PurGRO$_2$® iLS Technology

Presentation & Discussion

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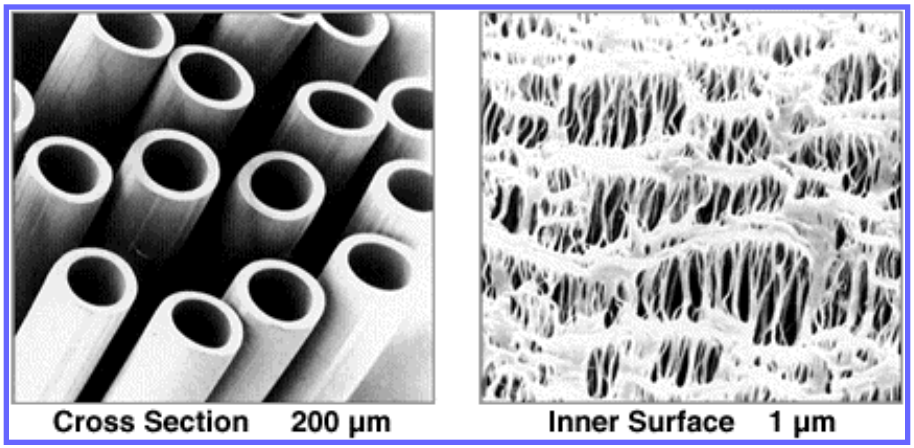
Gas inFusion Technology



