

The Wastewater Insight



MICRONUTRIENTS

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 are a blend of trace minerals, amino acids and vitamins designed to improve performance of biological systems at the bacterial or cell level. 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 do?

Research and field tests have shown that inadequate micronutrients can lead to poor settling or high effluent suspended solids due to unhealthy floc. Addition of micronutrients may also increase the biological degradation rate

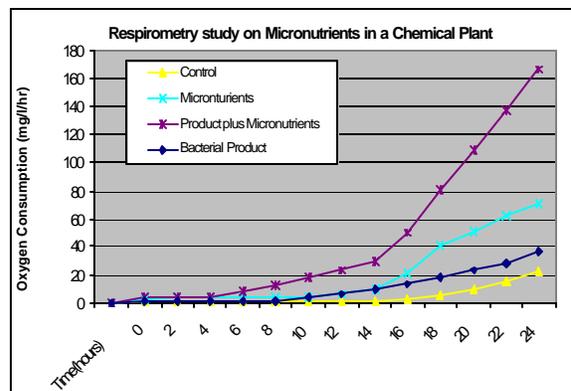
MYSTERY BUG OF THE MONTH

We started this month out with a new **Mystery Bug of the month!**



Check out our website for more photos of this very pink Spring Bug- our new colorful organism!!!!
WWW.EnvironmentalLeverage.com

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 and Control: Theory and Practice**, W. Wesley Eckenfelder and Petr Grau, pages 146-7

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"The biomass requires nitrogen and phosphorus in order to effect 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.

Table 4.6 Trace Nutrient Requirements for Activated Sludge

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

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.

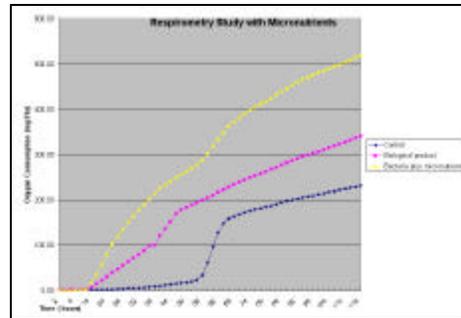
9.5.6 Other Specific Methods

Iron Compounds (e.g., ferrous sulfate, potassium ferrate, Ferrocystein) 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

help in the development of good floc formation by increasing the size as well as the characteristics of the floc structure.

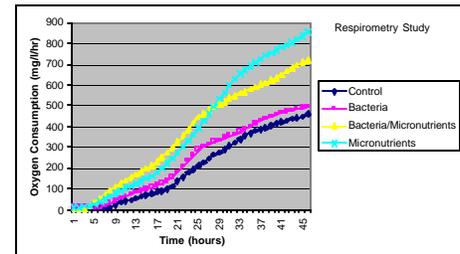


Regular application can provide numerous benefits to operators of all types of biological waste treatment processes. Daily or

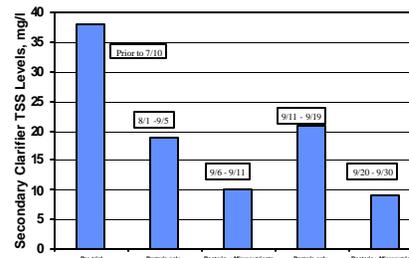
weekly application of micronutrients can help with settleability, filamentous control, dewatering ease, less polymer use and better solids control. Reduction in bulking sludge and better dewaterability typically results in lower solids handling costs.

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 papermill 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.

Papermills: Case History with Total System Optimization:

100% Recycle papermill-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 local supplier to 1-2 lbs of MicroClear 118 and 1 lb of Micronutrients.

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

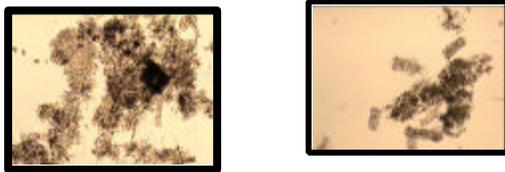
filaments are still in the floc structures, mostly Type 021N, but that is due to solids handling problems in the primary clarifier that are under consideration for optimization.

Prior to Bioaugmentation program changes



Smaller floc with lots of filaments Photos taken at 100x bright field
Zoogloea and spirillum Photos taken at 400x bright field

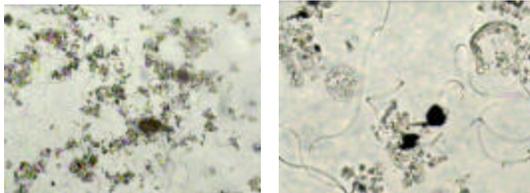
After addition of MicroClear 118 and Micronutrients



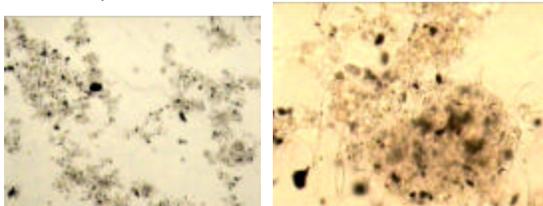
Large compact floc structures Significant increase in higher life forms, rotifers, less filaments and TSS
Both of these photos taken at 100x bright field

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!

Case History Industrial Facility- GunPowder Production Facility in the South East before Micronutrient Addition



100x Bridging filaments and open lacy floc 400x
After addition of Micronutrients Floc structures are larger and more compact



100x 400x
**Note, this plant produces gunpowder, to 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 does the Micronutrient product come ? 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".

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.

