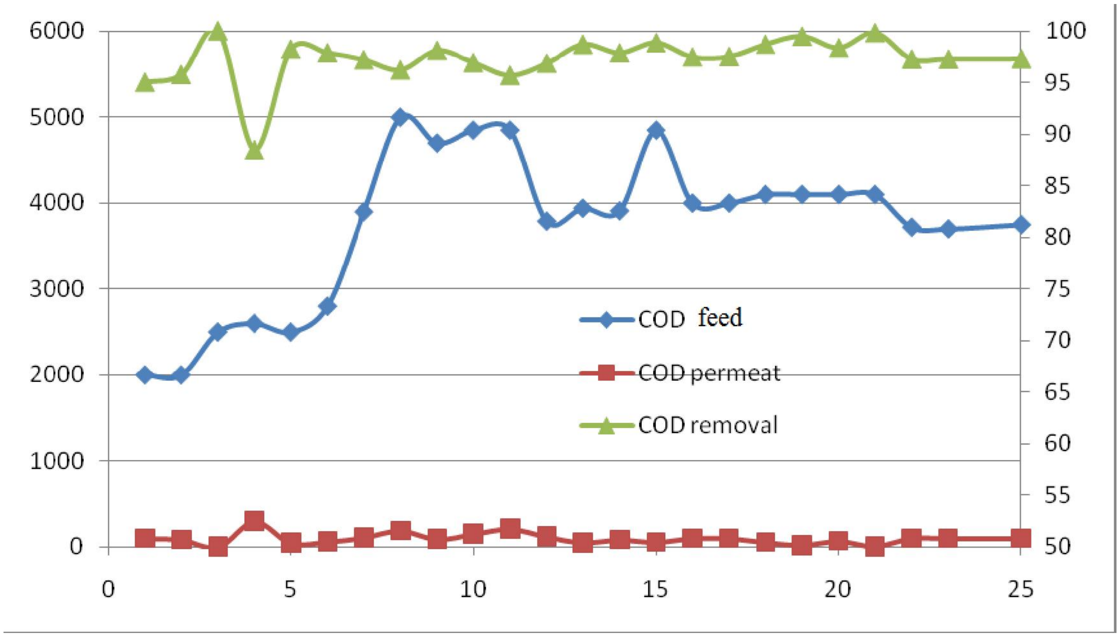

Figure (3) COD variation with time for ceramic membranes

5.2 - adapted activated sludge with phenol

This was done several times and each time, the amount of phenol was added than before. Yun Wu managed during the 2 months of the initial phenol concentration increased from mgl-1 to100 mgl-1 2000. MLSS value was reached at this time mgl-1 2000 mgl-1 10000. This project was conducted in a continuous manner, and thus the removal of phenol and ammonia were investigated. Hollow fiber membrane bioreactor was placed within the first 5 days with glucose as the carbon was launched. The experiment was carried out to determine the optimum amount of flux leakage. Then, gradually, glucose was replaced with phenol and phenol concentration after about 25 days every 4 days mgl-1 100 was added then it comes the mgl-1 500. MLSS value at this time was about mgl-15000. The mgl-1 1000 Phenol was chosen as the upper limit in this experiment. Some of the references have chosen this value [3] and [4]. Bioreactor volume was 10 liters and the system began with HRT about hr6/16. Membrane flow amount equal to Lmin-1 01 /0, which was the equivalent leakage flux, is equal to Lm-2hr-1 12. Phenol was added gradually to the sixth day, and the day I was admitted to the phenol mgl-1 100. After 4 to 5 days mgl-1 100 was added to this amount. Until one month after the start of the inlet phenol concentration on the amount of system activity mgl-1 1000 arrived. Process inputs and outputs as well as the removal of phenol changes in the diagram (5-6) is given. The graph shows good compatibility with phenol system.