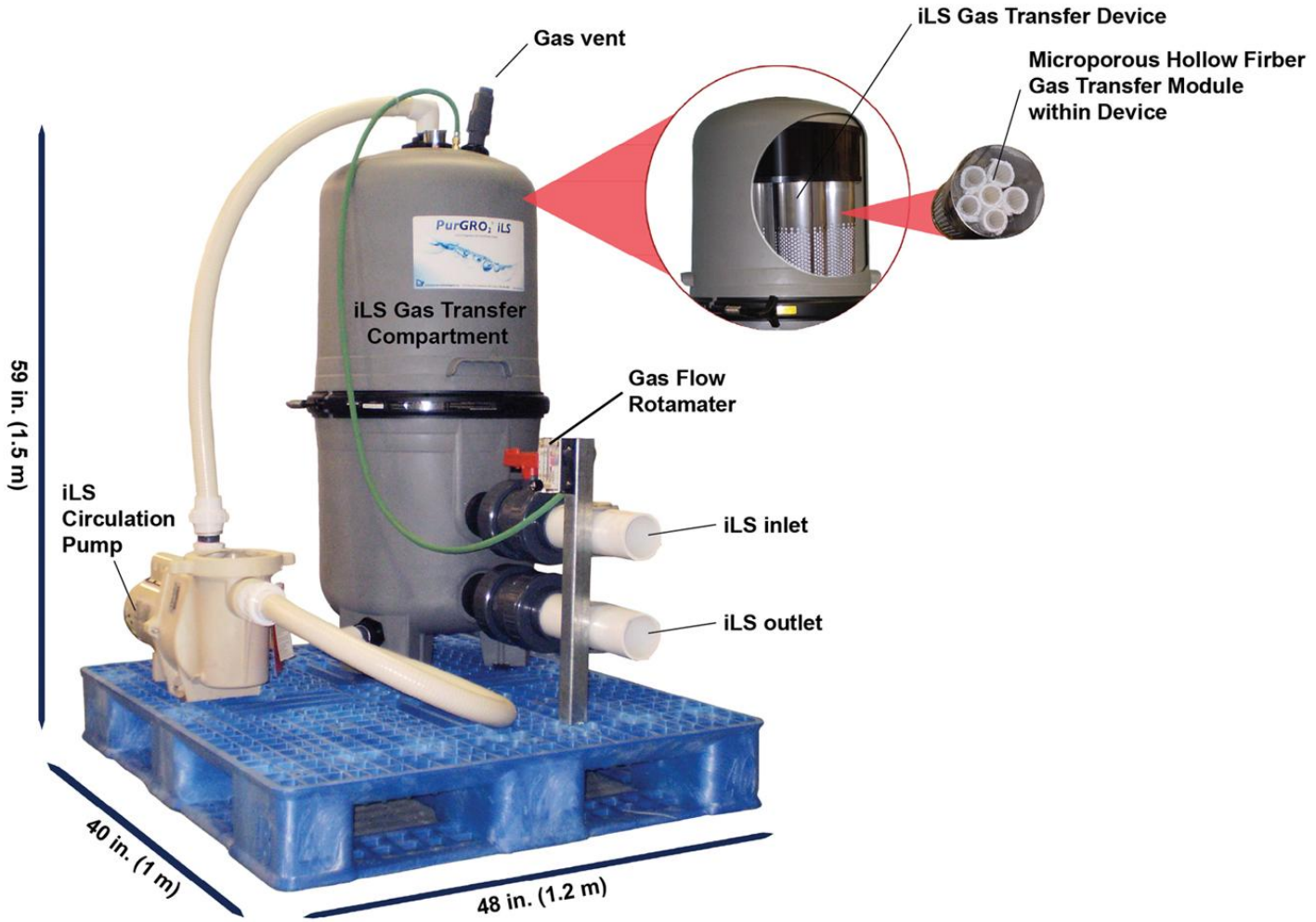
Microporous Hollow Fibre

- Achieves ultra-efficient mass transfer with hydrophobic microporous hollow fibre
- Enormous surface area in small volume (>7000 m^2 per m^3)
- No bubble, low energy, low decay, ultra-high dissolved gas concentrations (hundreds of mg/l)
- iTi design & manufacture
- ***Not*** a membrane
- Simple, small, low O&M, model predictable, easily retrofitted
- Equal efficiency in fresh & salt water
- Increases gas transfer with increased temperature

PurGRO$_2$® Technology

- Both a method & system designed to improve & optimize raising, growing out, & shipping of fresh & salt water species - both fin and shell fish
- Creates unique high oxygen, low nitrogen “controlled atmosphere” with normal TGP - stable in open tanks
- Delivery systems available in various sizes from high performance iLS to small tank holding & transportation model
- IP protected by patent & PCT - World Intellectual Property Organization:
    - (WO/2000/067886) Gas/Liquid Mixing Apparatus & Method
    - (WO/2004/039482) Controlled Atmosphere Gas inFusion

PurGRO$_2$® iLS


Gas vent
iLS Gas Transfer Device
Microporous Hollow Firber
Gas Transfer Module
within Device
iLS Gas Transfer
Compartment
Gas Flow
Rotamater
iLS
Circulation
Pump
iLS inlet
iLS outlet
59 in. (1.5 m)
40 in. (1 m)
48 in. (1.2 m)

PurGRO$_2$® iLS

iLS Performance Chart

iLS head	6ft (2m), 2.6 psi		Well Water	iLS head	15ft (3m), 6.5 psi		Well Water
Temperature	10° C	N_2 Inlet	110	Temperature	15° C	N_2 Inlet	110
O_2 Inlet	8 % sat.	O_2 Usage	8 LPM	O_2 Inlet	100 % sat.	O_2 Usage	8 LPM

Unit Throughput LPM	kg/day oxygen dissolved	kg/day nitrogen removed	iLS vessel % oxygen reading	iLS vessell % nitrogen reading	Unit Throughput LPM	kg/day oxygen dissolved	kg/day nitrogen removed	iLS vessel % oxygen reading	iLS vessell % nitrogen reading
800	7.81	2.79	68.83	96.86	800	8.60	2.74	174.06	95.88
600	7.54	2.68	86.27	93.19	600	8.26	2.63	194.84	91.92
400	7.04	2.48	117.65	86.65	400	7.65	2.43	231.73	84.89
200	5.82	1.95	189.19	66.58	200	6.24	1.99	314.90	68.96
100	4.35	1.47	278.93	49.59	100	4.54	1.45	412.49	50.06
50	2.88	0.98	367.04	32.71	50	2.92	0.94	502.72	32.29

