Study on NO_2^--N accumulationof soybean wastewater treatment by SBR process

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Abstract. The bean products wastewater treatment process has been studied by SBR. Theexperimentstudied effective of reaction timeunder low dissolved oxygen on SBR system. The experimental result indicated that under the condition of influent COD is 330～460mg/L, the reactor has a good degeneration ability of COD, NH_4^+-N、PO_3^--P、 NO_2^--N、NO_4^{3-}-P. And NO_2^--N accumulation reached a maximum after aeration 3 hours, Aeration and time were saved effectively while stop the aeration at this time, thus power and costs were saved.

Soy products food are made from soybean bean, broad bean, mung bean as the main raw material. Most soy products are made from soy bean curd, which is made from the fight of soy bean curd and its recycle products. Organic compounds (protein, starch, sugar, amino acid) in the production process of bean products are very high and easy to corrupt, not only containing harmful substances and easy degradation, but also it weak acid wastewater [1]. Production of wastewater directly efflux not only cause very serious environmental pollution, but also impact on people's living environment.

Bean products are rich in nutrition and high nutritional value. Contains a large number of protein and amino acids. It also has a good health care function, improve human immunity, prevention of osteoporosis and so on. Because of bean products has many tastes and diverse practices that more and more people regard it as daily snacks and cooking food. Therefore, the more people demandof bean products, The worse production of bean wastewater, which makes it urgent to strengthen and improve the processing technology of beanwastewater. [2-6]. At present, the treatment of bean wastewater of domestic and international mainly uses the biological treatment method has UASB, A_2O, contact oxidation method, biological turntable and other processes [7-9]. But most of them areExpensive equipment, installation of high technical requirements, the management is complex, covers a vast area.Using SBR has the process simplely, the strong capacity sewage treatment,flexible operation, easy automation, etc. On the contrary, it cover an area of area small. It is a more economical and practical wastewater treatment process in treatment of bean products wastewater[10].

1 Materials and methods

1.1 Experimental raw water sources and raw water data

Experimental wastewater came from a bean product Processing workshop in Harbin, the specific raw water datashown in table 1.

Table 1raw water data（mg/L）

COD	NH_4^+-N	PO_4^{3-}-P	NO_2^--N	NO_3^--N
2000~2500	55~110	6.1~11.3	0.03~0.87	0.16~1.01

1.2 Experimental device and method

1.2.1 Experimental device

The experimental device is an independent SBR reactor, and it is made of organic glass. Upper part of the reactor is cylindrical (with a scale) and the lower part of the cone (with anaeration head) on the hob. It is high 500mmand diameter 200mm. It has 12L effective volume and 8L drainage volume, the water filling ratio is 0.75. In the vertical direction of the cylindrical wall of the reactor with the five sampling portsinterval 10mm that uses ball valve to control sampling and drainage. There is a vent pipeat the bottom which control valve and vent mud. The aeration head is usedas a micro-porous aerator, and the aeration quantity is regulated byrotameter.

Specific experimental device as shown in Figure 1-1

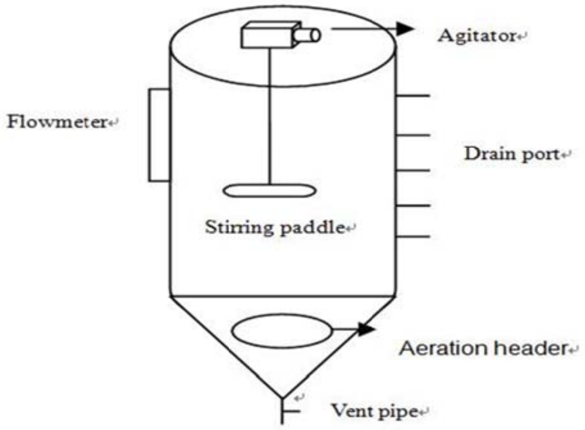

Figure 1-1 experimental device

1.2 Experimental detection methods

In this experiment were analyzed the COD, NH_4^+-N, PO_4^{3-}-P, NO_2^--N, NO_3^--N.The detection method is shown in Table 2

