# استزراع الأسماك
# الرابع/ قسم الأسماك والثروة البحرية

اعداد

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**المحاضرة الثامنة**

# تربية الأسماك في الانظمة المغلقة

النظام المفتوح — الانتاج في المياه الطبيعية

النظام شبه المغلق — الماء من مصدر طبيعي يمر خلال النظام مرة واحدة ويعود للمصدر

النظام المغلق — الماء يستمر بالدوران دون تبديل عدا تعويض النقص

## المكونات الاساسية للنظام المغلق

الترشيح

غرف الاستزراع

انواع المرشحات

الترشيح : فصل الخليط الى مكوناته

انظمة الترشيح

سائل & سائل

سائل & صلب

سائل & غاز

غاز & صلب

غاز & غاز

صلب & صلب

سائل & غاز& صلب

طريقة الفصل

الكثافة

حجم الحبيبة

الخواص الكيماوية

الخواص الكهربائية

الخواص المغناطيسية

الترشيح الميكانيكي

وظائفه | تقليل الكدرة | تقليل الغرويات العضوية | ازالة المواد المتراكمة

انواعه | المرشحات الرملية | الغربال الثابت | الغربال الدوار

بشكل طبقات | القمة رمل ناعم (2- 0.2 ملم ) | القاعدة حصى | لايزيل حجم اقل من 30 مايكرون

يعمل بطريقتين | حجز المواد العالقة | جذب الغرويات (اختلاف الشحنة )

تنظيف المرشح | تكون طبقة سميكة على السطح

انخفاض سرعة جريان الماء

انخفاض تركيز الاوكسجين الذائب

الغربال الثابت | يوضع عبر مجرى الماء | يصنع من فولاذ او قماش | تنظيف دوري بعكس اتجاه الماء

الغربال الدوار | غربال نصفه في الماء ونصف خارج الماء (رشاش باتجاه معاكس)

الترشيح البيولوجي

التخلص من المواد الايضية الذائبة

التحويل البكتريولوجي للمركبات الناتروجينية العضوية الى نترات

الامونيا ← نتريت ← نترات

| | | |
|---|---|---|
| Ammonification | تكسير البروتين الى احماض امينية | مرحلة 1<br>بكتريا لاذاتية التغذية |
| Deamination | تحول مركبات عضوية الى مركبات غير عضوية (امونيا غير متاينة و$CO_2$) | |
| Nitrification | اكسدة بيولوجية للامونيا الى نتريت ونترات | مرحلة 2<br>بكتريا ذاتية التغذية |
| Denitrification | اختزال النتريت (نترات) الى اوكسيد النتروجين | مرحلة 3<br>بكتريا ذاتية التغذية |

تحتاج اوكسجين

Nirosomonas

$$2NH_3 + 3.5\ O_2 \longrightarrow 2NO_2 + 3H_2O$$

Nitrobacter

$$NO_2 + O_2 \longrightarrow NO_3^-$$

$NH_4^+$ متاين

$NH_3$ غير متاين — سام بتركيز اقل من 1ppm — اجهاد بتركيز 0.006ppm

النتريت — اقل سمية من الامونيا 30 - 40ppm — مركب وسطي يزداد في بداية عمل المرشح

النترات — غير سام بتركيز 400ppm

ظروف المرشح البيولوجي هوائية لعمل البكتريا — توفر مساحة سطحية كبيرة لنمو البكتريا

الاوساط المرشحة : الحصى الخشن - بلاستك – فلين

الترشيح الكيماوي | ازالة المواد خاصة العضوية الذائبة من المحلول عن طريق الامتزاز او التجزئة او الاكسدة

الامتزاز | تراكم او تركيز المواد على السطح او بين سطحين (سائلين – سائل وغاز – سائل وصلب ...)