PurGRO$_2$® iLS

iLS Performance Chart

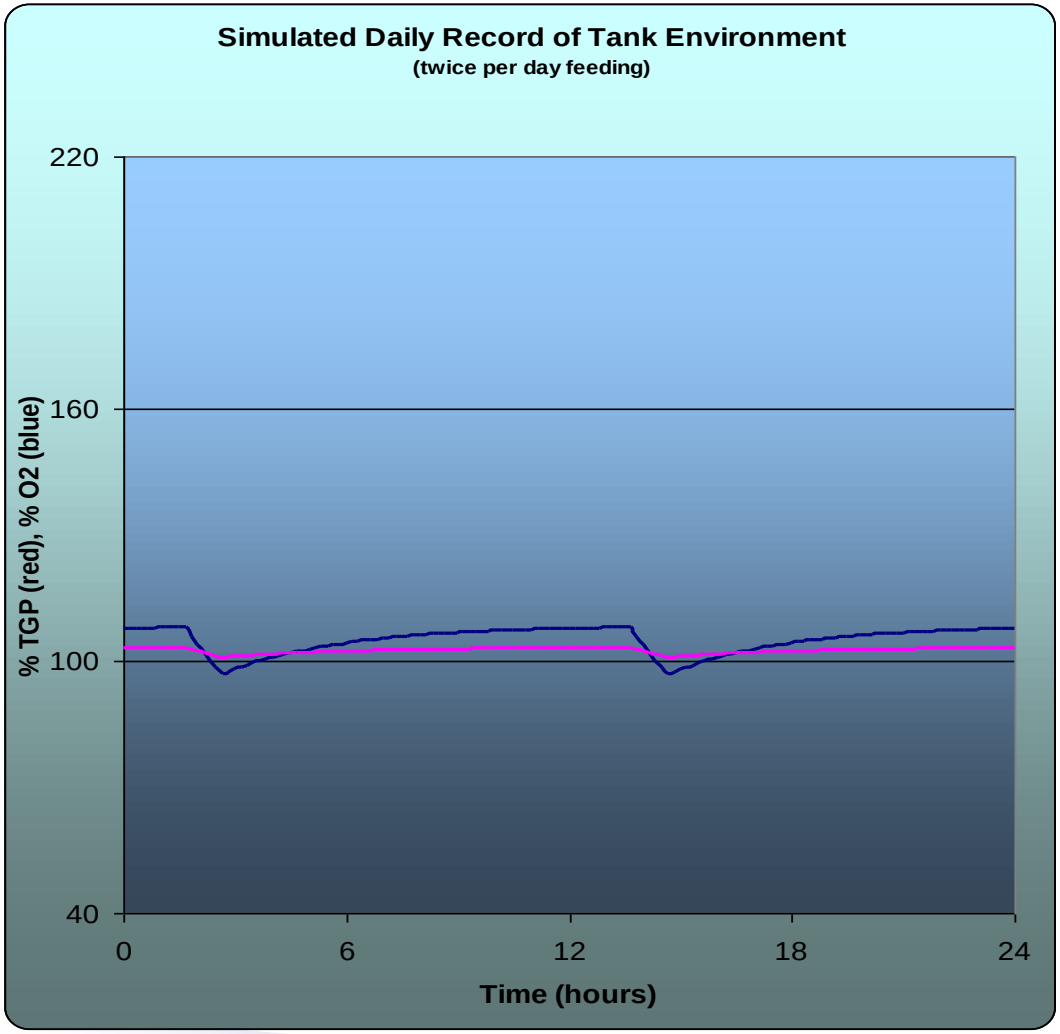
iLS Sensitivities				
Performance Characteristics	**Kg/day O_2 dissolved 0-12**	**Kg/day N_2O romoved 0-2**	**iLS % oxygen output**	**iLS % Nitrogen removal**
Increasing Variable	**Performance Change**			
Temperature	↑	↑	↑	↓
Gas Flow Rate	↑	↑	↑	↓
Inlet Oxygen Concentration	↓	↑	↑	↓
Salt Content	↓	↓	—	—
Water Throughput	↑	↑	↓	↑
Water Pressure	↑	↓	↑	↑

PurGRO$_2$® iLS Controlled Atmosphere

inVentures iLS Model Simulation Demonstration

Based on Crystal Springs Hatchery operational data

PurGRO$_2$® iLS Controlled Atmosphere



Baseline conditions: actual brook trout hatchery data- **Conventional Oxygenation**:

