next™ FOG Treatment

Too many disappointing results from adding enzymes and bacteria

The plethora of much vaunted claims for the revolutionary gains of biological solutions have too often been a mirage. Generally speaking, the introduction of a foreign biology is site specific and often ends up causing havoc downstream in the collection system.

This has caused those who have experienced poor results from these treatments to become sceptical and resistant to anything which remotely resembles them. Next ask—why introduce new colonies of bacteria when the indigenous population is already there and well adapted for the local environment? New bacteria colonies often die off, so why introduce them when instead, you can effectively stimulate the indigenous bacteria to produce natural enzymes inside the system.

Don't add bacteria and enzymes—accelerate the natural action of those already present in the system

Adding Next FOG formula to the sewer prevents the build up of FOG all the way to the sewage pumping station and sewage treatment works. Next Fog Formula's Molecular Kinetics technology works with the indigenous bacteria, and is proven to be a much more effective solution. The formula is less costly and more sustainable in the long run when compared to expensive bacteria/enzyme treatments that may have only short-term local effects, but not long term benefits... particularly downstream. If there isn't sufficient indigenous bacteria present, then there is a problem with the existing environmental conditions. Adding bacteria is unlikely to have much effect—maybe it will last a few days but dies off. Dosing with the Next Fog Formula at only a few ppm will stimulate the indigenous bacteria population and accelerate natural bio-degradation. Our approach is much more effective than introducing foreign bacteria colonies into a sewer situation.

Positive results in the field—technology verified by Isle Utilities for Technology Approvals Group (TAG)

The Next FOG Formula's Molecular Kinetics technology is successfully deployed across North America, Brazil, UK and UAE. This technology was recently successfully evaluated and deployed by an innovative water company, a global fast food restaurant chain, and multiple military bases.

This treatment is particularly beneficial in pumping stations, and in sewers servicing busy fast food restaurants.

next F.O.G. STOP™

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next™ The Science©

Yeast protein-surfactant complexes uncouple microbial electron transfer and increase transmembrane leak of protons.

Aims: To explore the combined effect of yeast proteins and surfactants on bacterial metabolism.

Methods and Results: Protein-rich cell-free supernatant from heat-shocked yeast Saccharomyces cerevisiae was combined with certain synthetic surfactants. These blends affected the metabolism of a Polyseed inoculum of aerobic bacteria, accelerating CO2 production and consumption of nutrients from a sterile nutrient broth solution, without a concomitant accumulation of biomass.

It was established that in the presence of the yeast protein–surfactant complexes, bacterial electron transport is uncoupled from biomass accumulation. The 'uncoupling hypothesis' is supported by experiments with model membranes, in which the same complexes induced proton leak similar to standard chemical uncouplers, such as dinitrophenol, indicating that uncoupling may occur at the stage of generation of the transmembrane pH gradient as the driving force for ATP production.

Conclusions: Yeast protein–surfactant complexes behave as uncouplers of oxidative metabolism in bacteria and appear to do so by increasing proton permeability of membranes.

Signigicance and Impact of the Study: Yeast proteins are of interest as nontoxic, environmentally benign and economically sound agents accelerating oxidative bacterial metabolism while uncoupling it from biomass accumulation.

There are actual and potential implications in waste water / soil decontamination, degreasing and other environmental technologies.

The major conclusion for this study is that the nature of the synergistic enhancement of the decontaminating effect of the yeast protein–surfactant complexes in natural environments are, at least partially, because of it's uncoupling of electron-transfer metabolism in a natural blend of bacteria, from the energy accumulating steps of generating the transmembrane pH gradient, and eventually ATP synthesis.

Such an uncoupling results in the acceleration of the electron transfer associated with increased consumption of nutrients and carbon dioxide production, hence increasing the rate of processing of hydrophobic organic contaminants, such as petroleum oil or grease, without a concomitant increase in bacterial biomass. At the same time, the complexes act as a powerful surfactant, drastically reducing the interface tension between the hydrophobic particles to be processed and eliminated from contaminated media. That facilitates the processing of contaminating microparticles of petroleum, fats and oils by bacteria. Moreover, the synergism most likely consists not only in the acceleration of bio-oxidation per se, but also the conversion of contaminating hydrophobic compounds, by enzymatic hydrolysis and partial oxidations, into heteropolar surface-active species, thus additionally facilitating further processing of hydrophobic contaminants.

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next™ Waste Water Treatment

The core technology, Molecular Kinetics, combines biologically active proteins, produced by a hybrid fermentation process, micronutrients, enzymatic cofactors and surface-active agents in a proprietary formulation. The mode of action for the formulation does not require a direct chemical reaction between the active ingredients of the formulation and the organic contaminants, rather the synergism of the individual components leads to a product effectively promoting the biostimulation (bioactivation) of indigenous micro-organisms.

Research data suggest that the 'stimulatory' effect is partly caused by a process similar in nature to the 'uncoupling' of the microbial metabolic pathways. Laboratory experiments demonstrated that the formulation not only amplifies the metabolic rate of organic carbon degradation, as indicated by the accelerated reduction of total organic carbon (TOC) and increased oxygen uptake rate (OUR), but also lowers the amount of biomass. The carbon mass balance shown in Figure 1, demonstrates how this accelerates the metabolism of organic carbon without a concomitant increase in biomass production compared to the control. The excess carbon metabolised with the treated sample was off-gassed in the form of CO2 rather than being converted to biomass or biofilm. These observations were confirmed in field trials, where feeding the formulation into the inlet stream of municipal and industrial wastewater facilities led to a decrease of biological oxygen demand (BOD) and total suspended solids (TSS), and an increase of dissolved oxygen (D.O.).