Table 2Monitoring items and detection methods

Monitorinitems	detection methods
NH_4^+-N	Nessler's Reagentspectrophotometry
PO_4^{3-}-P	Molybdenumantimony Spectrophotometry
NO_2^--N	N-(1-naphthyl) ethylene diaminespectrophotometry
NO_3^--N	Spectrophotometric Determination of Musk
COD	Microwave digestion method

1.3 Experimental operating conditions

In this study, the first wasanaerobic mixing, and then controlled the operation of low dissolved oxygen aeration.First of all, it wasthe Acclimation of Activated Sludge, a total of 60d. In the sludgeacclimation period, it includedtwo cycles every day, and 6 hours per cycle. Each cycle includes six stages: inlet water, oxygen and oxygen mixing, aerobic aeration, static precipitation, drainage and idle standby (different stages of different stages of time).And instantaneous water 0.5h, anoxic agitation 0.5h, aerobic aeration 3h, precipitation 1h, drain 0.5h, stand 0.5h. During the experimental stage, it is a cycle with 8h per day,andthe cycle includes instantaneous water 0.5h, 0.5h oxygen, aerobic aeration 3.5h, precipitation 2.5h, drain 0.5h, stand 0.5h. After the end of the cycle dischargea certain volume of slurry mixture to keep the sludge age in 10d~15d, SV in about 30%, SVI in the 100mL/g,and MLSS in about 3000 mg/L.

1.4 Parameter control

The temperature of anaerobic reactor is controlled at 20+1℃, the aeration rate is 0.5m^3/h, the stirring rate is 130r/min, the pHis controlled within the range of 6~9

2 Results and discussion

Experiments for SBR treatment of bean products wastewater under low dissolved oxygen conditions, analysisconcentration of COD, $NH_4{}^+$-N, $PO_4{}^{3-}$-P, $NO_2{}^-$N, $NO_3{}^-$-N five indicators changes in a running cycle and the energy-saving on maximum moment of $NO_2{}^-$-N in the shortcut nitrification process.

2.1 The effect of reaction time on the removal efficiency of COD,$NH_4{}^+$-N, $PO_4{}^{3-}$-P, $NO_2{}^-$-N and $NO_3{}^-$-N in the reactor system

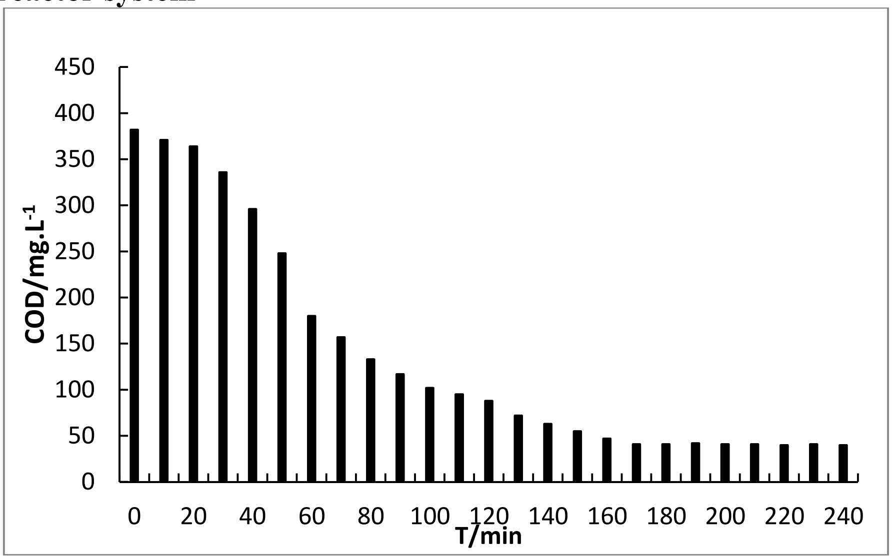

Figure2-1 Effect of reaction time on the removal efficiency of COD

As shown in Figure 2-1, after the raw water inlet, the COD concentration in the reactor decreased rapidly, because of dilution effect. After stirring for half an hour the COD removal rate was very low only about 11.63%, aeration at 1 h, COD removal rate can reached around 55.26% and aeration for 2 h, the COD removal rate was 76.58%, and aeration 3h, removal rate was about 85% ~ 90%, the COD removal rate can be seen aeration in for about 3 hours to COD removal rate of the most high and removal effect is very obvious.