Flow: 200 LPM

Temp: 7.5° C

Inlet water: 7.5° C, 90% O_2, 105% N_2

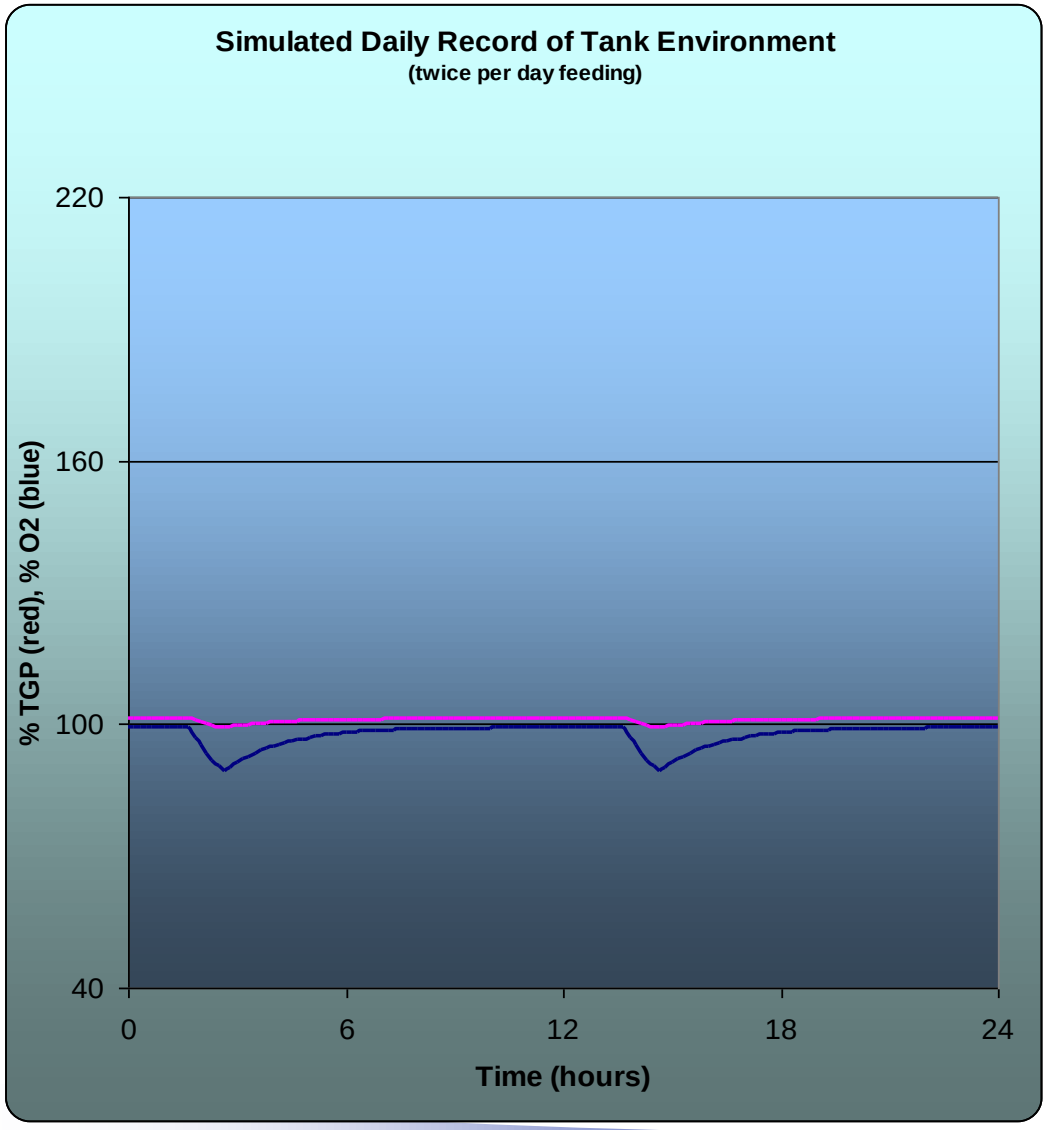
Oxygen Feed: 5.0 LPM

Tank Size: 40m^3, 4’ depth

Fish Density: 1000 kg; 25 kg/m^3

Poor growth conditions due to high TGP

PurGRO$_2$® iLS Controlled Atmosphere