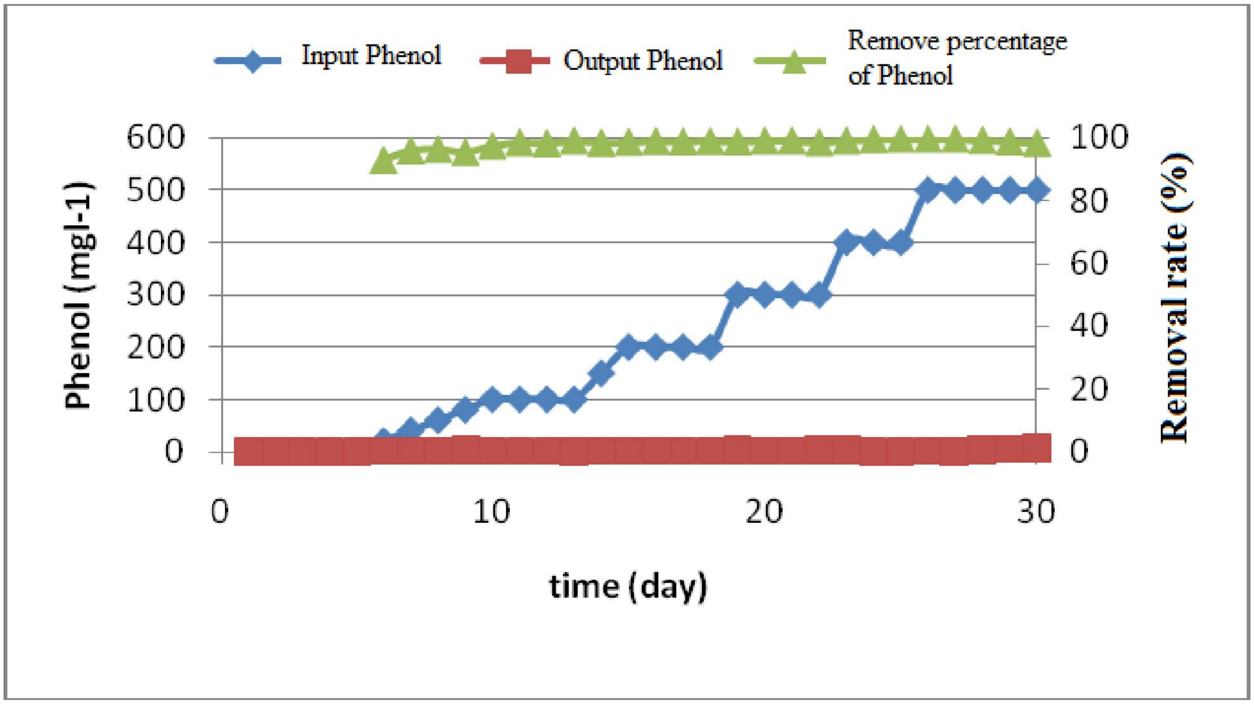

Figure (4) removal rate of Phenol in different concentrations of phenol

COD rate leaving the system for evaluation of other criteria pollutants are removed. Since most of the phenol test is the only carbon source in the system. This parameter can also be a criterion for phenol removal. In the diagram (4) COD variation in the input and the output is given. It is worth mentioning that in theory these equations g of glucose equivalent to 97/0 g COD per g of phenol in 387/2 grams of COD.