غرف الاستزراع | صغيرة – بلاستك – فايبركلاس – حديد – خشب

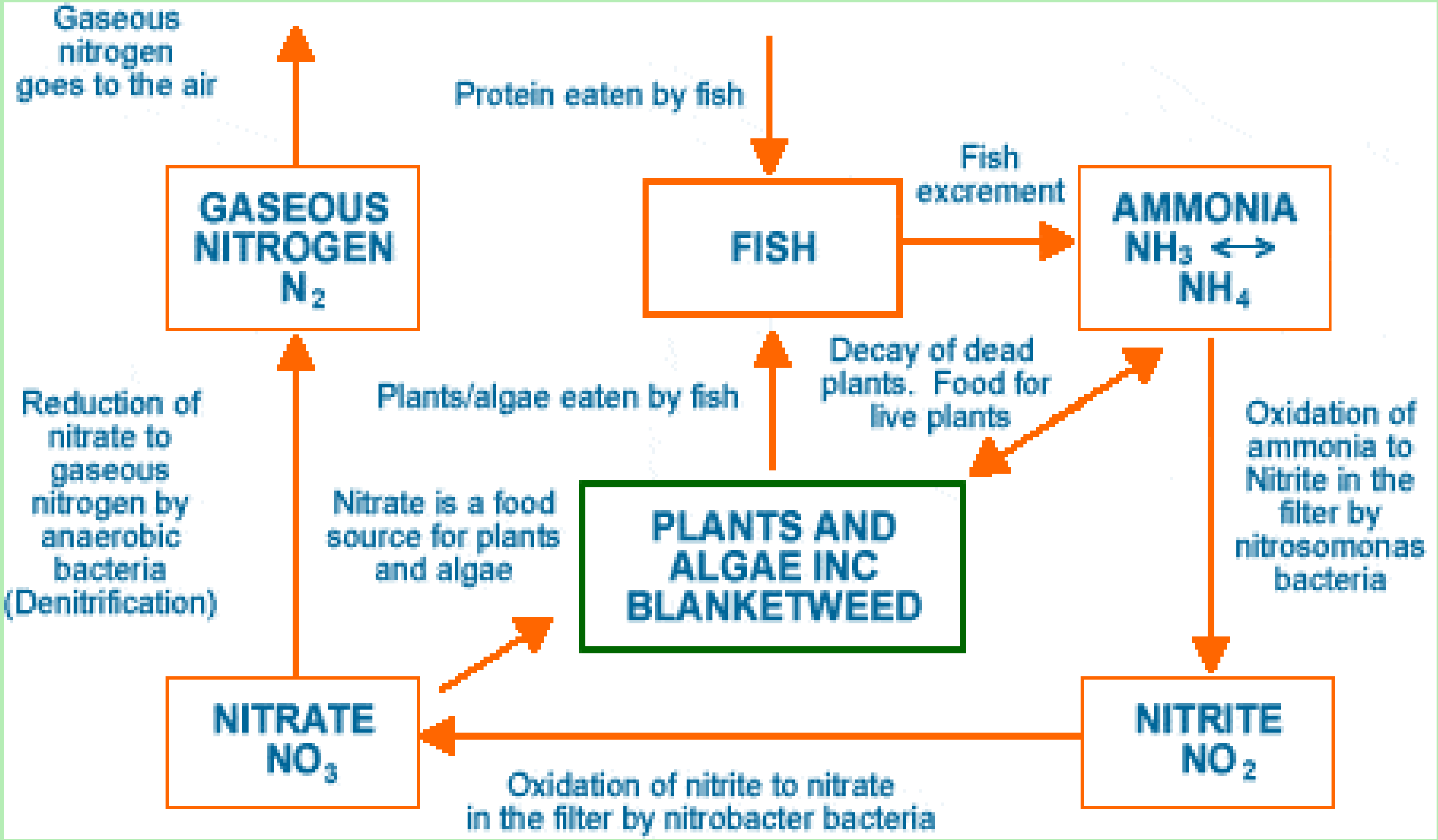
غرف الترسيب الاولي | لغرض استقرار الفضلات