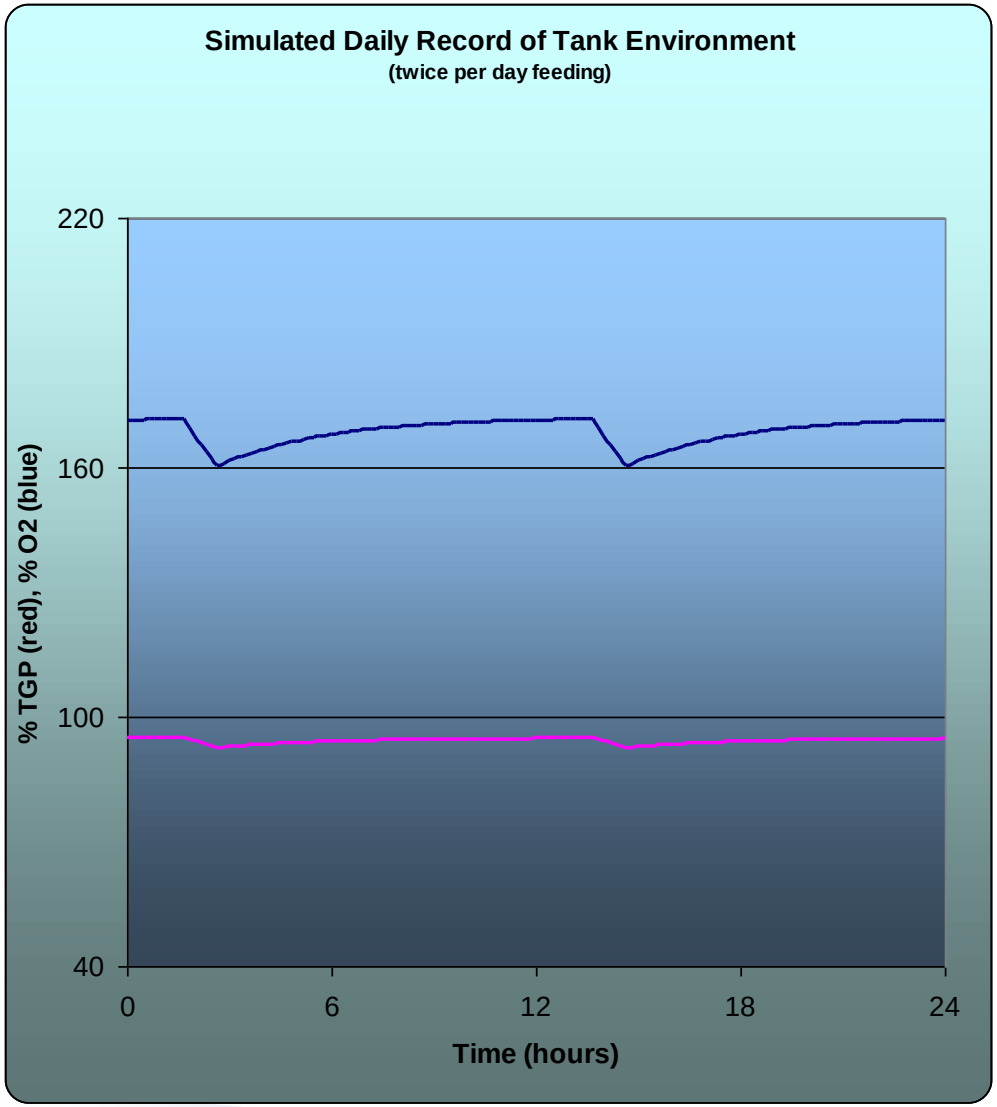
Conventional Oxygenation response to high TGP:

Flow: Increase to 400 LPM

Oxygen Feed Rate: 5 LPM

Results in TGP near 100% and adequate growth environment

PurGRO$_2$® iLS Controlled Atmosphere



PurGRO$_2$® Atmosphere with same baseline conditions of 4' head (<2 psi):

