Aquacultural Engineering Society News

AES News, Winter & Spring 2001, Vol. 4, Nos. 1 & 2

Letter From Your President

Dear AES Members,

Having been incorporated in 1993, AES is nearing the end of its first decade of service to the aquaculture industry and to its members. Past leadership has set AES on a path providing timely solutions to important problems through our official outlet, the journal *Aquacultural Engineering*, as well as through symposia, workshops and special publications. Members should be pleased with the level and quality of our products given the limited resources of AES. I thank Ron Malone for his leadership last year as President and Yan-Nan Chu, Kelly Rusch, Paul Hundley and Jaap Van Rijn for service during their two-year term positions as AES Directors. Further, Steven Summerfelt (1st Vice President) is thanked for organizing AES events at the *World Aquaculture 2001* program held January 21-25 in Orlando, Florida. Steven developed a full-day workshop entitled "Intensive Fin-Fish Systems and Technologies" and a half-day special session entitled "International Recirculating Systems." Both contributions were well attended and informative. Michael Timmons (2nd Vice President) is currently coordinating the AES involvement in *Aquaculture America 2002* planned for January 27-30 in San Diego, California. Our annual AES meeting will be held in conjunction with this conference so please plan now to attend. This newsletter also provides a summary of the program just finalized for the *AES Issues Forum* scheduled for November 11-14 in Shepherdstown, West Virginia. This members-only forum is held every two years. Attendance is limited to 100, so be sure to register early. These kinds of activities provide an opportunity for AES to share research findings with industry while also attracting new members. Membership remains at about 200 with a good mix of national and international representatives. Steve Hall has been asked to coordinate an AES membership drive targeting professionals in our area of interest to better position AES for expected industry growth. Please assist in this effort by instituting your own mentorship programs. Ron Malone, during his tenure as President, recognized that communication within and outside of AES is often hampered by the lack of a standard set of nomenclature. Doug Ernst and James Ebeling have been asked to satisfy this need through an analysis of relevant literature and through industry/membership surveys. Their recommendations will be presented to the membership during the *Aquaculture America 2002* Meeting and implemented in subsequent AES activities. Also scheduled for presentation in San Diego is a document describing priority aquacultural engineering research needs as identified by an AES committee chaired by Joe Hankins. Joe will use information obtained from private, state and federal sources as well as results from a panel discussion session held during the November 2001 *AES Issues Forum*. This summary will assist in resource allocation with the overall goal of improving the effectiveness and efficiency of AES member research programs.

Have a great year!

Barnaby

Barnaby Watten, President
Aquacultural Engineering Society

Inside:

Design of Gas Transfer Systems For Aquaculture: Part 3. Design and Selection of Aerators

By Dr. John Colt, National Marine Fisheries Service, Northwest Fisheries Science Center,
2725 Montlake Boulevard East, Seattle, WA 98112

INTRODUCTION

This is the third of a three-part series on the design of gas transfer systems for aquaculture. The first two parts of this article discussed site and water supply considerations and rating of aerators under standard and field conditions, respectively. This part will discuss the design and selection of aerators.

A wide range of aeration devices are available for aquaculture. The actual type selected will depend on a variety of factors related to characteristics of the aerator, culture system, site conditions, and system operations. It should be noted that aerator selection may require serious trade-offs between some of these parameters. Many of these tradeoffs may be difficult to quantify, especially if the long-term objectives of the culture system are not well-defined, or if the oxygen demand of the system changes significantly over the production cycle.

TYPES OF GAS TRANSFER SYSTEMS

Surface Systems

Surface gas transfer systems spray or splash water into the air. For example, the electrical powered paddlewheel aerator is commonly used in catfish ponds (Figure 1).

Figure 1. Paddlewheel aerator (Craig Tucker; used with permission).

Oxygen Gas

Oxygen is needed for oxidative phosphorylation, the underlying biochemical mechanism of energy transformation in fish. The minimum dissolved oxygen concentration to sustain life in water depends on species and life stage, but typically ranges from about 3-6 mg/L.

Subsurface Systems

The most common subsurface system is the air diffuser or airstone. These systems bubble air into the water, and oxygen is transferred into the water as bubbles rise to the surface.

Gravity Systems

A gravity gas transfer system is a special type of surface aerator that uses gravity rather than mechanical power. This type of unit is commonly used in flow-through systems where adequate head is available (Figure 2).

Figure 2.   Gravity aerator in a recirculating raceway system.

Enriched Gas-Phase Systems

Pure oxygen aerators use enriched oxygen gas (85-98%) rather than air. With some modifications, almost any type of aerator can be used. The most commonly used types of aerators are the u-tube, packed column, spray column, aeration cone, and high pressure oxygen injection. The low head oxygenator (LHO) can achieve up to 95% absorption of oxygen and requires only 12 - 14 inches of water drop (Figure 3).

Figure 3. Low head oxygenator (LHO) system. Water falls vertically through the perforated distribution plate into the oxygen-enriched gas zone and then flows out the bottom and down the raceway. (Water Management Technology Inc., used with permission).

SYSTEM LOCATION

The location of a gas transfer system will depend on the gas of interest, facility layout, and treatment requirements. For removal of nitrogen + argon, methane, hydrogen sulfide, and radon, stripping of only the influent water is typically required, as these gases are not commonly generated within an aquatic culture system.

Oxygen addition is commonly required for the influent flow and also within or between rearing units depending on the intensity of production. Carbon dioxide removal may be required for the influent as well as for the in-process water of high-intensity systems. Nitrogen + argon stripping may also be required after heating of process water.

SYSTEM CONFIGURATION

Depending on the system configuration or operational limitations, gas transfer units may be placed at different locations (Figure 4). The units may be located in the influent stream (Figures 4a, 4b, and 4c), recycle stream (Figures 4e), or rearing unit (Figure 4d and 4f). In the recycle configuration (Figure 4e), the recycle flow may be several times larger than the influent flow. In a side-stream system (Figures 4b and 4c), only a part of the water flow passes through the gas transfer system.