مزايا النظام المغلق

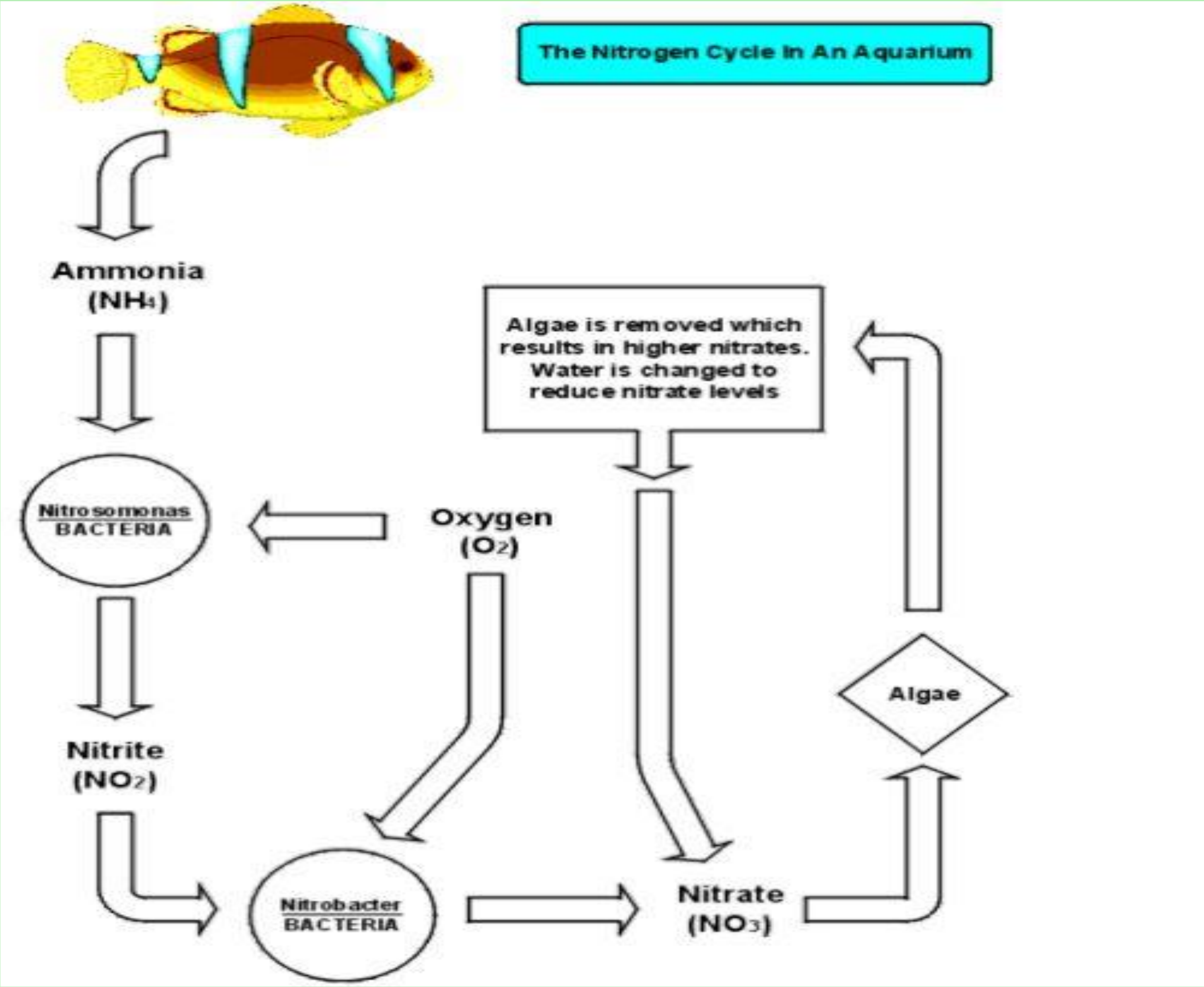
الاقتصاد في كمية الماء

السيطرة على بعض