Flow: 200 LPM

Oxygen Feed Rate: 5 LPM

Results in TGP below 100% and excellent growth environment

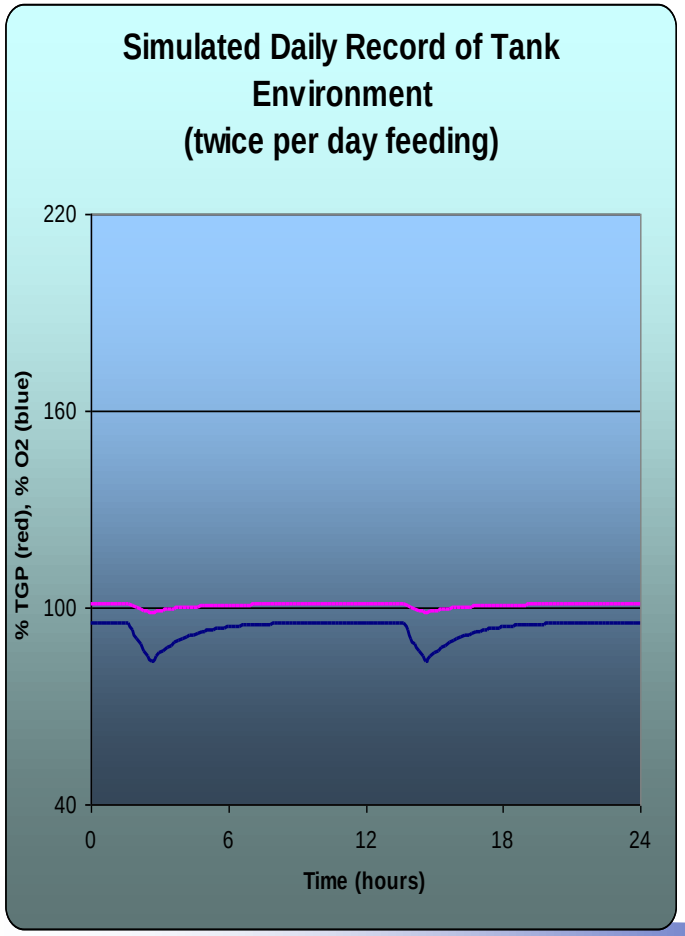
PurGRO$_2$® iLS Controlled Atmosphere

- Demonstrated PurGRO$_2$® Value Advantage:
  - Grow up to twice as fast
  - Convert food more efficiently
  - Create less waste
  - Have lower mortality rates
  - Show less stress
  - Feed less aggressively & longer
  - Use significantly less water
  - Use less oxygen while maintaining controlled atmospheres of 200 to 300%

