

Facility & Technology of Water Recirculating Aquaculture

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Outline



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III. Aquaculture management mode

IV. Recirculating aquaculture equipment based on
energy saving and environment friendly

V. Summary



I. General introduction

Development process of facility fishery:

Stage 1. Pond culture



Stage 2. Natural flowing water culture



Stage 3. Flowing water with controlled temperature culture



Stage 4. High density still water with increased oxygen culture



Stage 5. Enclosed recirculating fish culture



Stage 6. Automatic fish culture



1. Industrialized aquaculture overseas

- In developed countries, industrialized aquaculture techniques become more popularization, maximization and industrialization .
- Many aquaculture industry have already been in the stage of “***enclosed recirculating fish culture***” and “***automatic fish culture***” .

Micro-algae culture overseas

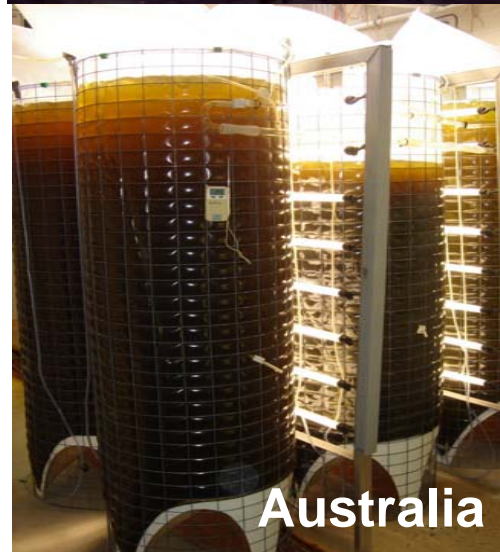
青
島
大
學



Israel



Spain



Australia



South Africa



Norway

青
島
大
學

Marine cage culture overseas



Inshore cage culture in Norway



Salmon culture in Canada



On-line monitoring & operating system



Open sea cage culture in Spain

Recirculating aquaculture overseas



Water treatment equipment in Spain



Land-based seed breeding in Norway



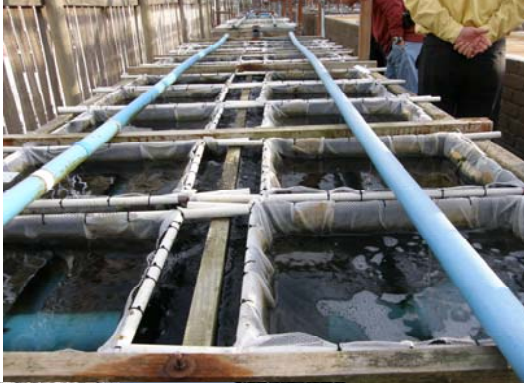
Halibut culture in Spain



Hatchery in Canada

Abalone culture in South Africa

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2. Industrialized aquaculture in China

- Developed rapidly in recent years
- Techniques begin to transform from “imitate & follow” stage into “independent innovation” stage
- Present status of industrialized aquaculture are still at primary stage, **only very few** projects reach to “enclosed recirculating culture” stage.



Problems

- late beginning, small scale
- lag in technology, waste resources
- poor practicability and reliability of equipment
- low intelligent and automatic level
- serious pollution
- inadequate re-exploit of equipment function



Marine micro-algae culture in China



Cement tank culture



Tank culture
(glass fibre reinforced plastic)



