

MicroClear® M100 Micronutrient Formulation

Ok, I have heard a lot about micronutrients. What are they?

Research biologists have long known the importance of micronutrients, such as trace minerals, amino acids and vitamins, in the growth and reproduction of healthy cells.

Micronutrients MicroClear® M100 are a blend of trace minerals, amino acids and vitamins designed to improve performance of biological systems at the bacterial or cell level. This is a unique blend formulated and manufactured by **Environmental Leverage® Inc.** Much of the work on micronutrients was pioneered in the agricultural industries of poultry, cattle and pig farming. This product is fed daily as a source of vitamins to the animals.

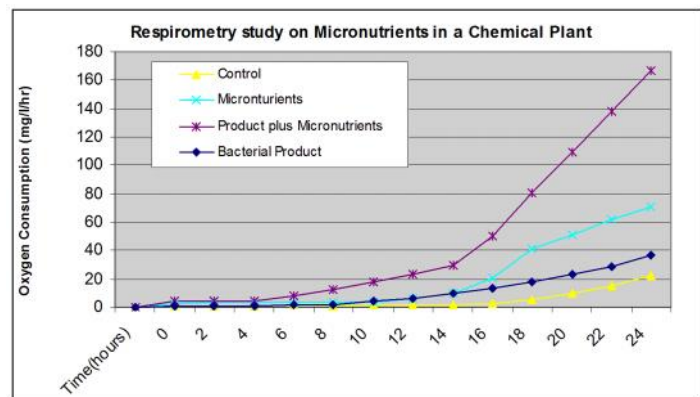


Under controlled conditions, researchers have been able to develop formulations that provide an optimum micronutrient balance to ensure rapid and healthy growth for bacteria in a biological wastewater setting. These micronutrients enhance biological growth and providing the critical building blocks necessary to maintaining a healthy floc-forming population. This product is a naturally occurring product, not a blend of chemicals.

Basically, it is the equivalent of "Bug Vitamins". The formulation consists of three types of micronutrients: trace minerals, amino acids and vitamins. There are sixteen trace minerals, including calcium, iron, magnesium, manganese, cobalt, copper and zinc. The formulation also includes twenty amino acids, such as lysine, and thirteen vitamins, including folic acid.

Micronutrients are metallic cations or anions such as: Ag, B, Cr, Co, Cu, F, I, Mn, Mo, Se, Si, Sn, V, and Zn. Although their composition is small in relative quantity, (less than 1% of total microbial weight), micronutrients are indispensable for life and form bio-molecules that have specific cellular functions.

Analysis of Micronutrients	Specification
16 Trace Minerals	Present in trace amounts
Calcium	1.9%
Iron	.08%
Magnesium	.123%
Zinc	.0035%
Phosphorus	0.1 %
<u>Vitamins</u>	Present in trace amounts
A, B, D, E, K	
Folic Acid	0.3mg
Ascorbic Acid	150,000 mg
Niacin	2,500 mg



What exactly can Micronutrients MicroClear® M100 do?

Research and field tests have shown that inadequate micronutrients can lead to poor settling or high effluent suspended solids due to unhealthy floc. The addition of micronutrients may also increase the biological degradation rate in many situations that will allow the biomass to respond more quickly to sudden increases in loads or toxic shocks. By maintaining adequate micronutrient levels, the system should also be more resilient to load swings or toxic shocks.

Literature has many references of the importance of trace metals and other micronutrients in the formation of biological floc to provide good settling.

From: Activated Sludge Process Design & Control: Theory & Practice, W. Wesley Eckenfelder & Petr Grau, pages 146-7

"The biomass requires nitrogen and phosphorus in order to affect metabolism and removal of organics in the process. In addition to this, however, trace levels of other nutrients are required to assure good floc formation."

Note: The section goes on to say that most trace elements are usually (but not always) present in sufficient quantities in the incoming wastewater.

