



## Improving Commercial Aquaculture with Applied GES Biotechnology

Successful commercial aquaculture involves raising the maximum number of healthy, on-flavor fish in confined or semi-confined systems. It is well known that increasing fish density causes potential problems ranging from ammonia and nitrite toxicity to sludge build up. The LLMO Aquaculture System provides a cost effective way to eliminate ammonia and nitrite build up plus reduce sludge accumulation.

### Advantage Number 1: Improved Nitrification and Denitrification

Nitrification is the aerobic conversion of ammonia to nitrite, followed by the aerobic conversion of nitrite to nitrate. Everyone in the aquaculture business knows how harmful ammonia and nitrite build up can be. Conversion of ammonia to nitrite is accomplished by the action of the bacterium, Nitrosomonas. The conversion of nitrite to nitrate is accomplished by Nitrobacter. Compared to other types of bacteria, these nitrifying bacteria grow and function rather slowly. When a system is being started up, or after significant water exchanges, establishing a good population of nitrifying bacteria is a difficult and often lengthy process.

Denitrification occurs in zones where dissolved oxygen is quite low (less than 0.5 ppm). Denitrification is the conversion of nitrate to nitrogen gas. It requires bacteria which perform denitrification, and it also requires a source of dissolved organic carbon. When all conditions are present, the nitrate is converted to nitrogen gas and the dissolved organic carbon is converted to CO<sub>2</sub>, water, and new bacterial cells. Of course, nitrogen gas is completely non-toxic.

The LLMO Aquaculture System completely removes toxic forms of nitrogen from your system by performing nitrification and denitrification.

### Advantage Number 2: Reduced Sludge Build Up

Sludge accumulation results from excess feed and fecal matter. Sludge build up causes blooms of anaerobic bacteria. These anaerobic bacteria often release hydrogen sulfide, which causes off flavor problems. Anaerobic bacteria are also likely to be pathogenic to fish. Minimizing sludge build up is critical to fish health and commercial success. The LLMO Aquaculture System bacteria actually digest sludge and other organic materials. This dramatically improves the overall water quality, and minimizes off-flavor and disease.

### Advantage Number 3: Patented LLMO Aquaculture System Beats All Competitors

In repeated controlled laboratory tests, LLMO consistently outperforms the competition. With our unique Delivery System, large quantities of selected bacteria can be introduced continuously at minimum cost. This means that start up of nitrification after water exchanges or toxic shock (such as antibiotic addition) is greatly improved. This also means that as the fish population increases in numbers and fish size, the bacteria will be able to keep up with the excess ammonia and fecal load.

LLMO Aquaculture System Components:	
<b>LLMO NL</b>	Liquid, concentrated, bacterial culture. 100% live bacteria. Effective against nitrogen, phosphorous, and organic accumulations. Added directly to Delivery System on a weekly or monthly basis.
<b>LLMO S-1</b>	Liquid, concentrated, bacterial culture. 100% live bacteria. Especially effective against organic sediments. Added directly to Delivery System on a weekly or monthly basis.
<b>LLMO Accelerator</b>	Concentrated, proprietary formulation of bacterial nutrients. Supports optimal growth of all LLMO bacteria. Added directly to Delivery System on weekly or as needed basis.
<b>Powdered Nitrifier Activator (PNA)</b>	Proprietary formulation of specialized bacterial nutrients. Continuously supports optimal growth of LLMO Bacteria. Added to Delivery System weekly or as prescribed.
<b>Delivery System</b>	Batch and continuous models available. Add LLMO products to delivery System. Call GES for additional information regarding choice of Delivery system and dose rate.

### Benefits Of The LLMO Aquaculture System:

**LLMO Works.** Proper dosage of the right kind of bacteria, grown on-site for maximum activity, stops ammonia / nitrite build up and prevents sludge accumulation

**LLMO Is Economical.** Unique Delivery System actually grows bacteria, delivering many times more bacteria per dollar than the competition.

**LLMO Increases Your Profits.** Reduce mortality, reduce off-flavor, less stressed fish increase profits.

**LLMO Is Safe.** Approved by U.S.D.A. for use in food processing plants. NOT A CHEMICAL OR ALGICIDE. No permit needed. Non-toxic, Non-pathogenic.