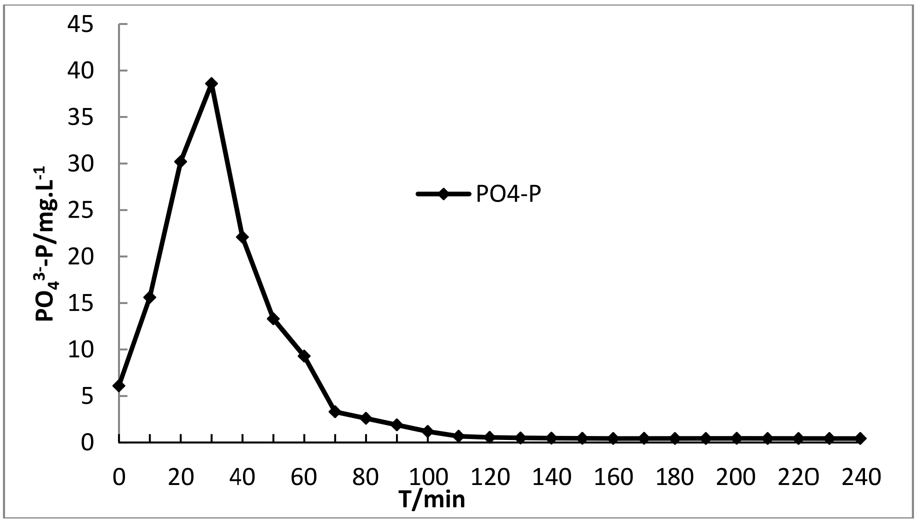

Figure2-2 Effect of reaction time on removal efficiency of PO_4^{3-}-P

As shown in Figure 2-2, with the increase of reaction time in anaerobic mixing stage PO_4^{3-}-P rapidly increased, and the aeration stage gradually decreased until close to zero. It is mainly because of thePAOsphosphorus releasein the anaerobic phase.

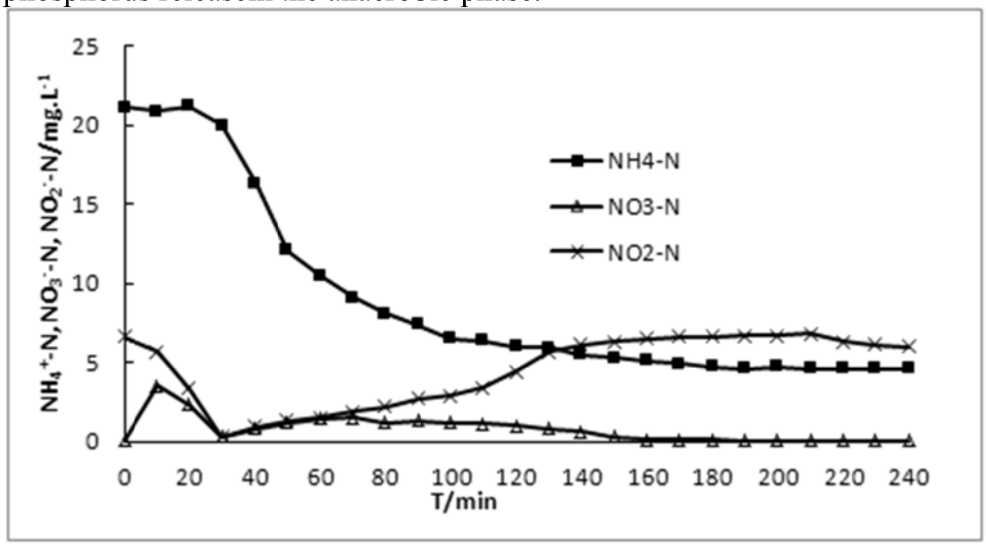

Figure2-3Effect of reaction time on removal efficiency of NH_4^+-N, NO_3^--N, NO_2^--N