$$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6\ H_2O$$

$$C_6H_5OH + 7O_2 \rightarrow 6CO_2 + 3H_2O$$

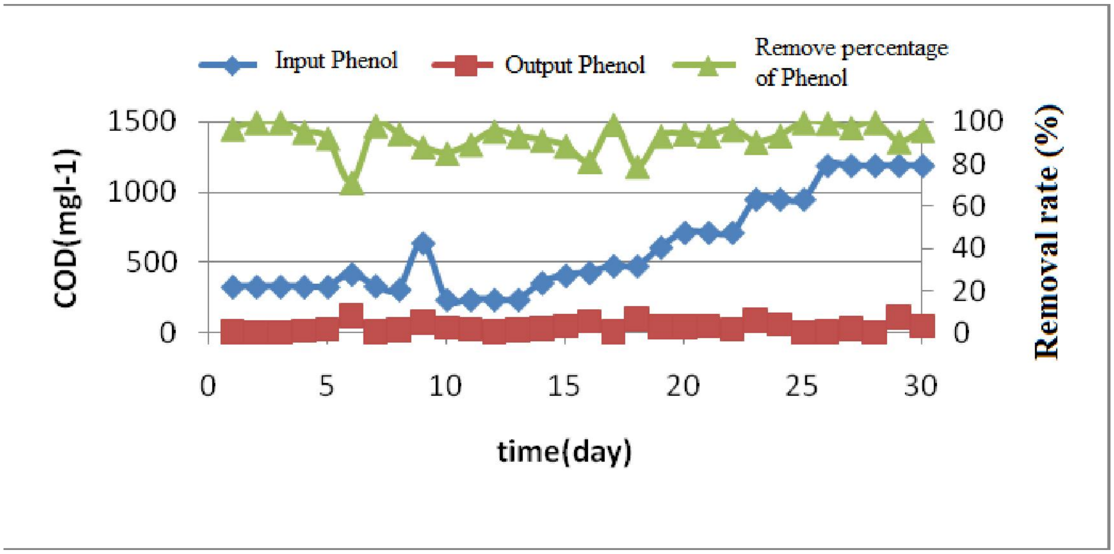

Figure (5) COD variation with time during phenol concentration in input and the rate of its removal

5.3 - Phenol removing in SRT infinite

Solids retention time (SRT) of the parameters that the system has always been a hallmark. The effects of different parameters for different systems are presented. SRT at different authorities have described as optimal values [5-8]. Unlike HRT, a fixed range is the papers (hr 16 - 6) SRT is very high extent. Many things without removing the MLSS in the system during the reported results represent the SRT theory is infinite [7]. In addition, SRT of 7 days, 10 days, 20 days, 30 days, 40 days, 50 days, 60 days and 80 days are considered as conventional SRT [5] and [8]. In this study infinite time SRT was selected as a typical value and the average value of SRT to 30 days as against 10 days as short SRT were investigated. Changes in the output of phenol and phenol removal rate was more than 99% when the amount of phenol in the input mgl-1 1000, shows that during the month of activated sludge is fully compatible and can be used with phenol to make this material as carbon source to consumption. In Figure (6) as well as changes in the output of phenol removal rate that is given.

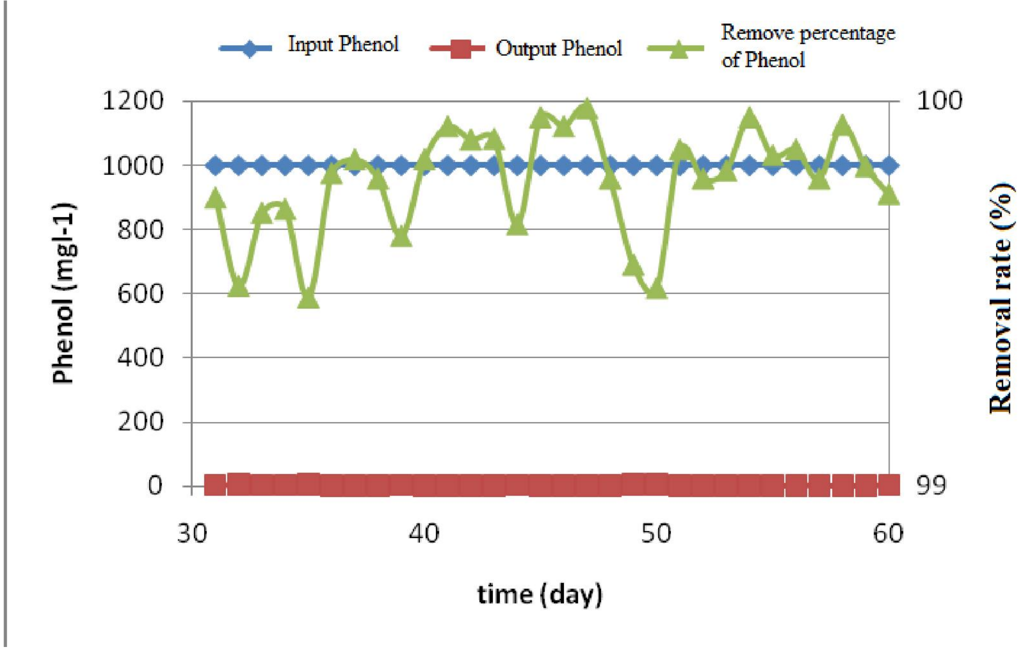

Figure (6) phenol removal rate for an infinite SRT

As noted, COD is as a measure of pollution. The changes are similar to the trends for phenol and COD removal rate is more than 95% of phenol by microorganisms is also indicated. The theory is used to calculate the amount of influent COD.