The full-flow configuration (Figure 4a) has been used when existing hatcheries are retrofitted with packed column or jet aerators. This configuration is ideal for sites with enough hydraulic head to operate the system without an external power input. The side-stream configuration (Figures 4b, 4c, and 4e) is much more flexible than the full-flow configuration, as the process water can be mixed in at several points (Figures 4c) to reduce problems with gas supersaturation. It is also possible to increase the capacity of an individual rearing unit by construction of additional gas transfer units, something that can not be done with the full-flow configuration.

COMPUTATION OF OXYGEN DEMAND AND SUPPLEMENTAL REQUIREMENTS

Sizing of aeration systems requires an estimate of the total oxygen demand by aquatic animals and other organisms, the available oxygen supplied by water flow (if any), and the supplemental oxygen requirement. Since the total oxygen demand of the animals depends on their number and size, and on water temperature, it is necessary to estimate these parameters over the whole production cycle on a weekly or monthly basis. Different procedures are used to compute oxygen demand for flow-through or reuse systems and pond systems.

Flow-through and Reuse Systems

Average Daily Oxygen Demand

The average daily oxygen demand is proportional to the total daily ration:

Equation 1

$$DOD_{aver} = (OFR)R$$

where:

DOD_{aver} = Average daily oxygen demand (lb/d)

OFR = Ratio of average daily oxygen demand to daily feed consumption (lb/lb)

R = Daily feed consumption(lb/d)

The oxygen requirement to process a given mass of feed depends on animal size, feeding rate, composition of the ration, digestibility of the feed components, and moisture content and can be described by the oxygen:feed ratio (OFR).

In production salmon and trout systems, OFR ranging from 0.20 to 0.22 lb oxygen/lb wet feed have been reported. In commercial high-density warm-water fish culture, a value of OFR = 1.00 lb oxygen/lb wet feed is commonly used. Limited data is available for OFR in recycle systems. The oxygen demand from bacterial oxidation of organic compounds, ammonia, and solids strongly depends on the unit processes and their operation. The upper bound for OFR equals the ultimate BOD (biochemical oxygen demand) of the feed, which for channel catfish feed is equal to 1.1 lb O2/lb dry feed. Careful feeding and rapid removal of solids from the system can significantly reduce the OFR.

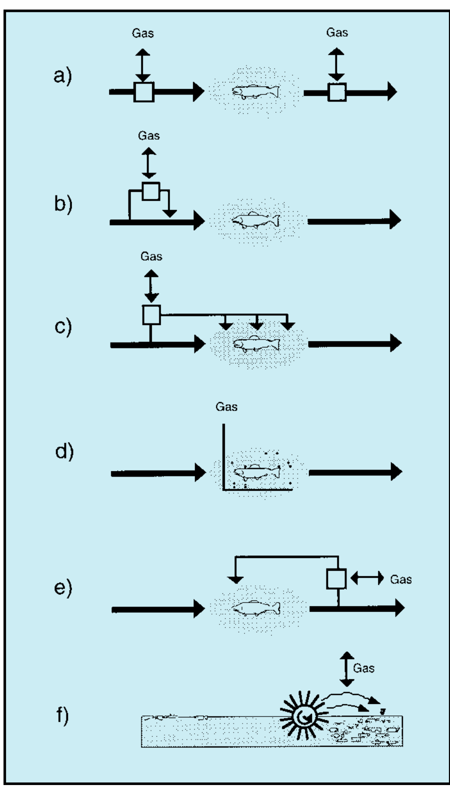

Figure 4. Location of gas transfer system (a) influent and effluent, (b) influent, side-stream mode with single point return, (c) influent, side-stream mode with multi-point return, (d) in-unit, (e) recycle, single point return, and (f) static pond system with emergency system

Maximum Daily Oxygen Demand

On a daily basis, the maximum oxygen consumption occurs 4 to 6 hours after feeding in a flow-through system. A "peaking factor" of 1.44 to account for the maximum daily oxygen consumption rate has been suggested:

Equation 2

$$OD_{max} = 1.44(DOD_{aver})$$

where:

OD_{max} = Maximum daily oxygen demand (lb/d)

DOD_{aver} = Average daily oxygen demand (lb/d)

Supplemental Oxygen Requirement

The amount of available oxygen supplied by the flow is equal to:

Equation 3

$$\text{Oxygen Supplied by flow} = 1.20 \times 10^{-2} (Q_w)(DO_{out} - DO_{min})$$

where

Q_w = Water flow (gpm)

DO_{out} = Effluent DO concentration (mg/L)

DO_{in} = Influent DO concentration (mg/L))

The amount of supplemental oxygen needed is equal to the difference between Equations 2 and 3:

Equation 4

$$\text{Supplemental Oxygen} = 1.44(OFR)R - 1.20 \times 10^{-2}(Q_w)(DO_{out} - DO_{min})$$

For design purposes, the supplemental oxygen requirement should be based on weekly or monthly biomass and feeding level. Depending on the harvest schedule and temperature, the maximum supplemental oxygen requirement may occur prior to the end of the production cycle. If there is a large variation in biomass between the various rearing units, it may be necessary to compute the supplemental oxygen requirement for each rearing unit.

Pond Systems

In production ponds, the metabolic oxygen requirement of the culture animals is commonly insignificant compared to oxygen consumption by algae and bacteria. In addition, minimum daily oxygen concentrations are strongly influence by recent levels of solar radiation. Lethal DO levels can be produced by a period of low solar radiation and low wind velocity following a period of high solar radiation. The minimum DO concentration typically occurs just before sunrise.

Because of the large daily variation in DO in ponds, it is usually impossible to provide enough aeration to maintain an acceptable DO throughout the pond. Therefore, the purpose of pond aerators is to typically provide a refuge area of high DO that allows the fish to survive until photosynthetic production increases the concentration of oxygen in the pond to an acceptable level (see Figure 4f).

The amount of aeration needed to provide an adequate area of high DO water has been determined by trial and error. In production channel catfish ponds, typical aeration densities range from 1.5-2 hp/acre (Craig Tucker, personal communication).