Micronutrient	Requirement (mg/mg BOD)
Manganese	10 X 10 ⁻⁵
Copper	15 X 10 ⁻⁵
Zinc	16 X 10 ⁻⁵
Molybdenum	43 X 10 ⁻⁵
Selenium	14 X 10 ⁻¹⁰
Magnesium	30 X 10 ⁻⁴
Cobalt	13 X 10 ⁻⁵
Calcium	62 X 10 ⁻⁴
Sodium	5 X 10 ⁻⁵
Potassium	45 X 10 ⁻⁴
Iron	12 X 10 ⁻³

Table 4.6 Trace Nutrient Requirements for Activated Sludge From Wastewater Biology: The Life Processes, Water Environment Federation, page 120

MINOR BIOELEMENTS. Several elements are required by organisms in minute quantities, and are termed the minor, or trace, bioelements. Zinc, manganese, cobalt, copper, and molybdenum are required by all organisms for various growth functions and play important roles in the activation and structural integrity of enzymes, energetic (energy conservation) pathways, and the formation of certain organic compounds, such as vitamins required for growth. Some organisms require other trace bioelements, such as tungsten or nickel.

From *Wastewater Microbiology*, Gabriel Bitton, pages 177, 183

9.3.7 Nutrient Deficiency

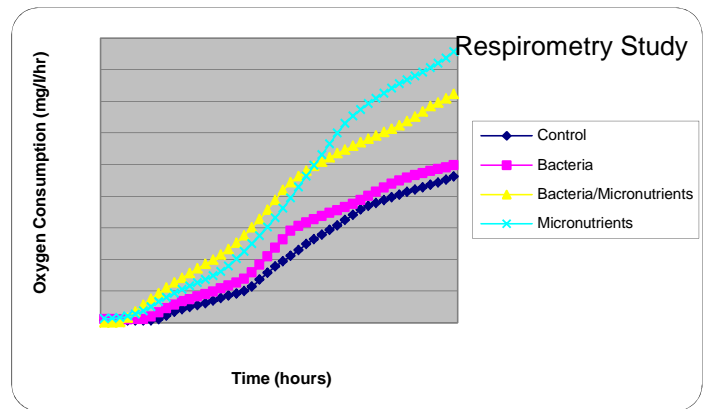
Deficiencies in nitrogen, phosphorus, iron or trace elements may cause bulking. This factor has not received much attention. The growth of *S. natans*, *Thiothrix* and Type 021N can be associated with nitrogen and phosphorus deficiencies. It has been suggested that the C/N/P ratio should be 100/5/1 (U. S. EPA, 1987a). It has also been suggested that iron and trace element deficiencies may cause bulking.

9.5.6 Other Specific Methods

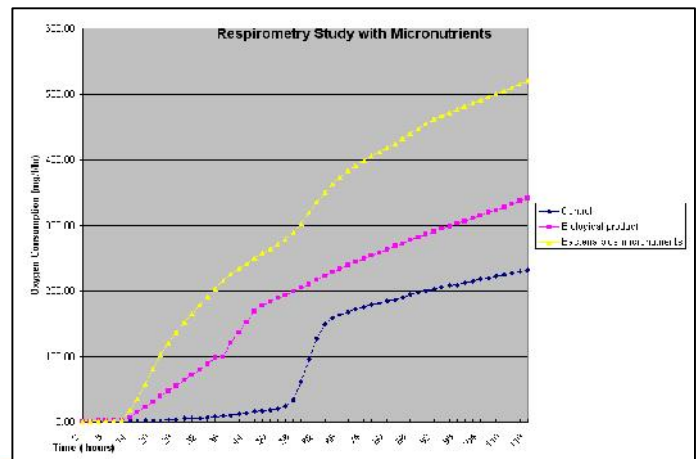
Iron Compounds (e.g., ferrous sulfate, potassium ferrate, Fe-custein) strongly inhibit the respiration of filamentous bacteria such as *Sphaerotilus*, *Thiothrix* and Type 021N (Chang et al., 1979; Kato and Kazama, 1991; Lee, Koopman, and Bitton, unpublished results). These chemicals deserve further exploration.

Examples of Respirometry Studies performed on various influents

Laboratory studies indicate that an application of micronutrients can lower final effluent BOD₅ levels by maintaining a healthy population capable of a more efficient organic reduction. Lab and field testing have shown that micronutrients are critical in the formation of development of new, healthy cells.