PurGRO$_2$® iLS Process Control

Response to Temperature Increase

Conventional Oxygenation

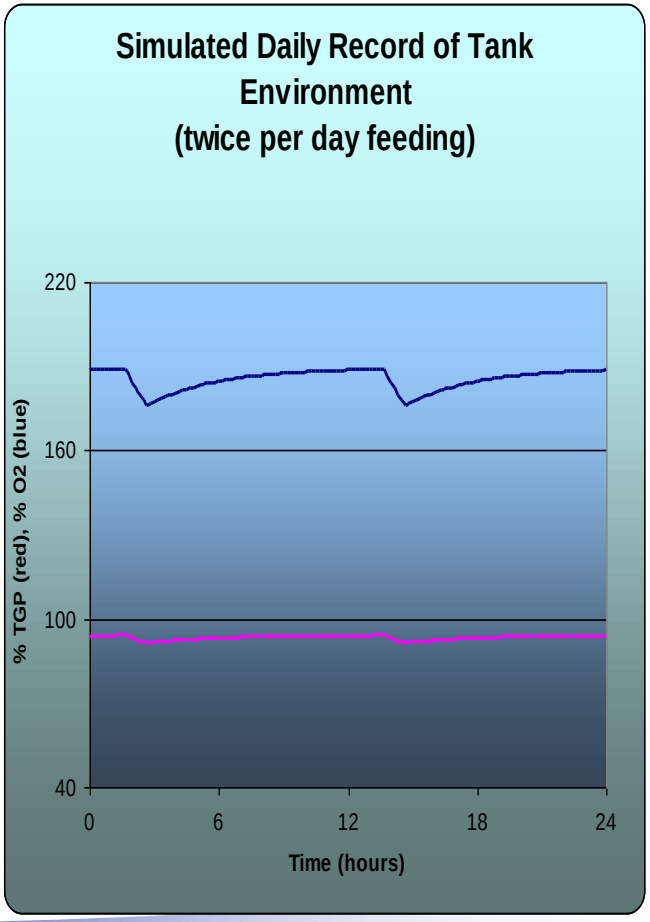


Temp: 15° C

Conv. Sys. at 400 LPM flow & 5 LPM O_2 reacts with less than ideal environment

PurGRO$_2$® system at 200 LPM flow & 5 LPM further improves with higher temp

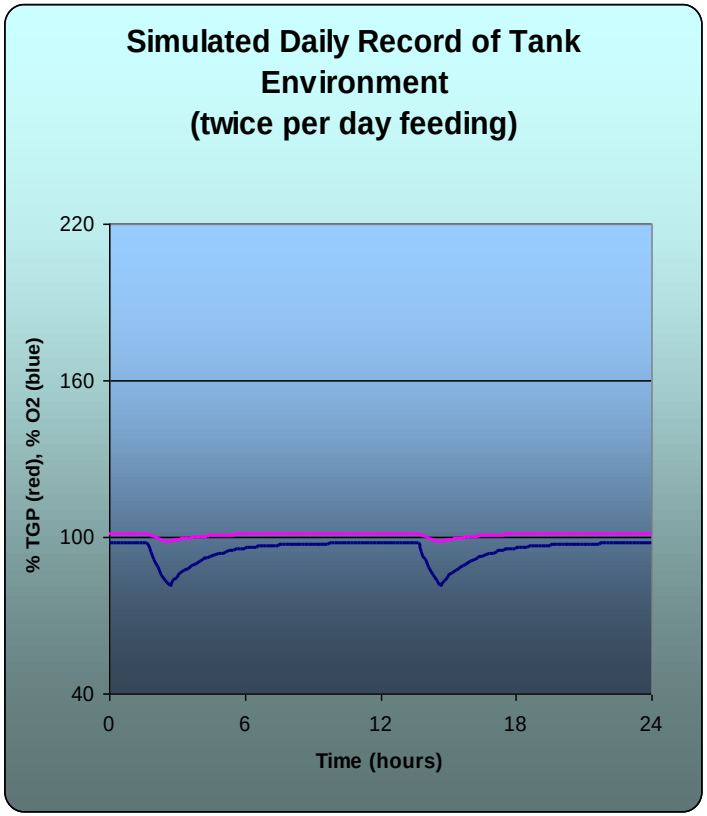
PurGRO$_2$® iLS



PurGRO$_2$® iLS Process Control

Response to Increased Temperature & Fish Density

Conventional Oxygenation

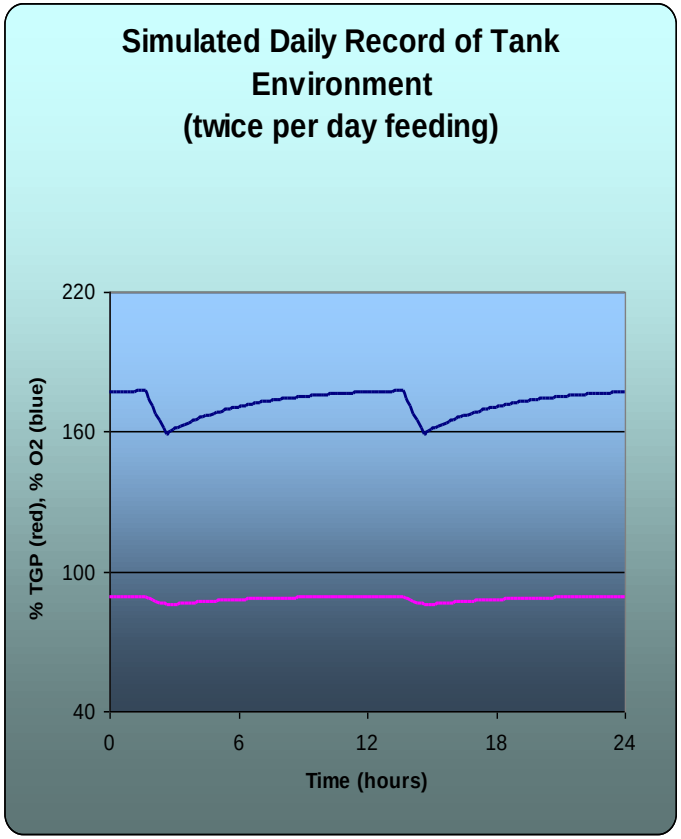


Temp: 15° C; Fish Density: 35 kg/m^3

Conv. System still at 400 LPM flow, now needs 7 LPM O_2, and still reacts with marginal conditions during feeding

PurGRO$_2$® System increases pressure by 1' head (<0.5 psi), and reduces flow from 200 to 175 LPM – still excellent conditions