العوامل البيئية

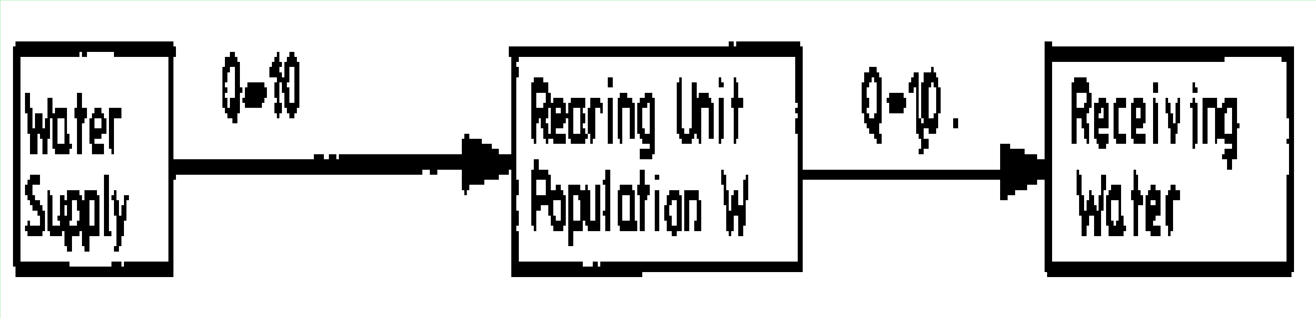
سهولة المعالجة ومكافحة الامراض والطفيليات