5.4 - Phenol removing at SRT 30 days

At this point, the theory of infinite SRT was reduced to 30 days. The effect of this decrease on the removal of phenol and COD and nitrogen plots (5-12) and (5-13) and (5-14) are presented. Observing these curves can be concluded that the reduced infinite SRT of 30 days has no effect on the removal of phenol and COD. Also the removal of ammonia did not affect the accumulation of this substance have continued. The changes have been stable phenol experiment.

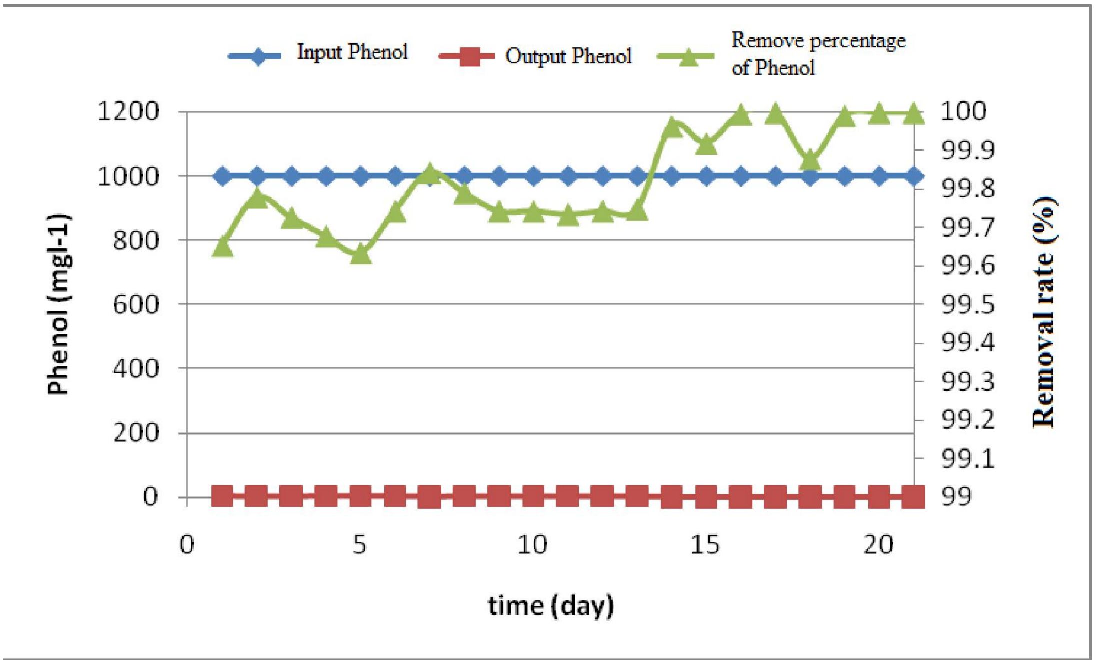

Figure (7) for the SRT 30 days of phenol (phenol inlet concentration mgl-1 1000)

5-5 - Phenol at SRT 10 days (with a different ratio of COD to N)

Further experiments to study the effect of MLSS SRT value were also reduced. SRT 10 days was observed in the MLSS concentration in the system with a very slow process increase, so that it can be considered almost constant. The changes in the conditions of phenol and ammonia and COD were investigated. After 10 days, a significant change was observed in this system. System with constant MLSS worked. Therefore, the continued accumulation of ammonia in the system was found 10 days after the entry of ammonia was reduced. And instead of COD to nitrogen ratio, which is a theoretical level, the carbon to nitrogen ratio of 20 was chosen which had been recommended by some authorities [4]. Phenol was eliminated almost entirely in SRT 10 days SRT 30 days, and the system is infinitely repeated. Figures (8) and (9) shows this change.