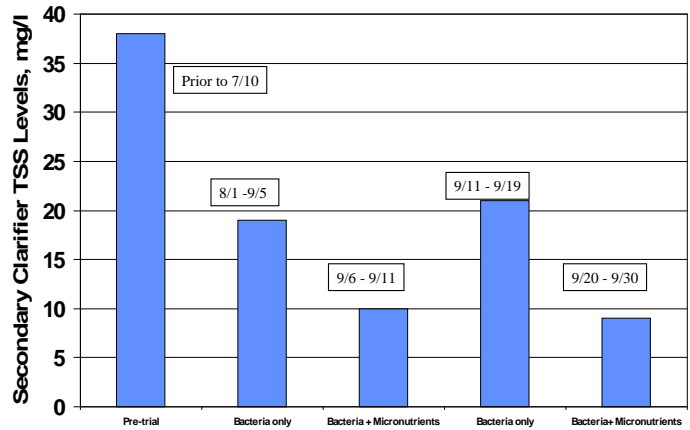
Micronutrients **MicroClear® M100** helps in the development of good floc formation by increasing the size as well as the characteristics of the floc structure. Regular application can provide numerous benefits to operators of all types of biological waste treatment processes. Daily or weekly application of micronutrients can help with settleability, filamentous control, dewatering ease, less polymer use and better solids control. Reduction in bulking sludge and better dewaterability typically results in lower solids handling costs. Studies have also shown decrease in final solids that need to be dewatered and land applied.



Micronutrients Field Trial Results

Field Test Results and Examples

This graph is from a paper mill in the southeast and contains actual data from monitoring and controlling the plant during the application of micronutrients. As you can see, TSS levels dropped significantly.



Paper mills: Case History with Total System Optimization:

100% Recycle paper mill -The first stage of the lagoon was aerated, second and third settling lagoons. Large amounts of algae scum and duckweed covered the last two stages of the pond. This pond was on a bioaugmentation program for years.



An audit was conducted; recommendations to move one of the aerators to the first half of the second stage were made to allow more oxygen to carry through the rest of the system.

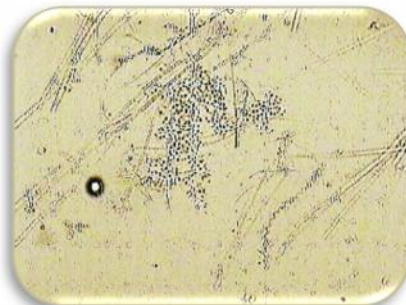
Bioaugmentation was changed from 2-5 lbs of product per day from their local supplier to 1-2 lbs. of **MicroClear® 118** and 1 lb. of **Micronutrients MicroClear® M100**

In less than 2 weeks, the scum was gone off the pond, the BOD and TSS removal improved, floc structures increased significantly and higher life activity went sky high. Short, free-floating filaments disappeared. Spirillum (usually an indication of septic conditions) and zooglea were gone after changes in treatment. Some filaments are still in the floc structures, mostly Type 021N, but that is due to solids handling problems in the primary clarifier that are under consideration for optimization.

*In the images below this is the plant prior to the Bioaugmentation program changes. Look at the top 2 images across. The bottom 2 photographs are after the addition of **MicroClear® 118** and **Micronutrients MicroClear® M100**.*

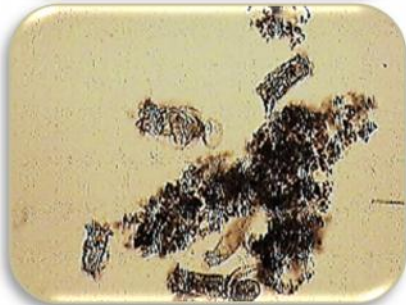
The primary clarifier still needs a bit of solids handling optimization, but the plant is waiting on an additional tank up front to store settled solids that are recycled back into the system.

The plant at one point had an upset for a two-week period; twice the loading of BOD was entering the lagoons. The final BOD was still below previous year's final effluent values and way below permit levels!



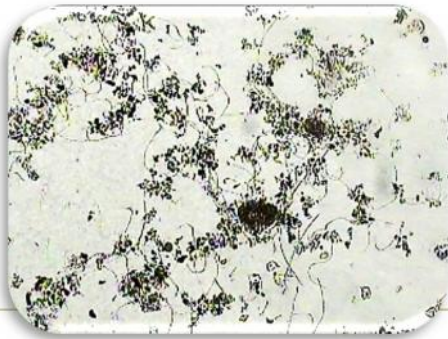
Zooglea & Spirillum
Microscope setting 400x BrightField in top left image.

