# Construction And Application of Sequencing Batch Double-Cycle Recirculating Aquaculture System

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## BACKGROUND

In order to improve the water treatment stability of industrial recirculating aquaculture system, increase the stocking density and survival rate, a sequencing batch double-cycle industrial recirculating aquaculture system was constructed. Hydraulic retention time was increased with sequencing batch biofilter for fully degradation of nitrogen pollutants. Solid particulate matter was removed continuously by arc screen. The start-up of the system and its effect on high density grouper culture was investigated.

## MATERIALS AND METHODS

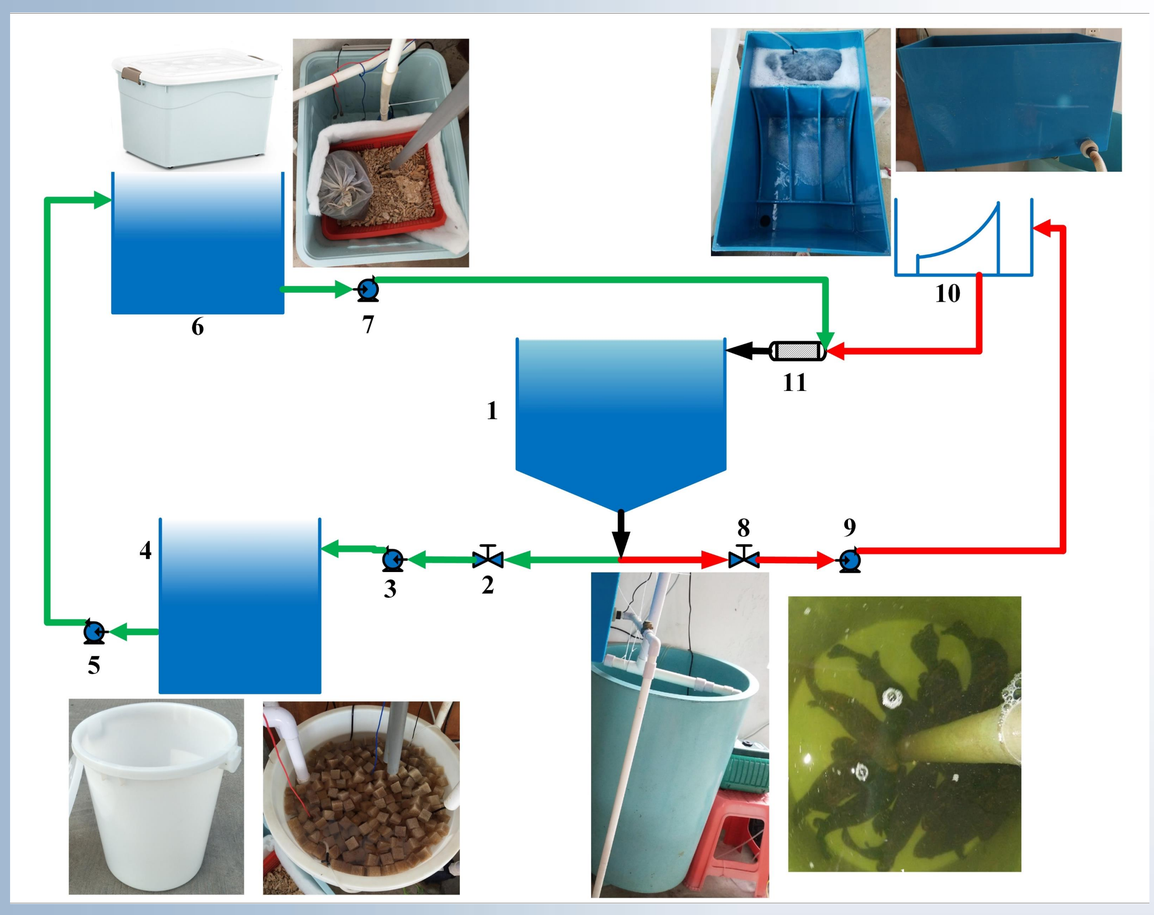


Fig. 1 Diagram of sequencing batch double cycle industrial aquaculture system (1. breeding barrel; 2, 8. ball valve; 3, 5, 7. 9. pump; 4. biofilm reactor; 6. balance tank; 10. arc screen; 11. UV sterilizer)

Note: Cycle 1 (the green route): breeding barrel 1- biofilm reactor 4- balance tank 6- UV sterilizer 11- breeding barrel 1.
Cycle 2 (the red route): breeding barrel 1- arc screen 10- UV sterilizer 11- breeding barrel 1.