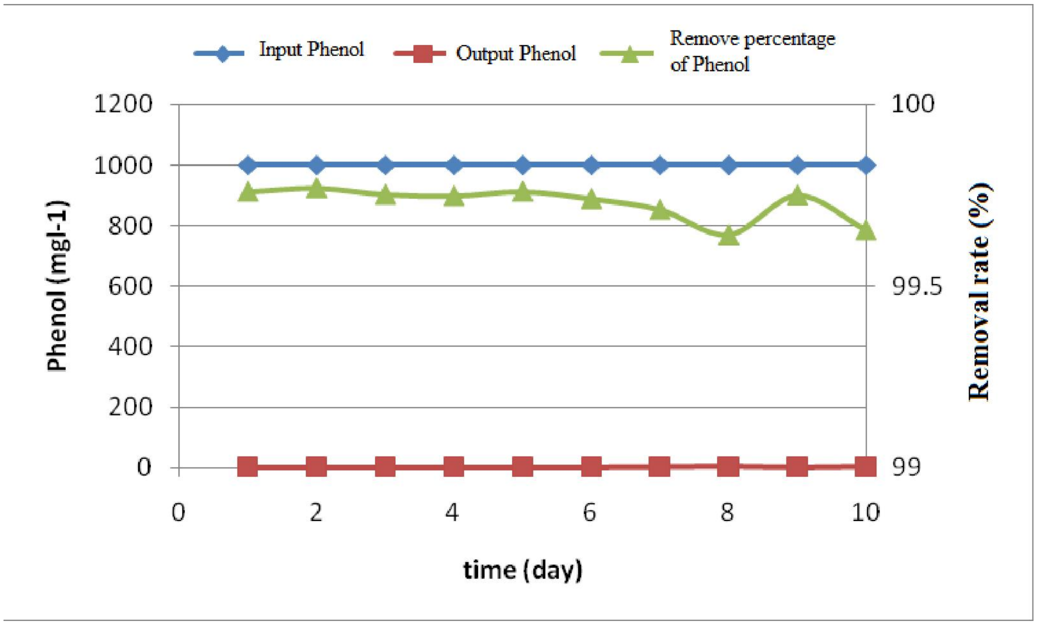

Figure (8) and phenol removal percentage change for the 10 days SRT (COD ratio to N 20)

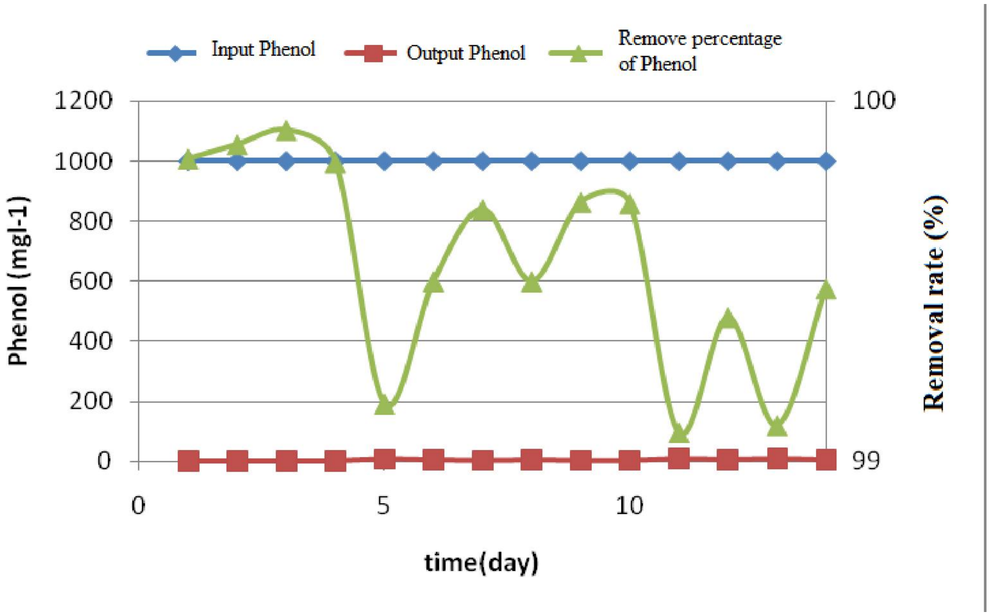

Figure (9) Changes in phenolic and remove percentage for SRT 10 days (C ratio to N 20)