Independent column culture



Industrial culture by photo-bioreactor

Land-based aquaculture company in China



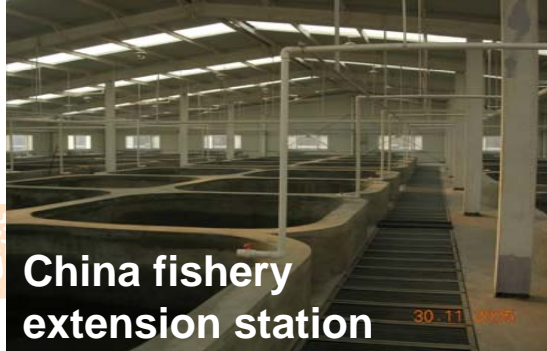
Haiyang Cun
shellfish hatchery



Fuzhou Bay
hatchery



Gaizhou
Culture factory



China fishery
extension station



Zhanjiang
Shrimp hatchery



Bangchuidao Group
Sea cucumber factory



Zhuanghe
hatchery



Lushun Beihai
Fish culture factory



Guangdong Yuehai
Shrimp hatchery



II. Recirculating aquaculture technology

1. Land-based aquaculture VS. Industrialized aquaculture

➤ **Land-based aquaculture method** is utilizing high-tech to control the main factors of aquaculture environment (including water temperature, water quality, feed, sterilization and water treatment) to get high density, high survival and growth rate. But this method neglect the characteristic of industrial, still belong to **agriculture category**.

➤ **Industrialized aquaculture** belong to industrial category should have three characteristic: **planning, stability, standardization**. eg. biological-pharmacy industry and beer industry.

2. Technology design based on ecological habit

- different organisms need for different culture facility
- professional culture technology is clustering the different aquatic animals into several types based on their ecological habit first
- and then designs suitable facilities for each type

At present, a series of professional facilities have been exploited by our company.

Dalian Huixin Titanium Equipment Development CO.LTD

- Research Center for Facility Fishery Engineer of Liaoning province
- National High-tech Enterprise
- The member of Chinese Society for Ocean Environmental Sciences and China Society of Fisheries
- Engaged in industrial aquaculture technology, engineer design, equipment manufacture

Products:

- Enclosed and continuous micro-algae culture system
- Controlled and ecological tank system
- Complete equipment for aquarium and seafood stocking
- Live fish transport system

A. Photo-bioreactor -- microalgae & photosynthetic bacteria

Nitzschia closterium:
40-70million cells/ml
Chlorella:
200-400million cells/ml



Primary amplification machine



Secondary amplification machine

Dicrateria zhanjiangensis:
20-40million cells/ml
Chlorella:
200-400million cells/ml



Micro-algae culture system (magnetic stir)



Production-level photo-bioreactor

Dicrateria zhanjiangensis:
10-20million cells/ml
Chlorella:
80-150million cells/ml



B. Cycling kettle -- larvae & zooplankton



Scallop:
30-70 inds./ml



Sea cucumber:
10-30 inds./ml

C. Multilayer tank -- zoobenthos (sea cucumber, sea urchin, abalone)



40-50g Abalone: 40 inds./unit



3-5g Sea urchin: 400 inds./unit



9 layers water recirculating culture system



5-10mm Sea cucumber: 400g/unit



D. Cycling water pond--small swimming animal & seed transition

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200-500g Flounder: 30kg/m³



300-500g Rainbow trout: 35kg/m³

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E. Cycling water pond (channel and cage inside)--large swimming animals

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40-50 kg/m³

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3. Result control & Process control



Result control:

- based on controlling the water quality parameters, such as T、COD、pH、 NH_4^+ *et al.*
- delay to the response, strong fluctuation of water quality
- passive adjustment

Process control:

- based on controlling the equipment
- keep water flow, air flow, water level , turbidity and residual diet condition within a rational range
- active adjustment