## RESULTS

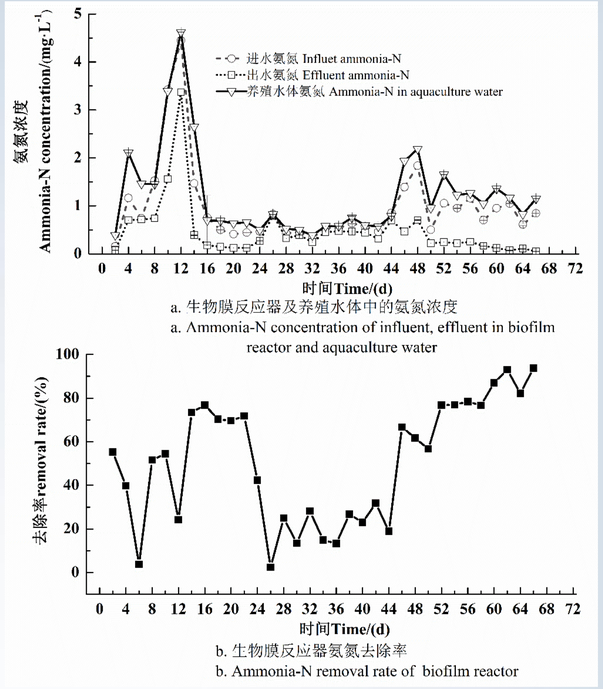


Fig. 2 Concentration of ammonia nitrogen and nitrite nitrogen in aquaculture water and the removal rate of ammonia nitrogen and nitrite nitrogen by biofilm during aquaculture

Tab. 1 Comparison of aquaculture results among different recirculating aquaculture systems

| 养殖品种 Culture species | 初始质量 Initial weight/ g/fish | 成活率 Survive rate/% | 养殖密度 Stocking density/ kg/m³ | 养殖水质 Water quality/mg/L | | | 文献 Refere-nce |
|---|---|---|---|---|---|---|---|
| | | | | 氨氮 Ammonium nitrogen | 亚硝酸盐氮 Nitrite nitrogen | 硝酸盐氮 Nitrate nitrogen | |
| 半滑舌鳎 Cynoglossus semilaevis | 305 | 98 | 40.00 | <0.2 | <0.1 | — | 10 |
| 澳洲宝石斑鱼 Scortum barcoo | 153 | 95.90 | 35.20 | <2 | <0.5 | — | 11 |
| 美国红鱼Sciaenops ocellatus Linnaeus | 202.37 | 90.91 | 28.65 | 0.5 | 0.1 | 63.58 | 12 |
| 云纹石斑鱼 Epiuephelus moara | 50 | 93.50 | 49.90 | 0.22 | 0.012 | — | 13 |
| 红鳍东方纯 Takifugu rubripes | 632.5 | 98.70 | 32.17 | 0.5-1.2 | 0.2-0.5 | — | 14 |
| 罗非鱼 Oreochromis niloticus | 24.17 | 100 | 36.87 | 19.0-20.0 | <0.97 | 70-100 | 15 |
| 半滑舌鳎 Cynoglossus semilaevis | 305 | 97 | 45.00 | 0.012 | 0.044 | — | 16 |
| 红鳍东方纯 Takifugu rubripes | 160 | 98 | 31.20 | 0.2-0.3 | <0.1 | — | 17 |
| 虎龙斑Epinephelus fuscoguttatus♀× Epinephelus lanceolatus♂ | 273 | 100 | 60.78 | 0.05 | 0.1 | 46.98 | 本试验* |

Tab. 2 Weight gain of grouper during aquaculture

| | 1 d | 35 d | 66 d |
|---|---|---|---|
| 平均重量 (g) Average weight | 273.00±12.22 | 400.98±62.21 | 552.52±107.04 |
| 养殖密度 (kg/m³) Stocking density | 30.03 | 44.11 | 60.78 |

## CONCLUSIONS

During the start-up period, it takes about 22 days to cultivate bio-film in sponge fillers using the method of inoculation with nitrifying biofloc. The mature biofilm showed high nitrogen removal efficiency. The concentration of ammonia nitrogen in effluent approached 0 mg/L, and the concentration of nitrite nitrogen was about 0.1 mg/L. After the biofilm was matured, grouper culture experiment was carried out with 30.03 kg/m$^3$ as the initial stocking density. After 66 days culture experiment, the average weight of grouper increased from 273 ± 12.22 g to 552.52 ± 107.04 g, and the final stocking density reached to 60.78 kg/m$^3$. The removal rates of ammonia nitrogen and nitrite nitrogen was gradually increased from 13.33% and 14.84% to 93.73% and 93.50%. In addition, it was found that the combination of foam separation and arc screen to form an aerated arc screen can remove fine particles and decreased the turbidity of the culture water obviously. The sequencing batch double-cycle industrial recirculating aquaculture system has good application in high-density grouper culture.