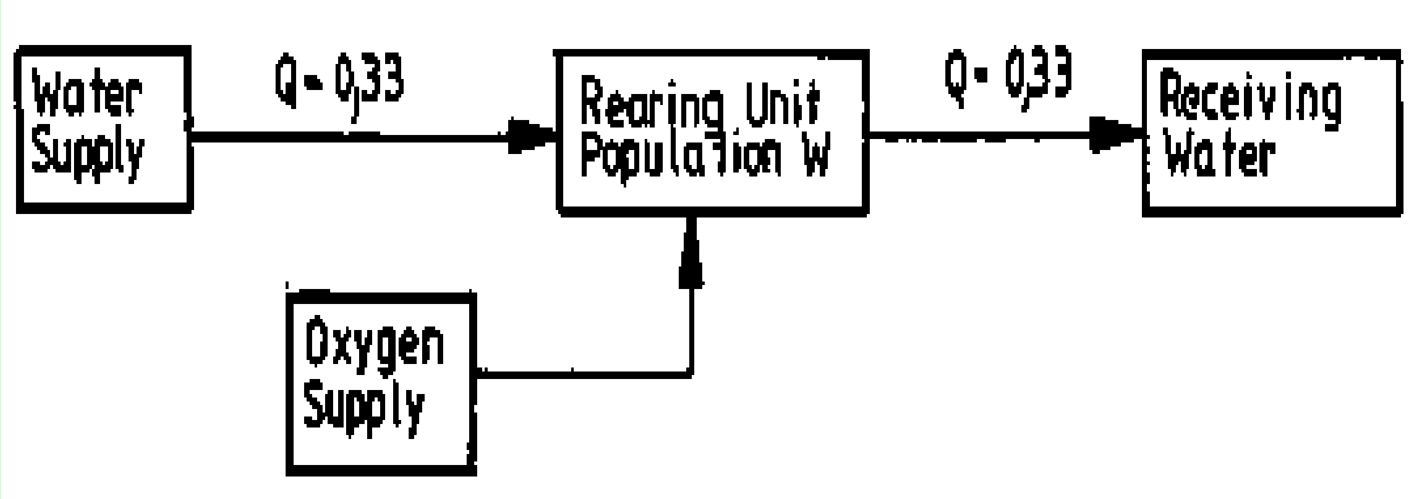

دورة الامونيا في البيئة المائية



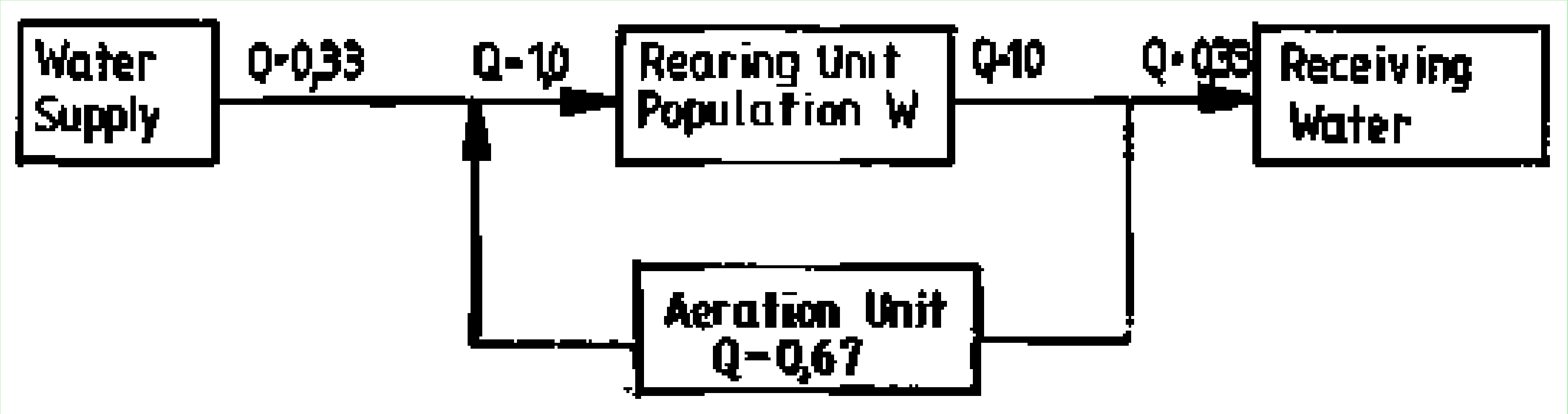
The Nitrogen Cycle In An Aquarium
Ammonia
(NH4)
Algae is removed which results in higher nitrates. Water is changed to reduce nitrate levels
Nitrosomonas
BACTERIA
Oxygen
(O2)
Algae
Nitrite
(NO2)
Nitrobacter
BACTERIA
Nitrate
(NO3)