Equipments for result control



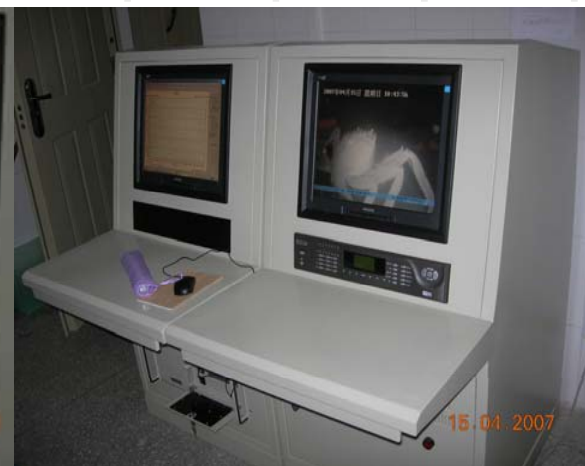
Alarm device



DO, pH,
Eh monitoring meter

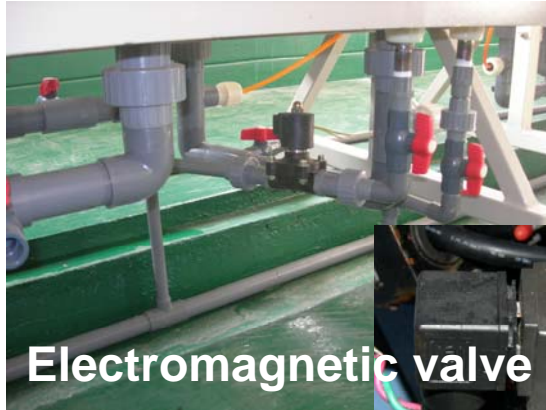


Underwater camera



On-line monitoring & operating system

Equipments for process control



Electromagnetic valve



Magnetic induction
Water Level Meter



Metering pump



Gas flowmeter



Voltage & flow control
pump



Inverter



Liquid flowmeter

III. Aquaculture management mode



- Enclosed recirculating culture system builds a controllable ecosystem through utilizing high-tech to control the main factors of aquaculture environment
- Many culture modes can be developed based on this system:



A. counter-season culture mode



B. whole year culture mode

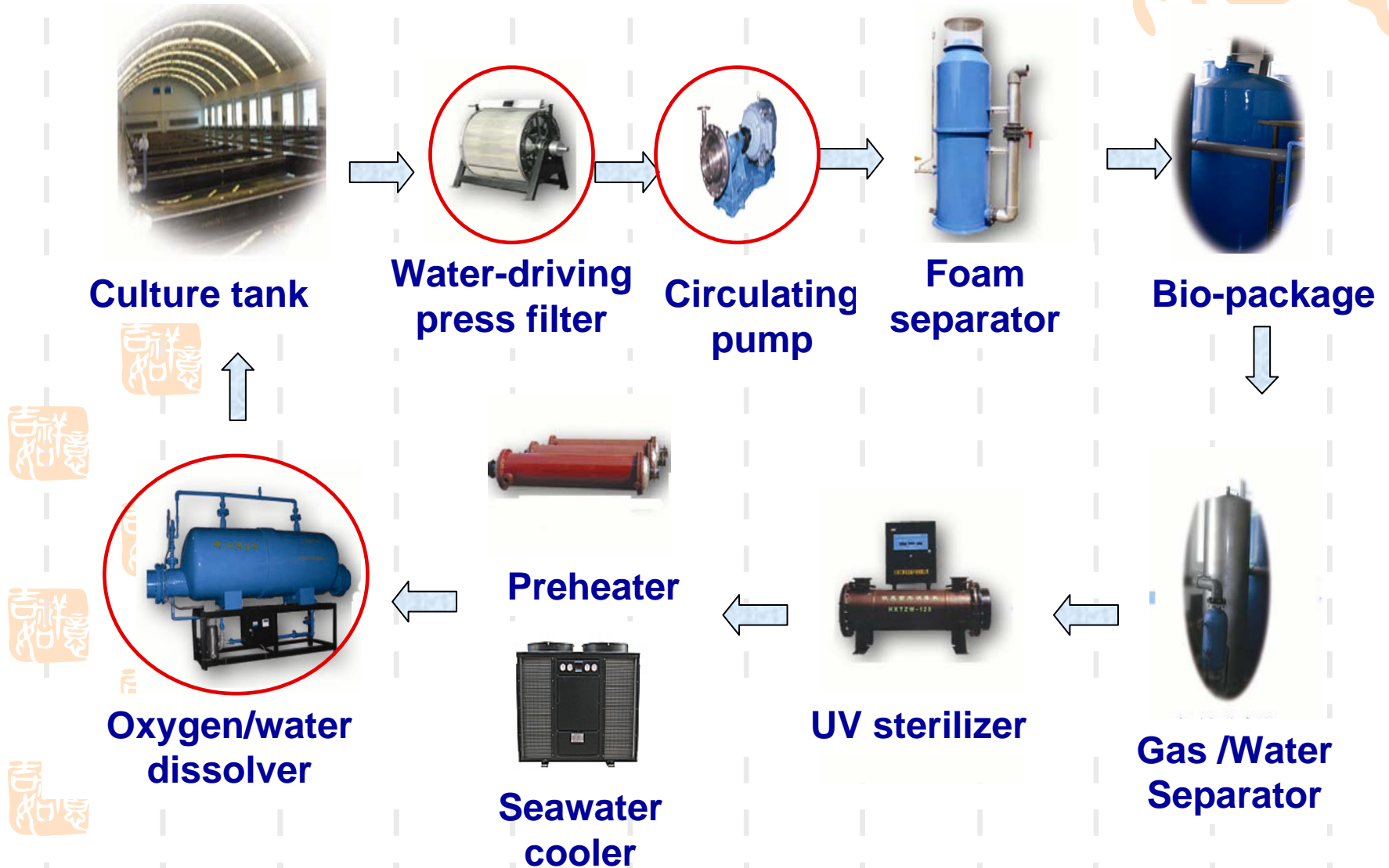


C. co-operation culture mode



IV. Recirculating aquaculture equipment based on energy saving & environment friendly

Technological process and equipment configuration

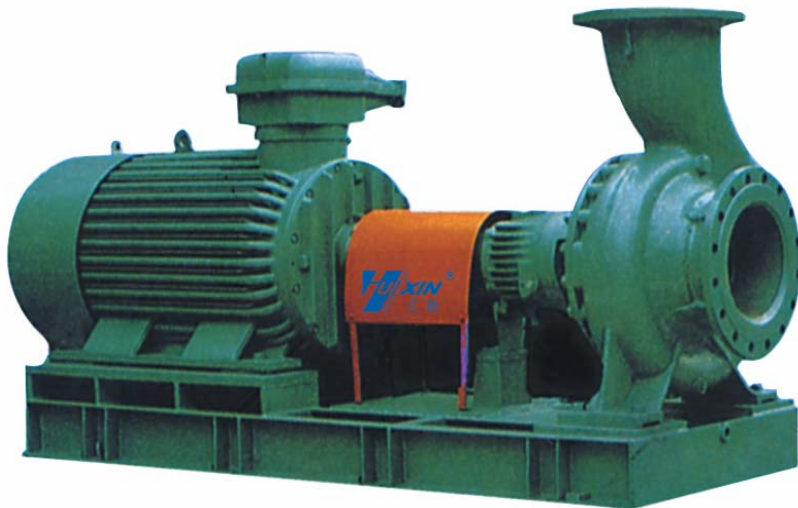


1. Application of the energy saving equipment

A. Energy-saving technique of water pump

- lift
- decrease lift : reduce the horizontal position difference of intak point
- advective technology

Take a water pump (100m³/h) for example, a decrease in 1m lift will lead to input power decrease about 0.75kw, water pump with large flow and low lift can save 30-50% energy than common technology.



B. Frequency conversion technology

- The water pump and oxygen pump run on rated speed for 24 hours, when the concentration is high enough, it will cause energy waste.
- Using the frequency conversion technology, the energy-saving rate can reach 30~50%, water-saving rate can reach 10~20%.



Blower



Frequency conversion machine



Roots Blower



Circulating water pump

C. Oxygen increasing technology

For 1000m³ water body:

	Oxygen level (mg/L)	Consumption	Expenses (yuan /d)	utilization rate
Air pump	5~7	2.2~4kw /d	52~96	2~6%
Pure oxygen	8	20~30kg O ₂ /d	40~60	60%



Liquid oxygen



Oxygen/water dissolver



Oxygen making machine

D. Water-driving press filter technology

- water geopotential energy as power resource
- no motor and deceleration machine inside
- annual electricity saving about 9000-10000 kWh



Water-driving press filter



V. Summary

Water recirculating industrialized aquaculture is a systematic project, it needs the cross use of multi-disciplines as the technical support. As for a concrete project:

- The investment intensity, capability of energy-saving and economic benefit are mainly depend on the choice of culture technology, management mode and suitable “project seed”
- The use of suitable water treatment equipment and water recycling control method are the main factor of the running cost and energy-saving efficiency.

A large school of silver fish swimming in clear blue water under a bright sun. The fish are densely packed and appear to be moving in a coordinated pattern. The sun is visible in the upper center, creating a bright glow and casting light rays through the water.

Thanks!