BULETINUL Universităţii Petrol – Gaze din Ploieşti	Vol. LX No. 4B/2008	148 - 152	Seria Tehnică

Effect of Fe^{3+} ions on active slurry performances used in waste water treatment obtained from petrochemical industry

Andra Mihaela Micu, Dorina Matei, Daniela Luminita Movileanu

Universitatea Petrol-Gaze din Ploieşti
andramihaelamicu@yahoo.com

Abstract

The experiment was carried out in order to establish, at laboratory level, the effect of iron ions over the composition and performances of an active slurry used for biological treatment of waste water in petrochemical industry. A proximity effect of steel walls can be observed from the experimental results. This leads to the reduction of cleaning efficiency and increase of speed sedimentation for the studied slurry.

Key words: *active slurry, waste water, biodegradation, iron.*

Introduction

In general, the presence of active microorganisms placed nearby metallic recipient walls is studied from the degradation point of view. The bacteria producing acid, sulfate – reducing and the iron – oxidant bacteria are the ones responsible for damages (as equipments destruction and unjustified stops) estimated to 250 million $ per year, by their metabolism products [1]. This experiment studies the noxiousness of iron ions released from these surfaces, from active slurry biochemism point of view.

Materials and methods

For this experiment an active slurry was used, in exponential phase of development, derived from a biological cleaning container of waste water resulted from petrochemistry. The growth medium was the waste water from the feed point of container, with addition of nutrients, in this way the initial conditions of growth, also for pH, being reproduced. The type and quantities of nutrients are similar with those from the laboratory of the cleaning plant.

For the experiment bioreactors of 1L were used, with work volume of 0,6 L, maintained at the 30^0C, in order to increase the metabolic reaction rate. The laboratory conditions do not exceed the usual working conditions from the cleaning unit. The ratio active slurry/waste water was 15 mL/45mL and the sterilized solution of nutrients was added to this. The experiment lasted 6 hours and during this period the mixtures from bioreactors have been aerated and continuously stirred.

The vessels and tools which were in contact with slurry suspensions (containers for getting in and transport, bioreactors, stirrings etc) were made of glass. Thus, the measured values were not influenced by the supplementary iron ions. The metabolic reactions were carried out, in parallel, in four bioreactors with the following iron concentration: 0 (control sample) / 0.023 / 0.041 / 0.091 iongram/L.

For the appreciation of iron ions effect over cleaning capacity of microorganism: waste water, primary slurry, clarified water control sample and cleaned water in the iron ions presence were analyzed spectrophotometrically (with Spectrophotometer Biochrom WPA S800). The characteristic absorption of iron ions, placed in the beginning of the wave interval taken into consideration, was eliminated for each case (330 – 800 nm).

Results and discussions

For the appreciation of the biodegradation quality, the optic density values of sampling slurry and feed waste water, for length waves by 330 – 800 nm were established in the beginning.

The tendency of slurry for decantation with high speed in bioreactors containing iron ions was evident, compared with control bioreactor, before measuring the differences of pollutant biodegradation from cleaned water in those four bioreactors.

Decantation of active slurry suspensions after 6 hours incubation is shown in figures 1 and 2. In the standard bioreactor, the decantation is observed spectophotometrically after 4 minutes after stopping the stirring and is carried on very slowly. In the next 4 minutes, the decantation is about 32.33% for a decantation column of 4 cm.