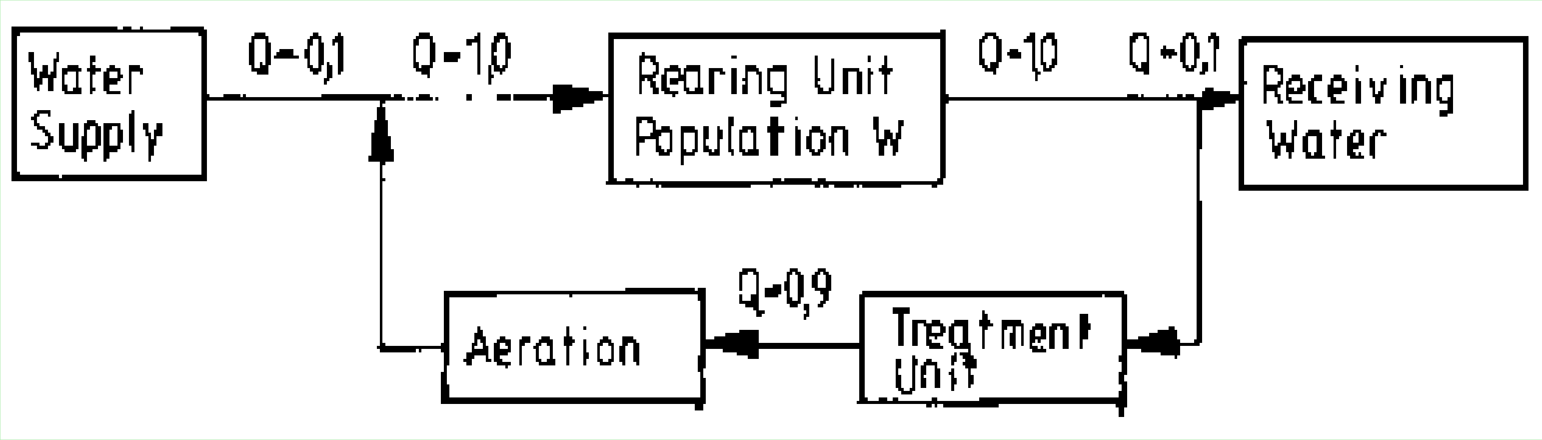

**Single-pass system**



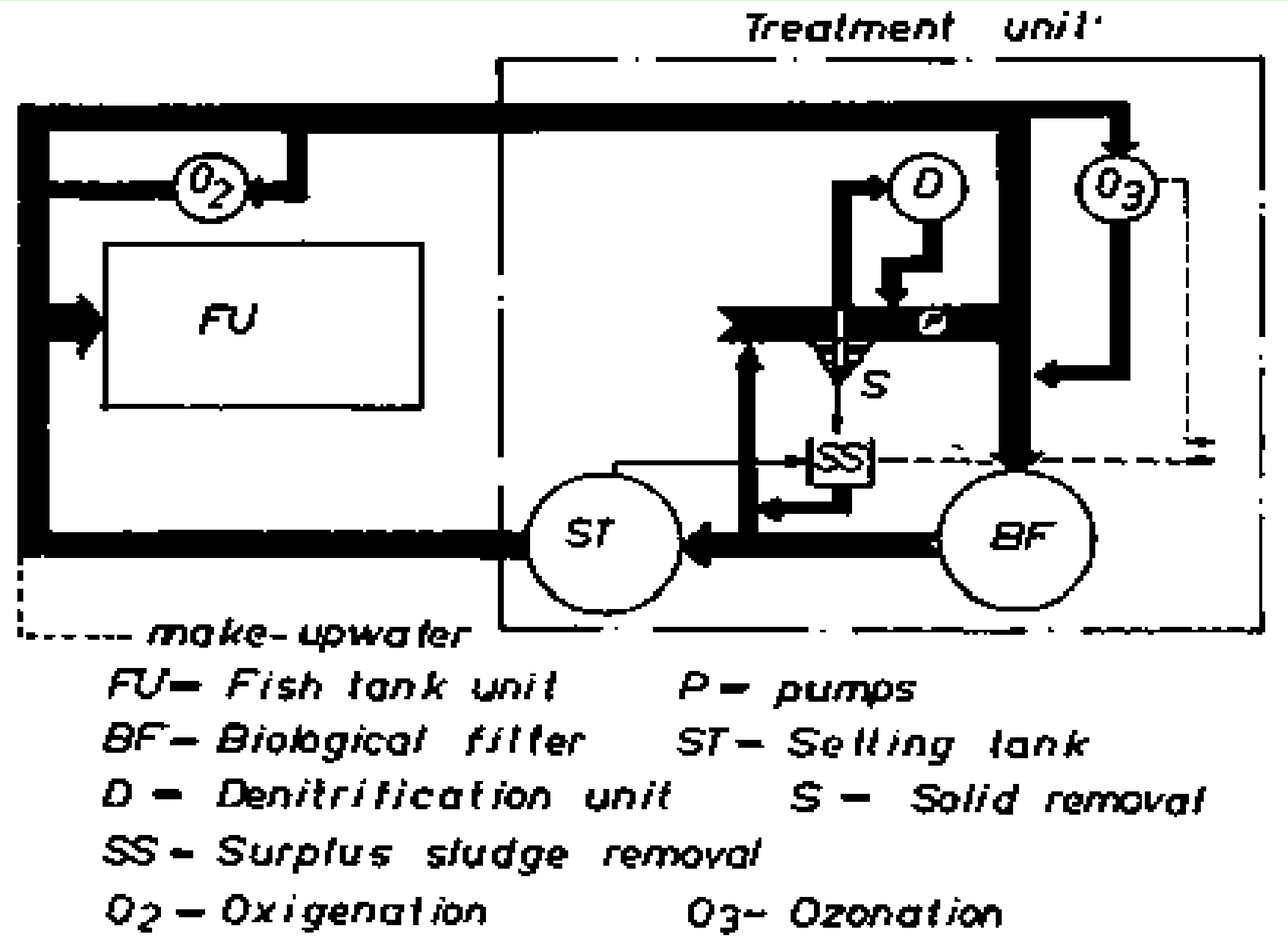

**Simple recirculation system with aeration**




Simple recirculation system using direct injection of oxygen




Complex recirculation system




**Advanced quasi closed multiple cycle system**

$$NH_3 \rightleftharpoons NH_3 + NH_4^{+}$$

$$\text{The ratio } f = \frac{(NH_3 - N)}{(NH_3 - N) + (NH_4 \pm N)}$$

## BEAD FILTERS

Floating plastic media have been employed since the mid-1970s in the biofiltration components of high density systems for raising food, game and ornamental fish. Although successful, the earliest air-washed filters were poorly understood and their use was limited. In the late 1980s, researchers in Louisiana State University's Civil Engineering Aquatic Systems Laboratory demonstrated that hydraulically washed bead filters were capable of performing both solids removal and biofiltration for high density catfish grow-out systems. These results stimulated additional research on bead filters. Development of mechanically washed units (U.S. patent #5126042) overcame many of the operational difficulties experienced by earlier designs. Shortly thereafter, the bubble washed bead filter (U.S. patent #5232586) was developed and tested for use on outdoor ponds. Since 1989, bead filters have been applied on systems holding foodfish species such as tilapia, catfish, striped bass, trout, and red drum, as well as systems for ornamental and tropical fish, alligators, crawfish, crabs, oysters, clams and turtles.