5.6 - Phenol at infinite SRT and C ratio to N equal 20

In the following experiments, the C: N ratio of 20 in reference [4] was used, were used. And also due to the similar behavior of this method for both SRT 30 days SRT infinity and eternity and was repeated for 10 days. The amount of phenol and COD for the SRT 10 days is given in Figures (8) to (9). As for the SRT infinite graphs (10) and (11) is given, the results show the start time is uniformly removed. In these experiments, the amount of phenol and COD removal constant is almost complete.

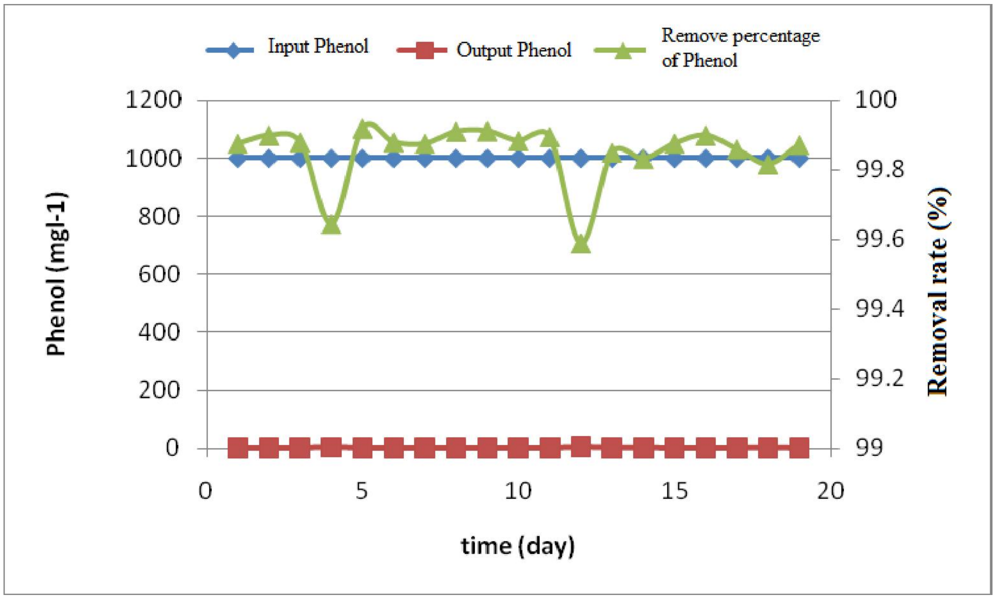

Figure (10) Changes in phenolic and remove percentage for infinite SRT (C ratio to N 20)