Field Aeration Efficiency

Standardized aeration efficiency (SAE) for aerators commonly used in aquatic systems are listed in Table 1. The SAE will typically range from 1.6 to 4.3 lb O_2/hp.hr. However, the SAE of some types of subsurface aerators may range as high as 5.2 to 5.7 lb O_2/hp.hr. If 0.5 to 1.0 m of head is available, the SAE of the U-tube and packed-column aerators can range as high as 70-140 lb O_2/hp.hr. The only power required is for injection of air into the u-tube or low-pressure fans for the packed columns.

The FAE values for aquaculture systems will be significantly less than the listed SAE values due primarily to the necessity of maintaining a dissolved oxygen concentration of 5 to 7 mg/L. For example, at 30 C and C = 5 mg/L, FAE is equal to only 36% of the SAE value. At high temperatures and C values, the value of FAE is significantly reduced. This impact of operating conditions on FAE was discussed in Part 2 of this article.

$$\text{kg } O_2 / \text{kW .hr} = \frac{\text{1b}O_2 / \text{hp .hr}}{1.644}$$

Field Oxygen Transfer Rate

In a number of systems, oxygen transfer rate is more important than efficiency. Tractor-powered paddlewheel aerators have been widely used in catfish ponds for emergency aeration and can easily be moved from pond to pond when needed. Diffused aeration with pure oxygen is widely used in transportation and emergency systems for high-intensity production systems due to their ability to transfer large amounts of oxygen without any external power input.

Table 1 Typical standardized aerator efficiency (SAE) for aerators used in aquaculture.

Type	SAE (lb O_2/hp•hr)
SURFACE AERATORS	
low-speed surface	2.0-4.0
low-speed surface with draft tube	2.0-4.0
high-speed surface	2.0-4.0
paddlewheel	
Triangular blades	4.5-4.8
PVC pipe blades	2.0-3.2
Tractor powered	2.2-3.3
GRAVITY AERATORS	
Cascade weir (45 °)	2.5-3.0
Corrugated inclined plane (20°)	1.7-3.2
Horizontal screens	2.0-4.3
Lattice aerator	3.0-4.3
Packed column	
zero head	2.0-4.0
0.5-1.0 m head	17-130 [a]
Aeration cone	4.2
SUBMERGED AERATORS	
Air-lift pump	3.3-3.5
Diffused-air	
fine-bubble	2.0-3.3
medium-bubble	1.7-2.7
coarse-bubble	1.0-2.0
Nozzle aerator	2.2-4.3
Propeller-aspirator-pump	2.8-3.2
Static tube	3.0-4.0
U-tube	
zero head	1.2-3.8
0.5-1.0 m head	17-70 [a]
Venturi aerator	3.3-5.5

[a] Does not include pumping power

DISSOLVED GAS CONCENTRATIONS AND PRESSURES

Dissolved gas concentrations (or pressures) in the effluent from aeration must be considered in aeration design and operation. Lethal dissolved gas pressure may be produced by some types of submerged aerators and depends primarily on the submergence depth of the unit.

MAXIMUM OXYGEN CONSUMPTION LIMITATIONS

In high-intensity flow-through systems, cumulative oxygen consumption is an important measure of system intensity. The cumulative oxygen consumption (COC) rate for a single rearing unit is equal to the amount of oxygen consumed (DO_{in} - DO_{out}). For a serial reuse system, the cumulative oxygen consumption for the overall system is equal to the sum of the oxygen consumed in all of the units.

The utilization of oxygen produces both carbon dioxide and ammonia. The depletion of oxygen may not always be the most limiting parameter, and when ammonia or carbon dioxide is more limiting, aeration will have little effect on carrying capacity. Maximum cumulative oxygen consumption (COC) based on pH, dissolved oxygen, and un-ionized ammonia limitations is presented in Figure 5 for water quality criteria typical of salmon and trout culture. For common pHs (7-8.50), the cumulative oxygen consumption is limited by available oxygen. At the low and high pHs, the cumulative oxygen consumption is limited by pH and un-ionized ammonia, respectively. If pure oxygen is used to increase the available oxygen, carbon dioxide becomes the limiting factor in the mid-range of pHs.

NUMBER OF UNITS AND POWER REQUIREMENT

The number of units and power requirement depends on the amount of supplemental oxygen needed (Equation 4), OTR_f, and FAE:

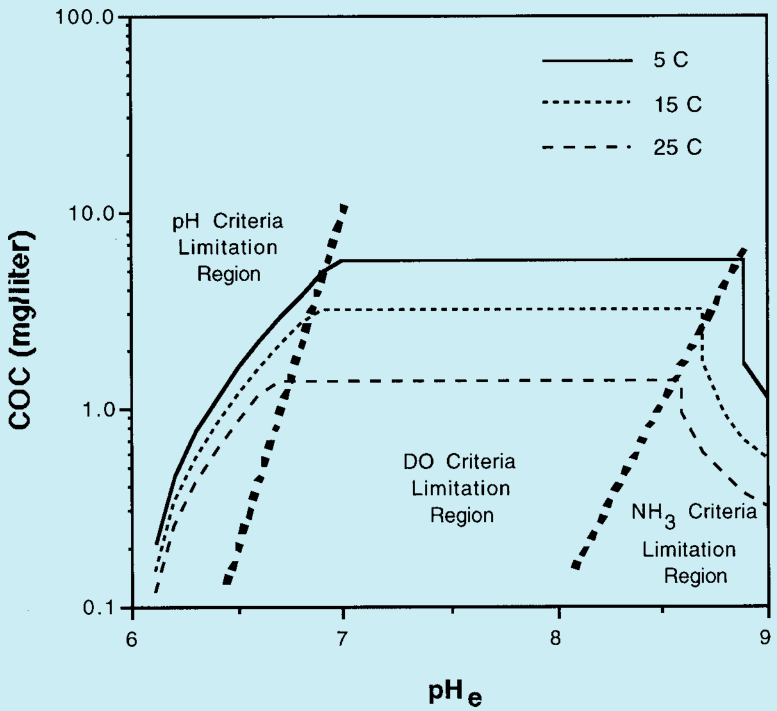

Figure 5. Maximum cumulative oxygen consumption (mg/L) as a function of equilibrium pH_e (pH of a solution in equilibrium with the atmosphere). At low pH COC is limited by the pH criteria, at intermediate pHes by the dissolved oxygen criteria, and at high pH by the un-ionized ammonia criteria.