# THEORY OF OPERATION

**Bead filters accomplish both solids capture and biofiltration. They operate very much like submerged rock beds or undergravel filters with the added advantage of easy cleaning. They are generally classified as "expandable granular biofilters" or EGBs and they are distinguished by the use of a buoyant granular medium. The packed bed of plastic beads, through which water from the rearing tank is passed, captures solids and simultaneously provides a large surface area for cultures of bacteria (Nitrosomonas sp. and Nitrobacter sp.) which remove dissolved nitrogenous wastes. Bead filters thus dramatically simplify aquatic farming operations by providing two of the most important water reconditioning processes, clarification and biofiltration, in a single unit.**

## CLARIFICATION

Clarification is the process of removing suspended solids from water. Suspended solids in a recirculating system are generally small particles (< 100 microns) of undigested or partially digested food, bacteria, algae, clay, and silt, which may remain suspended in the water for an extended period of time. Fine suspended solids tend to reduce the clarity of the water, whereas larger organic particles create a serious wasteload problem by consuming tremendous amounts of oxygen, thus adversely affecting the rearing system's ecology. Bead filters remove suspended solids by at least four different mechanisms as the recirculated water is passed through the plastic bead bed. Physical straining is probably the most dominant mechanism for the larger particles (>80 microns). The suspended particles between 20 to 80 microns are removed by interception, a subtle process caused by collisions between the particle and the bead media surface. The bead filter also removes finer particles (<20 microns), but at a slower rate. It is believed that bioabsorption, the capture of particles by the bacterial biofilm, is the dominant removal process for such fine particles. Bead filters are excellent clarification units, capable of maintaining display quality water at high waste loading rates.