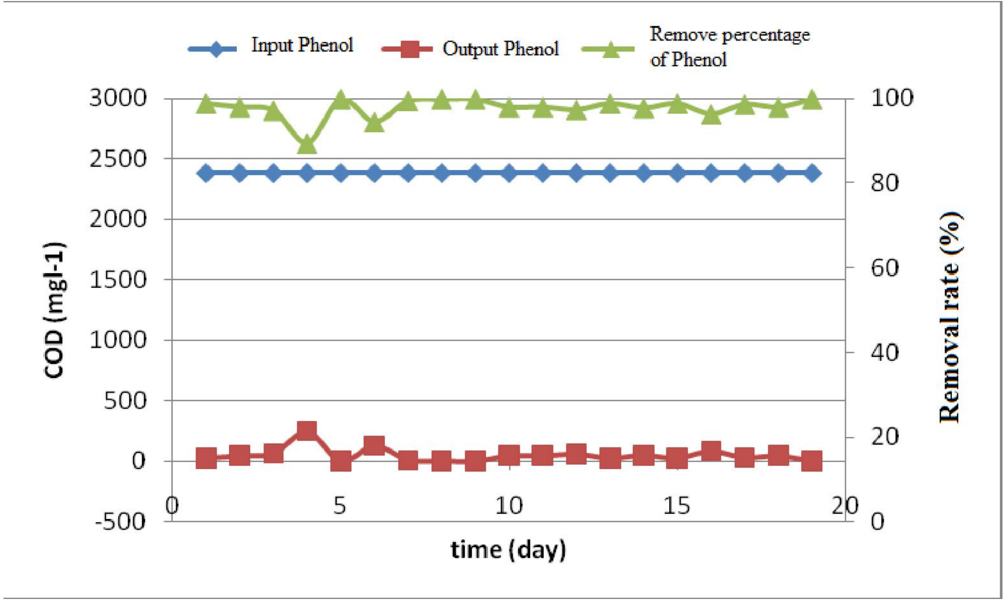

Figure (11) COD changes and remove percentage for infinite SRT (C ratio to N 20)

5-7 - Hollow fiber membrane behavior

To determine the optimal leakage flux in the experiment were related to changes in membrane permeation flux at different temperatures and pressures are given in distilled water were performed and the results of the table (1). With regard to the separation of the processes of micro-filtration and Ultra filtration is a pressure difference on either side of the membrane, and the membrane does not leak water in the path of no resistance, there is expected to increase the pressure of change of flux relationship direct and linear. Similarly, as can be seen in this table, changes of distilled water seepage flux hollow fiber membranes with increasing pressure and the square of linear correlation coefficient is equal to one (1 R2) for temperature ° C 25 is given. But the changes in the membrane bioreactor is inside is very different.

Table (1) changes in membrane permeation flux for distilled water at different temperatures and pressures

Temperature C ° Pressure (bar)	25	30	35
0.1	48	72	84
0.2	120	148	162
0.3	168	200	234

5.8 - Changes of MLSS, temperature, pH and DO with time

Increase in the number of microorganisms in biological and conventional systems due to the inability of these systems to provide nutrients and oxygen, causing death and subsequent failure of the unit. MBR units to address these two problems and the possibility of creating a stable food entry and oxygen supply to the desired rate increases in aerobic systems necessary conditions for increasing mass of microorganisms in the bioreactor as in biological systems than the usual amount of MLSS mgl-1 5000-4000 and above this amount may be considered as the critical state of a membrane bioreactor, but the amount may be increased to mgl-120000. The average value of MLSS is for common processes mgl-1 8000-3000. When phenol was chosen as the pollutant is most MLSS mgl-1 10000 selected references [4]. In some references, as well as lower values of initial MLSS has increased over time [9]. Figure (12) shows the variation of MLSS in the beginning of the process. This curve reflects the beginning of the experiment was that the amount of low-carbon source of the growth rate has been low, but the growth rate has also increased by increasing the amount of phenol in the input. The trend in the inlet phenol concentration in mgl-1 1000 kept constant, the growth rate is reduced to have continued after the MLSS mgl-16000. The above phenomenon can be justified on the grounds that are produced when the food source is more microorganisms and thus increases their mass within the system, but over time the number of microorganisms so it seems that there is a balance between the bacteria and the food source and a way to reach equilibrium. Due to mass production, but its dead bacteria can still be added MLSS concentration.