Equation 5

$$\text{Number of Units Needed} = \frac{\text{Supplemental Oxygen}}{OTR_f}$$

Equation 6

$$\text{Power Requirements (kW)} = \frac{\text{Supplemental Oxygen}}{FAE}$$

SYSTEM CHARACTERISTICS

The selection of aerators will also be based on the physical characteristics of (a) the site, (b) the number, size, and configuration of rearing units, (c) the hydraulics of rearing units, and (d) the mode of operation. In many cases, the system may be completed before the need for an aeration system is realized. Therefore, it is commonly necessary to design or retrofit an aeration system around a given system, rather than design a complete culture system from scratch. Some of the most common site considerations are presented in Table 2.

The number, size, and configuration of rearing units is important in the selection process. In large tanks or ponds, individual mechanical or floating aerators may be used. In the aquarium trade, where a large number of small tanks must be aerated, diffused aeration is commonly used. Although the amount of air available is relatively fixed, the air can be inexpensively distributed to a large number of individual units, and flow to an individual unit may be varied easily.

Aerators that interfere with the normal operation of a culture system or require extensive maintenance will probably not be used too long. Gravity or paddlewheel aerators, which can be constructed and repaired on-site, may be better choices for some operations even if their overall efficiency is lower than other types of aerators. The operational characteristics of different types of aerator systems are presented in Table 3.

Aeration systems also need to consider the size and biological characteristics of the culture organism. Sensitive life-stages such as larvae may not tolerate aeration systems that cause excessive turbulence in the culture unit. Also, some types of submerged aerator make enough noise to cause a fright response (the fish jump out of the rearing unit), especially when the units are turned on.

CONTROL

The oxygen demand of a production system has a significant daily and seasonal variation (Figure 6). In addition, oxygen demand from a single raceway or raceway series can change when transferring or harvesting fish. The amount of oxygen transferred can be adjusted by turning on an additional pump or blower. Thus, the degree of control depends on total number of aeration units, operational characteristics of the aerators, and layout of the rearing units.

The simplest control strategy for daily changes in oxygen demand is to design for the maximum oxygen demand (Figure 7a). This may result in low FAE values over much of the day.

Step control (Figure 7b) uses one system to provide base capacity and a second system to provide peak capacity. In raceways, surface aerators are commonly used to provide additional aeration when biomass is high and the output of gravity aerators is insufficient. Surface aerators can also be used to increase the oxygen-transfer rate

Table 2. Common site considerations.

Item	Considerations
Head	If enough head is available, operation of a gravity aerator may be possible without the use of external power.
Power	If electrical power is unavailable or unreliable, it may be necessary to use a motor-generator system or engine-powered aerators.
Location	In remote locations, the lack of spare parts and trained personnel may favor simple systems.
Subsurface	In areas with rocky or unstable soils, excavation may be expensive.
Layout	Retrofitting existing hatcheries may involve careful consideration of problems associated with installing additional electrical lines, piping, and pumps between or around existing structures and utilities. A side-stream pure oxygen system may be easier to retrofit at some sites.

Table 3. Common operational considerations.

Item	Considerations
Fouling of Diffusers	Diffusers (airstones) may foul due to the growth of algae or bacteria. Fine-bubble diffusers may require special air filters and non-metal air lines to prevent clogging due to rust and scale. Diffusers may foul rapidly if not operated continuously. Some types can be cleaned (with varying degrees of success) with acids or other chemicals.
Icing	Surface aerators and some types of gravity aerators produce enough spray to develop ice on walkways and roads. This may present a safety hazard to personnel.
Safety	Electrical lines, fuel tanks, or rotating shafts may present a safety hazard to personnel. Diffused aeration systems may be safer than other systems because the electrical lines are only required for the central blower unit. Electrical safety is a major concern in marine systems due to the high conductivity of seawater.
Harvesting/ feeding	In ponds, static tube or surface aerators may need to be removed prior to harvesting. Aerators should not interfere with the daily operations of the facility.
Repair	The ease of repair may be an important consideration in remote locations. This includes both the skills and tools required and local availability of spare parts.
Reliability	A simple and highly reliable aerator is desirable. When adequate head is available, gravity aerators will operate during power failures.

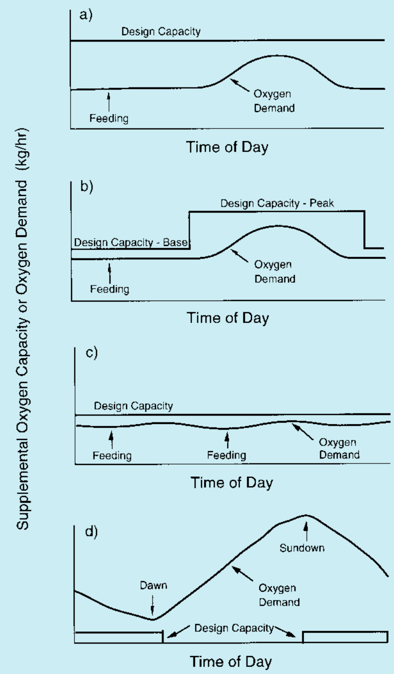

Figure 7. Control strategies (a) peak demand, (b) step control, (c) reduced peak demand, (d) pond systems.

following feeding when oxygen consumption of culture animals increases. In subsurface aerators, oxygen transfer can be changed by changing the air flow to the unit. A number of smaller units that can be turned on when needed may be more efficient than running a single large blower continuously.

Total required oxygen capacity may be minimized by staggering the feeding times within each raceway series to reduce the peak oxygen demand following feeding (Figure 7c). This may have the additional benefit of eliminating the need for continuous DO monitoring and on-line control.