# BIOFILTRATION

**Biofiltration depends on the formation of a filter bed through the attachment and growth of beneficial bacteria that extract dissolved chemicals from the water and convert them to particulate biomass or harmless dissolved compounds. Given a proper environment, the bacteria grow in a thin film covering the surface of each bead. Each cubic foot of packed media contains approximately 600,000 beads that provide 400 square feet of surface area for the propagation of bacterial films. There are literally hundreds of different species of bacteria at work in a biofilter. Most of the bacteria are classified as "heterotrophic" species, which actively break down organic materials into carbon dioxide and water. The most critical, however, are broadly described as nitrifying bacteria, consisting primarily of the genera Nitrosomonas and Nitrobacter. These bacteria are responsible for the conversion of the toxic nitrogen forms, ammonia and nitrite, to relatively harmless nitrate. Management of biofiltration is critical at the high loadings typical of recirculating aquaculture systems used for the production of food and/or ornamental fish. Several parameters that influence bead biofiltration have been identified (Table 1).**

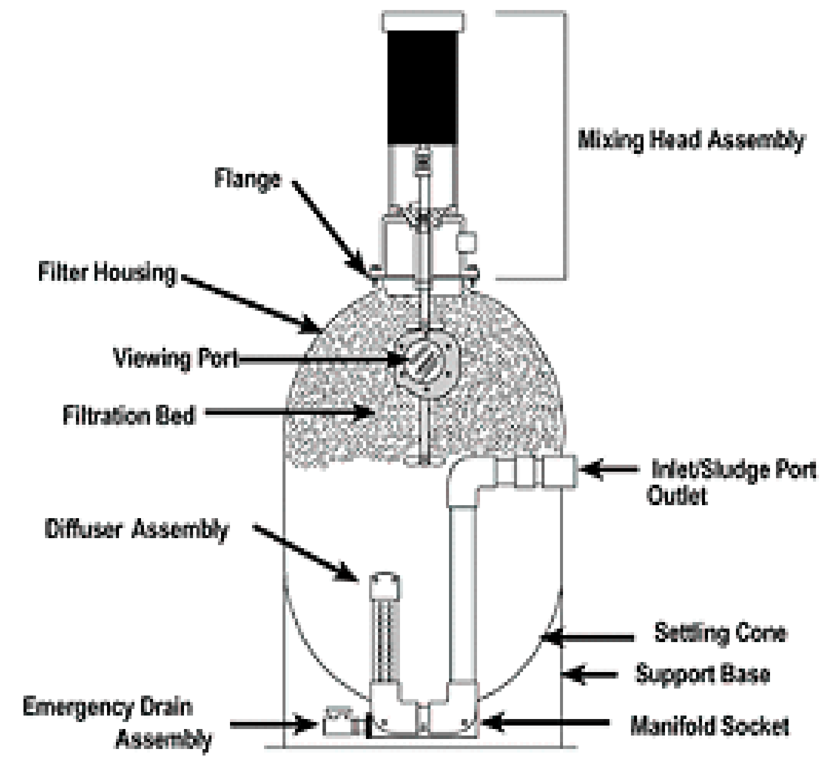



Figure 1. Propeller-Washed Bead Filter Series (cut away view)

Propeller washed bead filters contain a filtration bed of floating plastic beads in a configurationd esigned to facilitate solids capture and biofiltration. Water from the rearing tank enters the filter through a distribution manifold and passes upward through the bead bed, where the physical and biological purification processes occur. *(Fig. 1)*

Intermittent agitation of the medium (illustrated above) by embedded, high-speed propellers dislodges captured solids and biofloc, which sink and collect in an internal settling cone. Sludge is removed in a concentrated form, greatly reducing the water lost during the washing process.