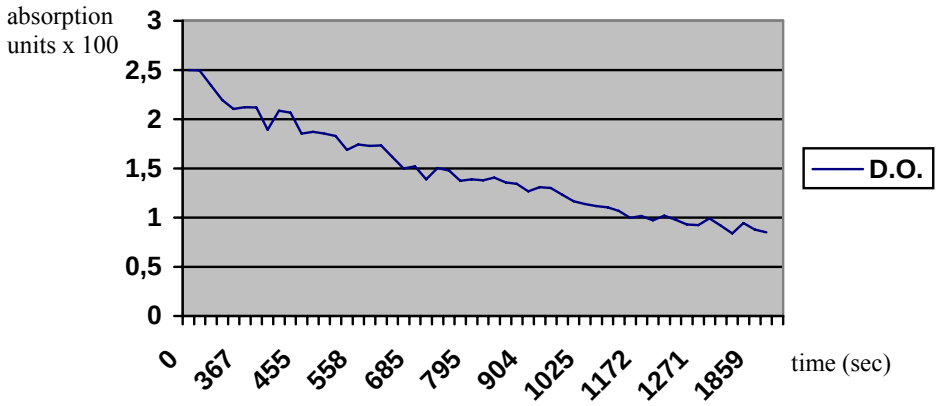

Fig. 1. Variation of optic density (D.O.) for active slurry in time (sec.) – in absorption units x 100 - without Fe3+, λ = 410 nm, after 6 hours

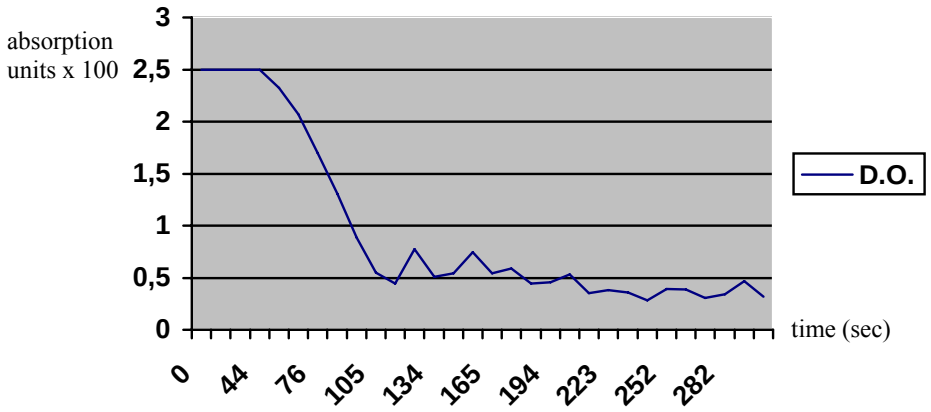

Fig. 2. Variation of optic density (D.O.) for active slurry in time (sec.) – in absorption units x 100 – with Fe3+, λ = 410 nm, after 6 hours

The values in table 1 represent the average of 10 measurements made for each case. The more the concentration of iron ions increases, the more the flakes disaggregate and the decantation is faster. For a concentration of 0,91 ion-gram/L during the first 4 minutes the slurry is almost completely decantated (99,98%).

Table 1. Decantation of active slurry after the first 4 minutes under iron ions influence (iongram/L)

Content of Fe3+ in suspension	Decantation after 4 min.
0%(control sample)	0%
0,025	22,60%
0,045	50,31%
0,091	99,98%

Comparing the optical density curves of initial waste water, submissive to cleaning, to those for resulted water, after 6 hours in bioreactors, in the presence of active slurry, the differences which denote the disappearance of pollutants from system can be obtained. The changes from the control bioreactor and also from the bioreactor which present the highest concentration of iron ions are showed in table 2.

Table 2. The experimental results of waste water biodegradation in the control bioreactor and in the bioreactor with the highest concentration iron ions. Δ D.O. represents the differences of optic density in absorption units.