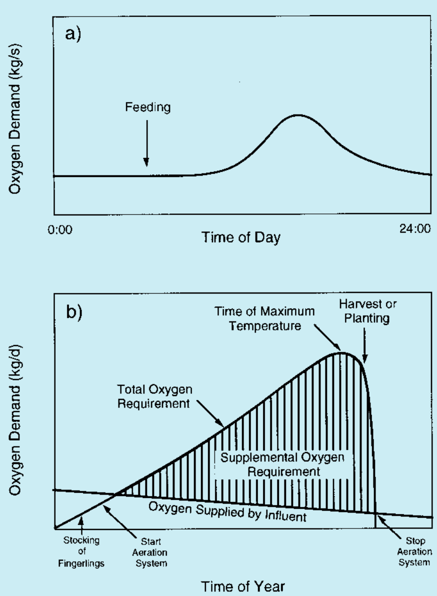

Figure 6. Variation of oxygen demand in a flow-through system with (a) time of day (b) production cycle.

Aerators in ponds are commonly run during the nighttime to provide a refuge area of adequate DO (Figure 7d). Two operational strategies have evolved in production catfish farms in the Southern U.S. for aerator control (Craig Tucker, personal communication):

The fixed method begins aeration at 10:00 pm and finishes at 8:00 am the next morning. The conditional method only aerates if dissolved oxygen drops below 4 mg/L and completes aeration by 8:00 am.

There is little experimental data available to favor one method over the other. There is a trend toward the installation of individual DO probes to control aerators in a specific pond.

Dr. John Colt is Editor of Elsevier's journal Aquaculture Engineering

ADDITIONAL READING

This is the final part of a three-part series on the design of gas transfer systems for aquaculture. The first two parts discussed site and water supply considerations and rating of aerators under standard and field conditions, respectively. Additional information on aerator design can be found in the following articles:

Colt, J. and B. Watten. 1988. Applications of Pure Oxygen in Fish Culture. *Aquacultural Engineering*, 7:397-441.

Colt, J. and G. Bouck. 1984. Design of Packed Columns for Degassing. A*quacultural Engineering*, 3:251-273.

Colt, J. and K. Orwicz. 1991. Aeration in Intensive Aquaculture. Pages 198-271 in *Water Quality and Aquaculture, Advances in Aquaculture, Volume 3*, D. A. Brune and J. R. Tomasso (Eds.), World Aquaculture Society, Baton Rouge, Louisiana.

Colt, J., and K. Orwicz. 1991. Modeling Production Capacity of Aquatic Culture Systems under Freshwater Conditions. *Aquacultural Engineering*, 10:1-29.

AES Committee Chairs and Liaison Appointments

AES members who want to be more active in our society should join one of the many AES Committees by contacting the appropriate AES Committee Chair. The following is a list of the AES Committee Chairs and Liaison appointments for 2001.

BOD Chairman	**AES President**
Program Committee Chair	**AES 1st Vice President**
Membership and Publications Committee Chair	**AES 2nd Vice President**
Nominating Committee Chair	**AES Past President**
AES Liaison with other societies (WAS, EAS, etc.)	**Raul Piedrahita**
Program Chairs:	
2001 AES Issues Forum in Shepherdstown, WV	**B. Watten and S. Summerfelt**
Aquaculture Europe 2001 in Trondheim, Norway	**Raul Piedrahita**
Aquaculture America 2002 in San Diego, CA	**Mike Timmons**
World Aquaculture 2002 in Beijing, China	**Shulin Chen**
4th International Conference on RAS 2002 in Roanoke, VA	**Mike Timmons**
Publications Committee Chair	**Kelly Rusch**
New Products Publications Co-Chairs	**John Colt and Mike Timmons**
Promotions and Meeting Committee Chair	**Tim Pfeiffer**
Paper Awards Committee Chair	**Fred Wheaton**
Membership Drive Committee Chair	**Steve Hall**
Standards Committee Co-Chairs	**Doug Ernst and James Ebeling**
Research Needs Committee Chair	**Joe Hankins**
JSA Aquaculture Effluents Task Force Representative	**Ron Malone**
AES Proceedings Editor	**Mike Timmons**
AES News Co-editors	**Steven Summerfelt and Mike Timmons**
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AES Listserv Manager	**Raul Piedrahita**
Corporate Sponsor Liaison	**AES Secretary/Treasurer**

Newsletter

The *AES News* is printed quarterly by the Aquacultural Engineering Society. You can receive the *AES News* by joining the Aquacultural Engineering Society. If you would like to discuss the contents of the *News*, or, if you would like to contribute information to the *News*, please contact either of the two Co-Editors:

Steve Summerfelt
Freshwater Institute
P.O. Box 1889
Shepherdstown, WV 25443
304-876-2815 ph
304-870-2208 fax
s.summerfelt@freshwaterinstitute.org

Mike Timmons
Agricult. & Bio. Engineering
302 Riley-Robb Hall
Cornell University
Ithaca, NY 14853-5701
607-255-1630 ph
607-255-4080 fax
mbt3@cornell.edu

UPCOMING MEETINGS

Aquaculture Waste Management Symposium

Virginia Polytechnic Institute and State University has organized an Aquaculture Waste Management Symposium to be held July 23-24, 2001, at the Hotel Roanoke and Conference Center in Roanoke, Virginia. The program will feature presentations that discuss waste management regulations and best management practices including presentations by several AES Members. An update will also be provided on the US EPA's process to regulate waste management in the aquaculture industry. For more information or to register for the Aquaculture Waste Management Symposium, contact: Conference Registrar, Division of Continuing Education, 810 University City Blvd., Suite D, Virginia Tech, Mail Code 0272, Blacksburg, Virginia 24061; phone 540-231-5182; fax 540-231-3306. The program for the Aquaculture Waste Management Symposium follows:

Monday, July 23, 2001

8:30-8:45	Greg Boardman & George Flick, Virginia Tech	Introduction & welcome
8:45-9:15	Max Mayeaux, USDA	JSA Effluent Committee efforts
9:15-10:00	EPA representative	Update on EPA regulatory process for aquaculture ind.
10:00-10:30	Refreshment break	
10:30-noon	Jane Walker, Kieth Gregg, Bill Martin	Industry perspective concerning waste management
noon-1:30	Lunch provided	
1:30-3:00	Claude Boyd, Auburn University	Best waste mngmnt. pract.for shrimp and catfish ind.
3:00-3:30	Refreshment break	
3:30-5:00	Harry Westers, Aquaculture Bioeng. Corp.	Best waste management practices for the trout industry

Tuesday, July 24, 2001

8:30-10:00	Greg Lutz, Louisiana State University	Best waste management practices for the alligator, crawfish and turtle industry
10:00-10:30	Refreshment break	
10:30-noon	Steven Summerfelt, Freshwater Institute	Best waste management practices for recirc. systems
noon-1:30	Lunch provided	
1:30-2:15	Tim Hovanec, Aquaria, Inc.	Recent developments in nitrification/denitrication
2:15-3:00	Steve Van Gorder, Aquamaring Fish Farms, Inc.	Management of aquacultural waste using aerobic stabiliz., reed beds and hydroponic trtmnts.
3:00-3:30	Refreshment break	
3:30-4:15	Lewis Carr, University of Maryland	Composing fundamentals
4:15-5:00	Lewis Carr, University of Maryland	Experiences and perform. of composting operations

Aquaculture America 2002

The California Aquaculture Association will be hosting *Aquaculture America 2002*, which will be the next meeting of the US Chapter of the World Aquaculture Society. The *Aquaculture America 2002* Conference and Tradeshow will be held January 27-30, 2002, at the Town and Country Resort in San Diego, California, USA. Abstracts for presentations (oral or poster) are due by July 31, 2001. For more information on the overall program and tradeshow at A*quaculture America 2002*, please contact John Cooksey, WAS Director of Conferences (phone: +1 760-432-4270: fax: +1 760-432-4275; e-mail: worldaqua@aol.com), or visit the World Aquaculture Society's website at: http://www.was.org The AES is an association sponsor of *Aquaculture America 2002* and will be organizing a half-day workshop, a half-day special session, and a 1-day session of contributed aquacultural engineering papers. Dr. Michael Timmons (mbt3@cornell.edu) is coordinating the AES involvement.

The AES is organizing a half day workshop on "Designing a 100,000 lb per year coolwater or warm water Recirculating Aquaculture System (RAS) and -Fish Systems", a half day workshop on "Design of Intensive Shrimp & Shellfish RAS Systems, a half day special session on "Effluent Treatment" and a one-day session of contributed aquacultural engineering papers during *Aquaculture America 2002*. The workshops are intended for fish farmers, biolobists, and engineers with some prior fin-fish culture experience. The special session on "Effluent Treatment" will overview a range of treatment methods and water reclamation techniques; this session is applicable to all those involved in fish and shellfish production. The contributed paper session contains a wide range of aquacultural engineering presentations. Dr. Michael Timmons (mbt3@cornell. edu) and Dr. Steven Summerfelt (s.summerfelt@freshwaterinstitute.org) are coordinating the AES involvement.

AES ISSUES FORUM 2001

Clarion Hotel and Conference Center, Shepherdstown, West Virginia, USA
November 11-14, 2001

President Barnaby Watten and First Vice President Steven Summerfelt are hosting this "Members Only" Issues Forum. The *AES Issues Forum* is intended for members of the AES to gather and reflect upon the advances that have been made in the field of aquacultural engineering and discuss the important issues we now face. Invited speakers will be discussing AES issues in five special topic sessions arranged over 2.5 days. The major topic areas covered will include: Engineering Challenges for Aquaculture Effluent Treatment, Pond Production Methods, Net Pen Systems, Ozone & UV Treatment, Aquacultural Engineering Research Needs. As in the first *AES Issues Forum*, this Forum has been organized to allow 10-20 minutes of audience discussion following each presentation. In addition, attendees will tour the Freshwater Institute's new research facility during a social event on the evening of November 13. And, an optional tour of the new USDA-ARS National Center for Cool and Coldwater Aquaculture will be provided on November 14th, after the conclusion of the *AES Issues Forum*. Registration for the *AES Issues Forum* will be $210 for AES Members ($285 for non-members that are joining the AES with their registration). Registration also includes the NRAES published conference proceedings1, two lunches and two dinners (November 12-13), the tour of the Freshwater Institute on the evening of November 13, and break refreshments during the five sessions. Register early! Also, accommodations at the Clarion Hotel (304-876-7000 or www.clarion-shep.com) must be reserved by October 11, 2001, in order to receive the special *AES Issues Forum* $84/night room rate. Please contact Steven Summerfelt (ph: 304-876-2815; email: s.summerfelt@freshwaterinstitute.org) if you have questions or if you want more information on the AES Issues Forum.

AES Issues Forum Program on page 10

Aquaculture Europe 2001

The *Aquaculture Europe 2001* Conference, organised by the European Aquaculture Society (EAS) in co-operation with the Nor-Fishing Foundation (Nor-Fishing), will be held in Trondheim, Norway, August 7-10, 2001. The *Aquaculture Europe 2001* conference is held immediately prior to Aqua Nor, the world's largest aquaculture trade exhibition that attracted nearly 20,000 visitors in 1999. The *Aquaculture Europe 2001* program focus will be "New species, New technologies." The conference program has been designed to provide the essential ingredients to facilitate discussion and debate by members of an industry faced with increasing interest by the public and greater media coverage in times of uncertainty and change. To this end, fundamental topics including production, genetics, nutrition, flesh quality, food safety, new species, farm animal health, animal welfare, integrated management systems, marketing, communication, networking and funding opportunities provide the backbone of the program.