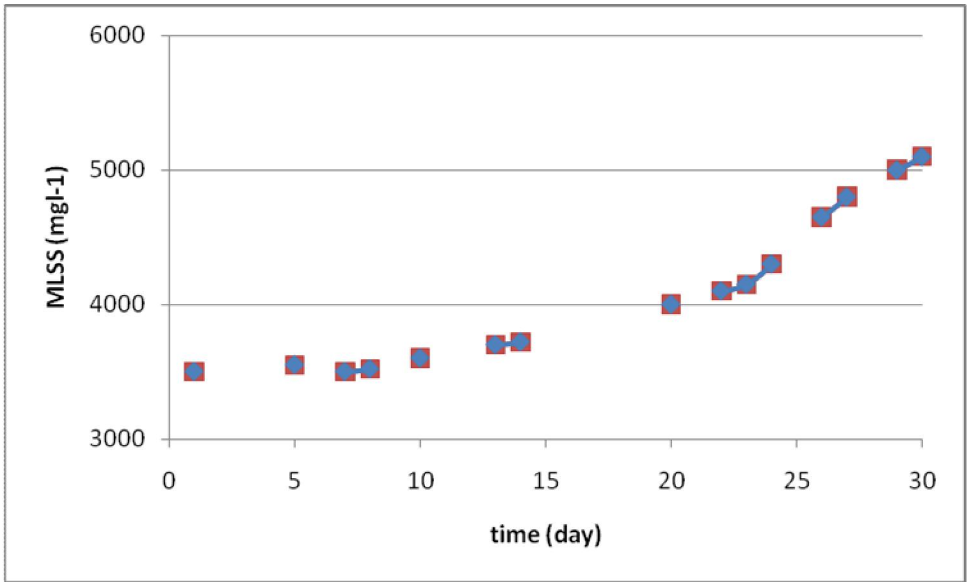

Figure (12) MLSS changes for phenol concentrations less than mgl-11000

6- Conclusion

Organic wastes are a major source of pollution in water environments. There are aromatic compounds such as water, is causing many problems. However, the accumulation of ammonia in the water leads to algae growth. Due to severe water shortages and the need for treatment of waste water from industries and cities are required. Due to the low efficiency of conventional wastewater treatment, waste water treatments in general, the use of new processes such as membrane processes, which have high economic efficiency are essential. It is the process of membrane bioreactor in the past decade has greatly progressed and developed. Ceramic membranes have been used due to its many advantages such as chemical resistance, long life and polymeric membranes due to the low cost and the ability of such membranes, made in drinking water treatment PVDF. In this study, the PVDF polymer and ceramic membranes for wastewater treatment has been studied in organic synthesis and growth and yield of activated sludge has been studied from Tehran refinery, performance is overcapitalize system. The results show that the HRT hr 32 hr 95% of COD removed with ceramic membranes is possible. However, with phenol, indicating that microbes grown from mgl-1 4000 are higher MLSS value after adjustment for the removal of phenol can be used in high concentrations. Removal rate has been above 8/99%. The main innovation of this study is the accumulation of nitrogen when phenol removal in a membrane bioreactor. Since, research on ammonia accumulation in membrane bioreactor in removal of phenol has not been reported.

References

[1] Keith Brindle, Tom Stephenson, Michael J. Semmens "*Nitrifcation and oxygen utilisation in a membrane aeration bioreactor*", Journal of Membrane Science, 1998 pp. 197-209.

[2] M.. Khakbazan Varkany, "Evaluation of biological removal of phenol in a bioreactor aircraft" MS Thesis in Chemical Engineering, University of Science and Technology, 1387

[3] Soojeung Ahn, Shankar Congeevaram, Youn-Kyoo Choung,Joonhong Park" Enhanced phenol removal by floating fungal populations in a high concentration phenol-fed membrane bioreactor" ,Desalination ,2008, pp. 494–501.

[4] A.Barrios-Martinez, E. Barbot, B. Marrot, P. Moulin , N. Roche" Degradation of synthetic phenol-containing wastewaters by MBR"Journal of Membrane Science ,2006, pp. 288–296

[5] H Hasar, C Kinaci, and A Unlu ," An alternative for pre-treatment of high-strength raw whey wastewaters: submerged membrane bioreactors " *Journal of Chemical Technology and Biotechnology,* 2004, *pp.* 1361–1365.

[6] Teck Wee Tan, How Yong Ng, Say Leong Ong , "Effect of mean cell residence time on the performance and microbial diversity of pre-denitrification submerged membrane bioreactors " Chemosphere, 2008, pp. 387–396 .

[6] Darren Delai Sun, Swee Loong Khor, Choon Teck Hay, James O. Leckie "Impact of prolonged sludge retention time on the performance of a submerged membrane bioreactor " Desalination , 2007, pp. 101–112,

[8] G. Laera , A. Pollice, D. Saturno, C. Giordano, R. Sandulli , "Influence of sludge retention time on biomass characteristics and cleaning requirements in a membrane bioreactor for municipal wastewater treatment" Desalination, 2009 pp. 104–110.

[9] Yun Wu, Hongwei Zhang , "Biodegradation of synthetic high phenol contamination wastewater by an immersed memb rane bioreactor" 2009 International Conference on Environmental Science and Information Application Technology, 2009.

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