λ (nm)	D.O. waste water	Δ D.O. clarified water			
		control sample	control sample, filtrated	Fe^{3+} 0,091 ionigram/L	Fe^{3+} 0,091 ionigram/L filtrated
330	0,064	0,082	0,078	0,125	0,106
335	0,065	0,117	0,099	0,117	0,118
340	0,065	0,091	0,094	0,129	0,124
345	0,057	0,077	0,105	0,121	0,125
350	0,051	0,092	0,091	0,114	0,125
355	0,050	0,074	0,102	0,111	0,128
360	0,050	0,066	0,096	0,108	0,130
365	0,047	0,073	0,097	0,098	0,132
370	0,043	0,091	0,100	0,097	0,131
380	0,041	0,086	0,102	0,072	0,130
390	0,028	0,076	0,111	0,084	0,140
400	0,023	0,050	0,114	0,082	0,143
410	0,017	0,081	0,109	0,066	0,132
420	0,019	0,052	0,105	0,054	0,123
430	0,019	0,040	0,101	0,061	0,118
440	0,022	0,041	0,105	0,060	0,118
450	0,018	0,076	0,106	0,047	0,119
460	0,014	0,053	0,100	0,041	0,112
470	0,012	0,063	0,100	0,049	0,108
480	0,010	0,057	0,098	0,049	0,108
490	0,010	0,040	0,091	0,037	0,100
500	0,010	0,029	0,101	0,056	0,112
550	0,009	0,053	0,091	0,052	0,096
600	0,004	0,032	0,078	0,039	0,085
650	0,027	0,041	0,070	0,041	0,073
700	0,010	0,055	0,084	0,042	0,083
750	0,001	0,040	0,074	0,042	0,074
800	0,001	0,044	0,069	0,033	0,069

Conclusions

The iron ions included in the system have a high contribution to slurry precipitation. The precipitation becomes easy observable from 0.91 iongram/L, when the decantation speed reaches 1 cm/min value. Near the metallic walls – pipes, tanks, cleaning container, decanters, aerating and stirring systems etc – in the presence of water and pollutant solutions, but especially in the presence of secretions of metabolites in microorganism medium, the eliminated iron ions increase significantly the decantation speed of slurry.

The microscopic analysis shows that the flakes disintegrate, due to modifications which appear at the zooglee level**.** The results from table 1 show a clear proportionality between the iron ions content from the bioreactor and the elimination of slurry from the system. In the last phases of the cleaning cycle, when the contact with microorganisms is finished, the metallic recipients represent an advantage in excluding the slurry from biological cleaning containers.

Efficient and continuous stirring of reaction mixtures – which cannot be realized in industry – significantly improves the cleaned water quality, even if of iron ions are prsent – nearby metallic walls which contain this element. One part of the remaining compounds, in cleaned water or resulted from the microorganism metabolism is retained by filtration. This can be observed from the values of optical density presented in table 2.

References

1. Tunaru Mariana, Dragomir Maria, Dragomir, S., Voicu Anca - *Implicarea coroziunii induse microbiologic in sistemele centralelor electrice nucleare*, Forumul Regional al Energiei – FOREN-Neptun, 15-19 iunie, 2008, Cod lucrare SP-64-ro, www.cnr-cme.ro/foren2008/CD_ROM_1/poster_ro/pdf/Sp-64-ro.pdf.
2. Micu Andra Mihaela, Niculae, Gh., Rusen Rodica - *Consideratii teoretice privind cai de biotransformare a unor xenobiotice*, Buletinul Universitatii Petrol – Gaze Ploiesti, vol.LVII, Seria Tehnica Nr.2/2005.
3. Niculae, Gh., s.a. - *Valorificarea metalelor rare din catalizatori uzati prin procese biotehnologice* - lucrare de cercetare - ZECASIN S.A Bucuresti, mai, 1993.

Efectul ionilor Fe^{3+} asupra performanțelor unui nămol activ utilizat la tratarea apelor uzate rezultate în industria petrochimică

Rezumat

Experimentul s-a efectuat pentru a se stabili, la nivel de laborator, rolului ionilor de fier asupra compozitiei si performantelor unui namol activ utilizat la epurarea biologica a apelor uzate provenite din industria petrochimica. Datele obtinute au pus in evidenta existenta unui efect de vecinatate al peretilor din otel, care duce la diminuarea eficientei epurarii si la cresterea vitezei de sedimentare pentru namolul studiat.