A special one-day workshop titled "Better use of water, nutrients and space" will be held on the first day of the exhibition, August 7, 2001, in the Nidarohallen facilities (site of the Aqua Nor trade show). The two-session workshop will bring together aquaculture producers and scientists to present and share the latest information. The first session will address water quality, water reuse and recirculation and will include presentations and discussion on: the use of ozone and UV; dissolved carbon dioxide stripping; and the economics of recirculation systems. The second session will address use of nutrients and space, including discussions on: multi-species systems and sites; use of nutrients; fish health aspects; food safety; and regulatory aspects. Delegates registered for the conference will have access to the workshop, but workshop-only participation may also be purchased. For more information on *Aquaculture Europe 2001*, contact: European Aquaculture Society, Slijkensesteenweg 4, B-8400 Oostende, Belgium; ph: +32 59 32 38 59; fax: +32 59 32 10 05; email: ae2001@aquaculture.cc; website: www.easonline.org.

World Aquaculture 2002

The World Aquaculture Society and the China Society of Fisheries are planning *World Aquaculture 2002* International Conference and Exposition to be held at the Beijing Convention Center in Beijing, China, from April 23-27, 2002. The AES is an associate sponsor of this international conference and Dr. Shulin Chen (chens@mail.wsu.edu) and Dr. Song-Ming *Zhu* are coordinating our involvement. For more information on the overall program and tradeshow at World Aquaculture 2002, please contact John Cooksey, WAS Director of Conferences (phone: +1 760-432-4270: fax: +1 760-432-4275; e-mail: worldaqua@aol.com), or visit the World Aquaculture Society's website at: http://www.was.org.

Membership Dues

There is still time to renew your membership for 2001. AES members receive eight issues of the journal *Aquacultural Engineering*, four issues of the *AES News*, and the AES Member Directory.

AES ISSUES FORUM 2001 PROGRAM

SUNDAY EVENING, NOVEMBER 11

7:30-9:30 PM	Registration and Welcome Social, Rumsey Tavern, Clarion Hotel & Conference Center	

MONDAY, NOVEMBER 12

8:00-8:30	Barnaby Watten, US Geological Survey, USA	Welcome & Introduction
Engineering Challenges for Aqua. Effluent Treatment		Session Chair: Shulin Chen, Washington, State University, USA
8:30-9:00	Shulin Chen, Washington State University, USA	Current knowledge and research needs for recirc. syst. effl. management
9:00-9:50	Asbjorn Bergheim, Rogaland Research, Norway	Effluent treatment for flow through systems and European Environ. Reg.
9:50-10:00	Break	
10:00-10:40	Craig Tucker, Mississippi State University, USA	Effluent management for pond systems
10:40-11:20	Marta Jordan, US EPA, USA	National Aquaculture Effluent Guidelines: EPA's perspective
11:20-12:00	Jim Zehringer, Meiring Poultry & Fish Farm, USA	Aquaculture effleunt management in practice: Farmer's perspective
12:00-1:00	Lunch	
Pond Production Methods		Session Chair: David Brune, Clemson University, USA
1:00-1:40	John Hargreaves, Mississippi State University, USA	Pond catfish production: practices, problems and potentials
1:40-2:20	Mike Massingill, Kent SeaTech Corporation, USA	Wetlands for aquaculture nitrogen, alkalinity and temperature control
2:20-2:40	Break	
2:40-3:20	Yoram Avnimelech, Israel Inst. of Technology, Israel	Scaling of suspended culture aquaculture ponds
3:20-4:00	David Brune, Clemson University, USA	High rate algal systems for aquaculture
4:00-4:40	Robin McIntosh, Belize Aquaculture Ltd., Belize	High rate bacterial systems for shrimp prodution

TUESDAY, NOVEMBER 13

Net Pen Systems		Session Chair: John Riley, University of Maine, USA
8:30-9:00	John Riley, University of Maine, USA	Introduction to marine net pen culture in North America
9:00-9:40	Chris Bartlett, University of Maine, USA	Recent developments and challenges in feeding systems for salmon ind.
9:40-10:00	Break	
10:00-10:40	Royann Petrell, Univ. of British Columbia, Cananda	New fish tags for cage culture: Where are the fish and what do they eat?
10:40-11:20	Sebastian Bell, Maine Aquaculture Assoc., USA	Containment of net pen cultured fish, a growing problem
11:20-12:00	Cliff Goudey, Massachusetts Inst. of Technol., USA	Future directions in net pen culture
12:00-1:00	Lunch	
Ozone & UV Treatment		Session Chair: Steven Summerfelt, Freshwater Institute, USA
1:00-1:20	Steven Summerfelt, Freshwater Institute, USA	Introduction and current knowledge of ozone and UV treatment
1:20-2:00	Phillip Lee, Univ. of TX Marine Biomed. Inst., USA	Engineering issues of ozonation within recirc. marine aquaculture syst.
2:20-2:40	Anthonie Schuur, Harbor Branch Oceanic Inst., USA	Engineering os ozone systems at large-scale shrimp farms
2:40-3:00	Break	
3:00-3:40	Edward Cryer, Montgomery-Watson, USA	Engineering experiences with ozonation and UV Disinfection
Aquacultural Engineering Research Needs		Session Chair: Joseph Hankins, Freshwater Institute, USA
3:40-4:20	Joseph Hankins, Freshwater Institute, USA	Aquacultural engineering research needs
4:20-5:00	Panel Discussion	Aquacultural engineering research needs
5:00-7:30	Tour & Social at Freshwater Institute	
7:30-10:00	Dinner at Bavarian Inn	

WEDNESDAY, NOVEMBER 14

Bacterial Systems for Aquaculture Water Treatment		Session Chair: Sean Wilton, PRAqua Technologies Ltd., Canada
8:00-8:40	Sean Wilton, PRAqua Technologies Ltd., Canada	Biofilter applications at large commercial coldwater fish farms
8:40-9:20	Jean-Paul Blancheton, IFREMER, France	Biofiltration of intensive marine fish culture effluents
9:20-10:00	Ronald Malone, Louisiana State University, USA	Floating bead bioclarifier treatment of southern greenhouse tilapia syst.
10:00-10:20	Break	
10:20-11:00	Jaw-Kai Wang, University of Hawaii, USA	Algae based recirculating oyster and shrimp systems
11:00-11:40	Brian Brazil, Virginia Tech, USA	Denitrification of recirculating
	AES Issues Forum Ends	
1:00-4:00	Optional Tour of USDA-ARS National Cold & Coolwater Aquaculture Center	

OTHER NEWS

AES Presentation Notebooks from *Aquaculture 2001* Now On-Line

The AES organized a one-day Workshop on 'Intensive Fin-Fish Systems and Technologies' and a half-day Special Session on 'International Recirculating Systems' during *World Aquaculture 2001*, January 23-24, 2001, in Orlando, Florida. Presentation Notebooks containing summaries of each of the talks were available to participants attending the AES Workshop and AES Special Session. These two Presenation Notebooks are now available on-line as PDF files that can be accessed at the AES website (www.aesweb.org) under the NEW items catagory.