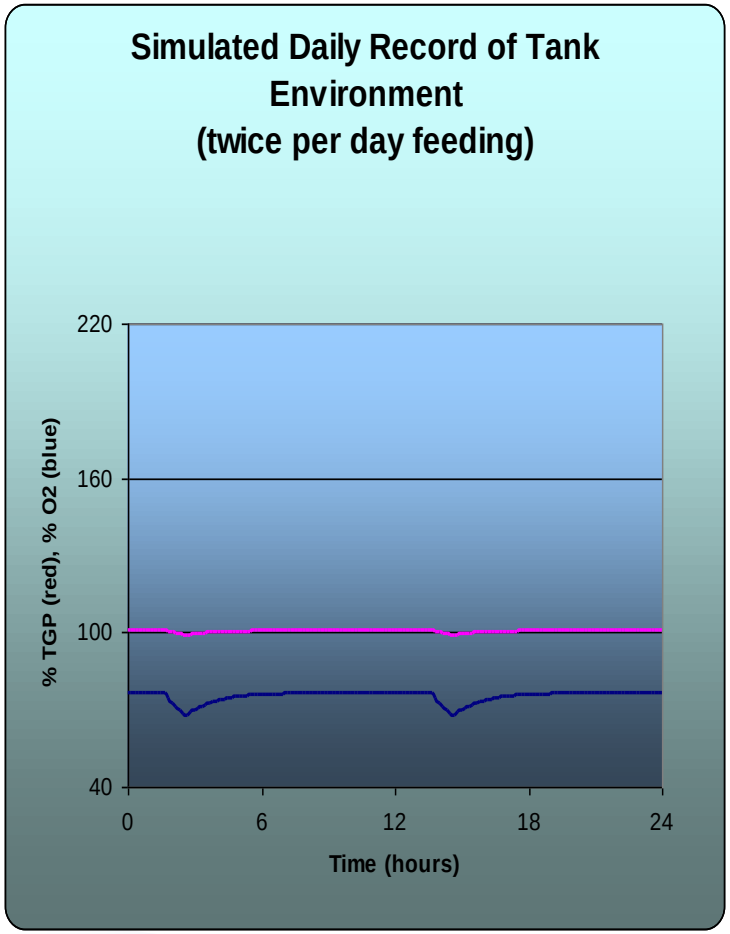
PurGRO$_2$® iLS



PurGRO$_2$® iLS Process Control

Response to Increased Temp, Fish Density & Lower Inlet DO

Conventional Oxygenation

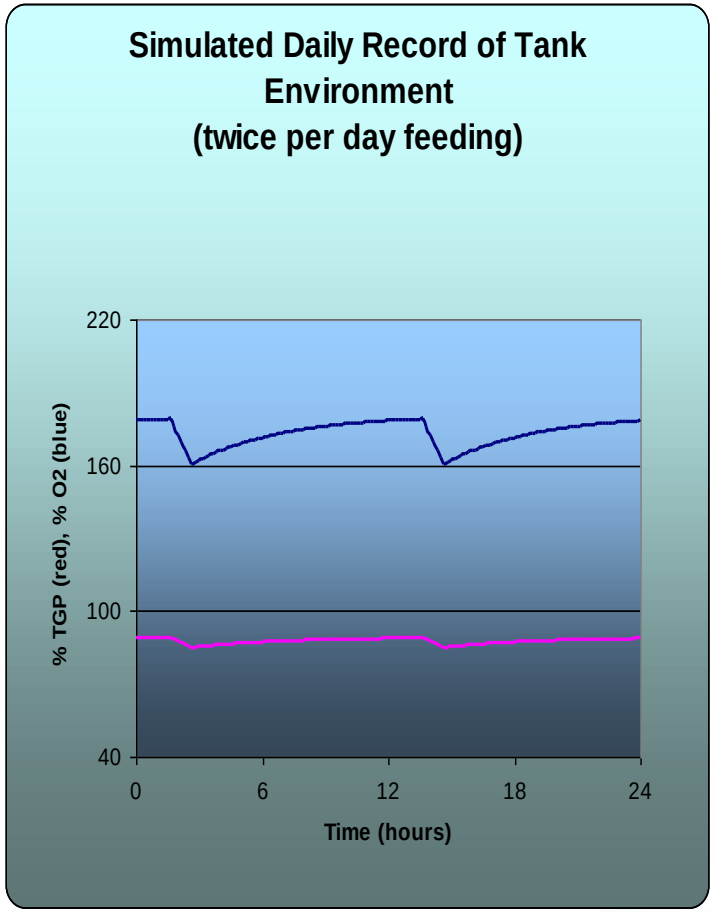


Temp: 15° C
Inlet O_2: 15%
Inlet N_2: 110%
Density: 35 kg/m^3

Conv. System increases flow to 500 LPM flow, O_2 to 15 LPM, reduces fish density to 20 kg/m^3, and still fails.

PurGRO$_2$® System increases pressure by 5' head (~2 psi), increasing O_2 by 1 LPM to 6, and reduces flow from 175 to 150 LPM – still excellent cond.

PurGRO$_2$® iLS



PurGRO$_2$® iLS Controlled Atmosphere

Remember, PurGRO$_2$® is *NOT* an oxygenation system.

PurGRO$_2$® *IS* an oxygenation & denitrogenation system that creates a controlled atmosphere through a simultaneous infusion of oxygen AND removal of nitrogen to maintain a Total Gas Pressure of less than 100%.

For more information:

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