Smaller Floc with a lot of Filaments
Microscope setting 100x BrightField in top right image.

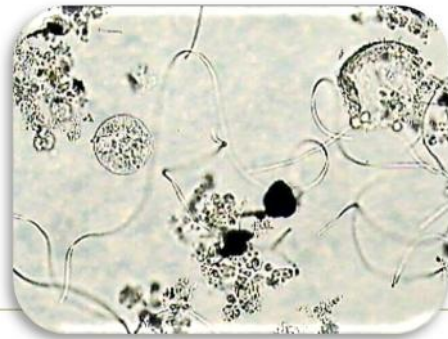


Larger compact Floc structures now.
Microscope setting 100x BrightField in bottom left image.

Significant increase in higher life forms, rotifers, less filaments & TSS
Microscope setting 100x BrightField in bottom right image.

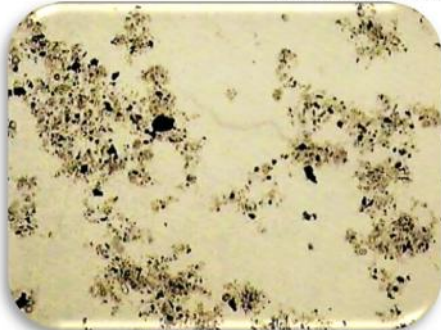


100x above image.

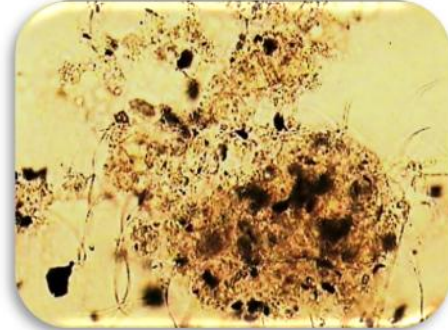


400x Bridging filaments & open lacy floc

Case History Industrial Facility - The top 2 images are a Gunpowder Production Facility before MicroClear® M100 Micronutrient administration



100x



400x

Look at these 2 images above, after addition of MicroClear® M100 Micronutrient.
Floc structures are larger & more compact which will create better settling.

**Note, in the above images of this plant which produces gunpowder, the black spots do not indicate septicity or anaerobic sludge like you would normally suspect, just carbon particles that are present in the influent. The plant still has some issues with low DO from influent EQ tanks and primary clarifiers that are contributing to some of the filaments, but those are process changes that will need to be mechanically fixed with time. Overall, the health of the system is better, settling has improved and more active higher life forms, just with the addition of micronutrients. Bacterial supplements have not been implemented here since at this time, the plant already runs an extended air sludge age due to nitrification demands and BOD removal is not a problem.

How is Micronutrient MicroClear® M100 packaged? MicroClear® M100 is a dry powder packaged either in bulk or individual water-soluble pouches of one pound each. It comes in 5-gallon pails weighing 25 pounds each. The product is available in the water-soluble bags or in "bulk".

If you would like more information on this product call 630-906-9791 or Email us at ... elfenvironmental@aol.com



How do you feed it? Ideally the product would be fed continuously. You can divide the daily dosage up and feed 1/2 or 1/3 on each shift, depending on the shift schedules. The product can be fed directly to the aeration basin or into the influent to the basin or lagoon or mixed in with a RAS line.

Product Dosage Rates: The dosage required will vary from plant to plant, but is generally based on the BOD₅ or COD loading to the system. The more organic material to be assimilated into biological cells, the more micronutrient required. The product must be fed on a regular basis to ensure that the proper balance of trace minerals, amino acids and vitamins is consistently available to the bacteria.

Additional Comments: If using this for a guideline to compare biological programs and vendors, please take into consideration Total Program value, cost per equivalent product in ratio, evaluations of shake flask testing, BOD/TOC as well as TSS comparisons. Health of the biomass after addition of product, technical support, training, program consulting, experience and additional corporate back up are also considerations that need to be accounted for. Many times the EPA can be involved with plants, new permit evaluations, etc. make sure your vendor is capable of providing you these services and recommendations if needed.