Nominating Committee Seeks Your Input

The AES Nominating Committee is seeking nominees for several AES positions. The committee is charged with the responsibility of recommending candidates for:

- 2004-2005 AES President. This candidate will succeed from 2nd Vice President to 1st Vice President to President
- 5-7 Directors for the Board of Directors

Suggestions for candidates are needed now. Elected candidates will have a significant impact on the AES's future. The ability to lead the society and interact effectively with other society members should be a high priority.

Send your nominations to the Nominating Committee Chair, Dr. Ron Malone at RMalone@lsu.edu.

AES Donates to NAA Auction at *World Aquaculture 2001*

The AES donated two complete sets of the journal Aquacultural Engineering (volumes 22 and 23) to the National Aquaculture Association Auction (NAA), which was held during *World Aquaculture 2001*. The NAA was able to auction these two sets for $110 and proceeds from the annual event will be used to expand NAA membership services.

Several Complete Sets of Aquacultural Engineering (volumes 22 and 23) Now For Sale

The AES is selling several complete sets of the journal *Aquacultural Engineering*, which were issues sent to AES Members during 2001 (volumes 22 and 23). This includes the two special Aquacultural Engineering issues titled "Developments in Recirculation Aquaculture System Technology" (Vol. 22, Nos. 1-2) and "Computer Tools for Siting, Designing, and Managing Aquaculture Facilities" (Vol. 23, Nos. 1-3). You can purchase a complete set of Aquacultural Engineering Volumes 22 and 23 for only $55 (US$), plus shipping and handling. To purchase a complete set please contact Brian Vinci, AES Secretary/Treasurer, c/o Freshwater Institute, PO Box 1889, Shepherdstown, West Virginia 25443, USA; phone: 304-876-2815; fax: 304-870-2208; email: b.vinci@freshwaterinstitute.org.

AES Superior Paper Award

The AES Paper Awards Committee selected the 'Superior Paper' from all papers published in 1999 issues Elsevier's journal *Aquacultural Engineering*. The 'Superior Paper Award' was given to the paper by Richard N. Patterson, K. Christopher Watts, and Michael B. Timmons, titled, "The power law in particle size analysis for aquacultural facilities," from *Aquacultural Engineering* Volume 19, Number 4. Also, two 'Honorable Mention Paper Awards' were given: (i) one award to J. Jed Brown and Edward P. Glenn for their paper titled "Reuse of highly saline aquaculture effluent to irrigate a potential forage halophyte, *Suaeda esteroa*," and (ii) one award to Jose L. Ramirez, Susana Avila, and Ana M. Ibarra for their paper titled "Optimization of forage in two food-filtering organisms with the use of a continuous, low-food concentration, agricultural drip system."

New AES Officers And Directors

The AES Officers and Directors plan and coordinate our society's participation in conferences and special work groups. The AES Directors serve a two-year term and the Officers serve a one-year term. The rotation of AES Officers and Directors occurred at the end of the AES Annual Meeting, which was held during *World Aquaculture 2001* in Orlando, Florida this past January. Following is a list of the changes in AES Officers and Directors.

New Officers		Departing Officer	Returning Directors	New Directors	Departing Directors
Pres:	Barnaby Watten	Thomas Losordo	Ivar Warrer-Hansen	Ep Eding	Yan-Nau Chu
1st VP:	Steven Summerfelt		James Muir	Kuen-Hack Suh	Kelly Rusch
2nd VP:	Michael Timmons		James Ebeling		Paul Hundley
Past Pres:	Ronald Malone		David Brune		Jaap van Rijn
Sec/Treas:	Brian Vinci		Raul Piedrahita		
			Rod McNeil		
			Shulin Chen		

AES Sponsors

The AES is looking for sponsors within the aquaculture industry to support the increased cost of producing the *AES News*. The sponsors listed below have donated generously to support the AES. For this donation, the AES will be inserting a one-page product literature sheet in one of the newsletter mailings, and list the vendor as an AES supporter in four consecutive newsletters. Please contact one of the *AES News* Co-Editors if you would like to be a sponsor.

Aquatic Eco-Systems, Inc.
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fax: (407) 886-6787
e-mail: aes@aquaticeco.com
web site: http://www.aquaticeco.com

Aquaculture Systems Technologies, LLC.
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fax: (504) 837-5585
e-mail: AQUASYS@BeadFilters.com
web site: www.BeadFilters.com

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fax: (858) 541-2048
e-mail: info@aquaneering.com
web site: www.aquaneering.com

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fax: (504) 736-9373
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www.aquaculture-supply.com

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54 West Dane Street, Unit A, Beverly, Massachusetts 01915,U.S.A.
ph: (978) 927-8720
fax: (978) 921-0231
e-mail: sales@marinebiotech.com
web site: www.marinebiotech.com

For more information on the AES, visit the AES web page at: http://www.aesweb.org

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To join the AES, please fill out the following information and send with payment to: Brian Vinci, c/o Freshwater Institute, P. O. Box 1889, Shepherdstown, WV, 25443, USA (fax: 304-870-2208). Make cheques payable to the Aquacultural Engineering Society. You do not have to provide education information to become a member.

Name ______________________ Position ______________________

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