Be prepared for this spring, give your treatment plant a boost with Micronutrients from Environmental Leverage today!!!!

S

pring is just around the corner. Is your plant ready for the change in weather?



During the winter months, aerated digester capacity is sometimes maxed out due to cold weather limitations, decreased activity, and land application limitations. Many plants often

forget that the digester has the same "Critical 5" components as the aerated or secondary portion of the wastewater system.

The only difference is that you are starving the bacteria in the digester to decrease solids. The bacteria in the digester still need pH control especially since CO₂ and respiration continue. N and P are usually not a concern, due to the re-release of nutrients from the dying bacteria. Oxygen is critical and many plants do not make sure that mixing and DO levels are maintained and digestors often turn septic and create many of the filament problems found in a plant due to the fact that the supernatant is returned to the front of the system. This spring, when biological activity starts to increase as temperatures rise, make sure that all 5 of the critical parameters are met in your aerobic digester.

Spring rains can cause hydraulic washout in a system if excessive. Make sure that you check the beds in your clarifier carefully. Too high a bed or too old sludge will increase the chances for solids washout with high flows.

Spring or fall turnover also may contribute to temporary odor control issues in wastewater lagoons. Turnover occurs as the lagoon is heating up in the spring or cooling down in the fall. During turnover, water from the bottom (which is high in odor) comes to the top and water from the top moves to the bottom. Increasing the air or DO and mixing in the lagoon can help shorten the turnover period.

Why does spring turnover happen? The density of water changes as temperature changes. Water is the most dense at 39°F. Both above and below that temperature, water expands and becomes less dense. This means that in the spring, just before the ice melts, the water near the bottom will be at 39°F. Water above that will be cooler, approaching 32°F just under the ice. As the weather warms, the ice melts and the surface waters begin to heat up. Wind action and increasing density cause this surface water to sink and mix with the deeper water.

The sequence of events leading to spring overturn include: (1) the melting of any ice cover; (2) the warming of surface waters; (3) density changes in surface waters producing convection currents from top to bottom; (4) circulation of the total water volume by wind action; and (5) vertical temperature equality. The overturn results in a uniformity of the physical and chemical properties of the entire water mass.

Drinking water

Taste and odor problems with the tap water can come from numerous sources. Lake turnover that occurs in the spring and fall can create problems from



organic material from the bottom of the lake.

Another thing to consider with the coming warm months—With the increase in temperature, light and residual N and P, algae

growth will increase. Algae control on the weirs of the clarifiers or other parts in the system. Algae can lead to a false BOD reading. Each milligram per liter of algae in the effluent exerts approximately 0.5 mg/L of BOD₅ as a rule-of-thumb. Algae can also impact DO levels. Lower levels of dissolved oxygen as a result of algal blooms causes fish kills in the receiving final body of water. Weir maintenance is critical in spring and summer months.

Biological activity increases and decreases with temperature changes. For every 10-degree change, the activity of the bacteria changes one logs growth. Make sure that you are prepared for the increase in activity as the temperature warms up. DO requirements will increase as activity goes up. Nutrient addition is applicable at your plant will increase. MLSS values will need to be lowered in your system. Clarifiers beds need to be monitored and adjusted. PH will need to be monitored as activity increases.

Pollution Prevention

More and more private businesses and public entities are adopting pollution prevention as an integral part of their operational strategy in order to maximize production efficiency and minimize waste. Adopting pollution prevention in your organization will help to:

- Reduce waste and pollution
- Increase efficiency
- Develop alternatives to treatment and disposal
- Provide sustainable use of resources
- Create a healthy work environment
- Promote regulatory integration
- Address compliance regulations

There are a number of sites that have information on pollution prevention.

<http://www.epa.gov/p2/aboutp2/index.htm>

P2 Programs :

The goal of the Pollution Prevention Act is to reduce waste at the source, before it is generated. EPA's P2 program is designed to facilitate the incorporation of pollution prevention concepts and principles into the daily operations of government agencies, businesses, manufacturers, nonprofit organizations, and individuals.

Pollution Prevention Grant Program NEW! FY '05 Request For Application EPA expects to have approximately \$4.5 million to support pollution prevention grants to States, Tribes, and Intertribal Consortia in FY 2005 for prevention activities during FY 2006. The Request for Application is now available online.

EPA provides funds annually through P2 Grants to help develop and sustain state P2 program activities and pioneer new P2 approaches in the states.

www.epa.gov/p2/ppis/ppis.htm

We have found some very interesting as well as informational websites on the Internet. Rather than write



training on every subject, which could take forever in the area of wastewater treatment, we have no problem directing you to other useful sites that may save you time and energy in solving a problem. We hope you enjoy these and we will provide a

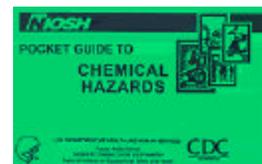
few more each month! If you have a special request, let us know since we explore the world through the Internet all the time!!

<http://www.cdc.gov/niosh/npg/npg.html>

NIOSH Pocket Guide to Chemical Hazards (NPG)

contains information on 677 chemicals or substance groupings.

Printed copies are available from the National Technical Information Service (NTIS) and the Government Printing Office (GPO).



<http://www.msds.com/> Free Material Data Safety Sheets

<http://www.osha-slc.gov/dts/osta/oshasoft/> OSHA eTools and Electronic Products for Compliance Assistance

COMING NEXT MONTH

Beneficial Reuse in Industrial facilities

Solids Handling and ways to optimize- land application