As shown in Figure 2-3, The NH_4^+-N decreased slowly during the anaerobic mixing reaction, while NO_2^--N and NO_3^--N both decreased rapidly to almost zero. This is because the denitrifying bacteria change NO_3^--N and NO_2^--N into N_2 in the anaerobic phase.After the start of aeration, the NH_4^+-N was decreased rapidly, and the reasonisnitrification bacteria converted NH_4^+-Ninto a few NO_3^--N and of large number NO_2^--N. With the reaction time, the NO_3^--N appeared small fluctuation and the NO_2^--N increased gradually. The NO_2^--N without increased at the time of aeration 3h.

2.2 Energy saving

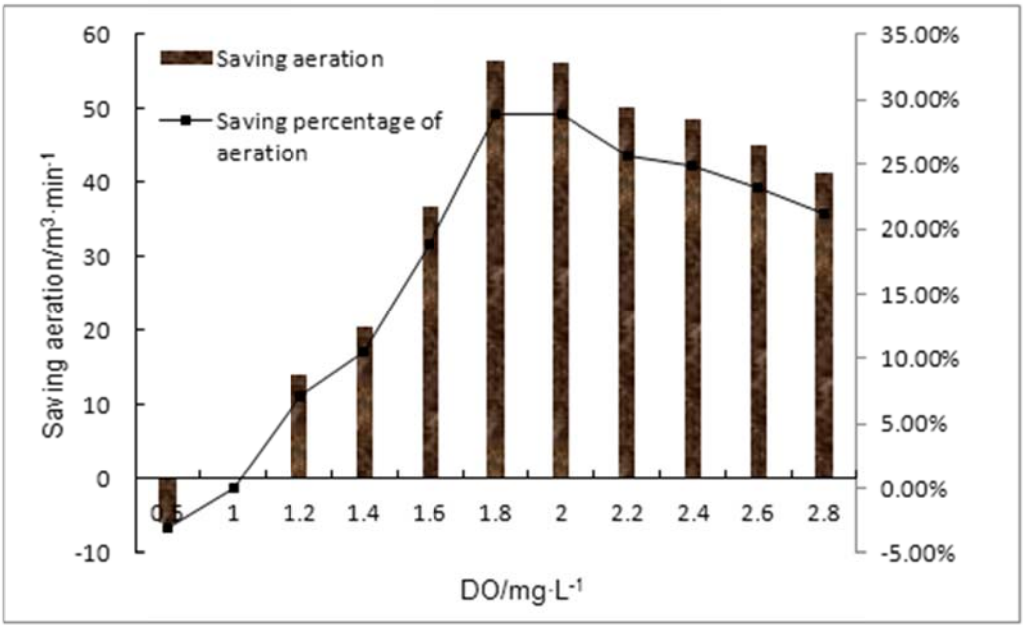

Figure2-3 saving aeration under different DO conditions

As shown in Figure 2-4, the amount of saving aeration with the increase of DO first increased and then decreasedunder different dissolved oxygen conditions.DO value in the range of 1.6~2.2mg/L savings reached 18%~28%. In the process of NO_2^--N accumulation, it is guaranteed that the DO value is less than 1.6~2.2mg/L, which can effectively save the amount of aeration.Thus save the electric energy.

3 Conclusion

(1) Under the condition of low dissolved oxygen, the COD decreased with the increase of reaction time, and it is basic stability about reaction was 3.5h.

(2) Under the condition of low dissolved oxygen, the NH-N was degraded with the increase of reaction time. TheNO_2^--N was accumulated slowly along with aeration time. The NO_3^--Nchanges small fluctuation with aeration time and almost disappeared in the end.

(3)Under the condition of low dissolved oxygen, the amount of NO_2^--Naccumulated was the maximum in aeration 3hwhen the DO was about 1.6~2.2mg/L. It reduce the aeration time effectively when the aeration control in the nitrite nitrogen stage. Thus save the electric energy.

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