Nutrient metabolism without a concomitant increase of biomass can be achieved by uncoupling biochemical degradation (catabolism) from biochemical synthesis (anabolism). Uncoupling can occur during the oxidative phosphorylation resulting in lower adenosine triphosphate (ATP) formation, or by dissipating generated ATP through 'energy spilling' (Russel and Cook, 1995). Low and Chase (1998) demonstrated the use of chemical uncouplers for reducing biomass production during biodegradation by adding various levels of para-Nitrophenol (pNP) to a monoculture of Pseudomonas putida. These studies demonstrated:

1. The addition of the organic protonphore pNP reduced biomass production and increased the specific substrate uptake rate.

2. When there was reduced energy availability as a result of uncoupling by pNP, cells satisfied their maintenance energy requirements (membrane potential, motility, etc.) prior to providing energy for growth (protein, DNA synthesis etc.).

High costs associated with the use of synthetic uncouplers for wastewater treatment have been at least partly responsible, why this approach has not found widespread application.

Decreasing the ATP available for biosynthesis, reduces the growth rate of bacteria and therefore the amount of biomass or sludge. If microorganisms exhibit a similar behavior to mitochondria in their metabolic regulation, a reduction of cellular ATP would provide a stimulus to the feedback control loop, promoting further catabolism of organic material in order to compensate the 'ATP-starvation'. If use of the formula is discontinued, the bacteria revert to their normal respiration/metabolic rate.

next™ Molercular Kinetic Studies

Molecular Kinetics affects the rate at which the biomass utilises oxygen. As a rule of thumb, 6 kilograms of BOD will require 10 kilograms of oxygen. The use of this formula does not change that fact. However, laboratory and field data demonstrate that it does improve the oxygen uptake/oxygen utilisation rates of the biomass. This might be in part due to an improved oxygen transfer rate, caused by the formulations reduction of the critical micelle concentration (CMC). A more efficient use of the available oxygen and a reduction of oxygen adsorbing soluble and non-soluble carbon, will lead to increased D.O. levels and inevitably to a decreased aeration power consumption.

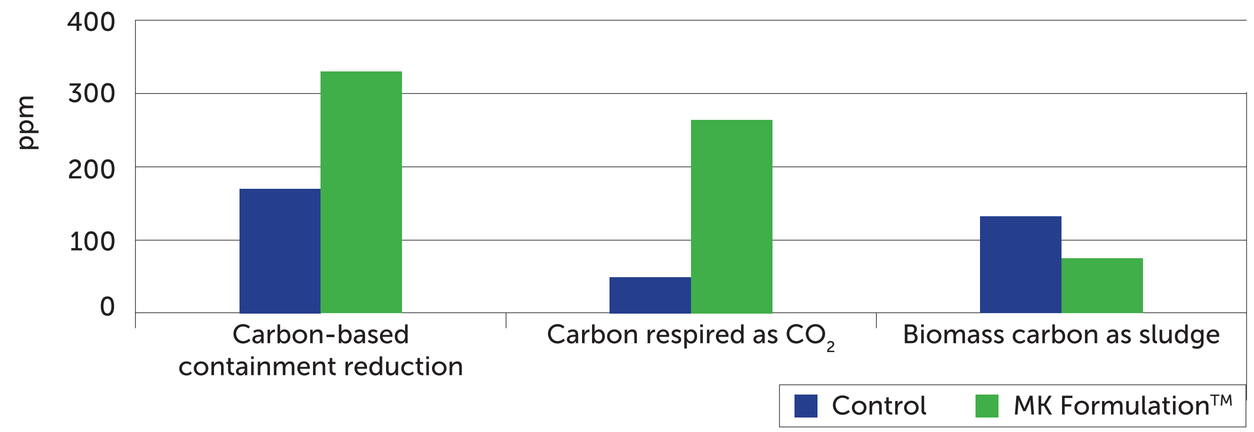
The degree to which the MK formulation facilitates the metabolism of the carbon source is not dependent on the type of carbon source (e.g. carbohydrates, proteins, fats, etc.), but rather the availability of the carbon source. Therefore, if the carbon source is readily available to the bacteria and all other environmental conditions, i.e. temperature, pH, electron acceptor are conducive to microbial metabolism, the formulation will greatly accelerate the degradation of contaminants such as grease and oil, over what would be seen in its absence.

The product functions well in aerobic municipal and industrial wastewater treatment systems, as well as in wet wells and gravity sewer lines where there is oxygen available in the headspace and turbulence to facilitate oxygen transfer. Formed byproducts are those that would be naturally produced by indigenous bacteria, with or without the introduction of the formulation, that is; biomass, CO2, water and inorganic salts.

The formulation is non-toxic and completely biodegradable. It has been cleared by the USDA for the usage in food processing facilities.

CARBON MASS BALANCE STUDY

Biodegradation of Synthetic Wastewater after 4 Hours



	Untreated	MK Treated™	% Difference
Carbon-based containment reduction	175.3	328.6	↑ 87.5
Carbon respired as CO_2	49.5	263.8	↑ 432.9
Biomass carbon as sludge	142.8	76.8	↓ - 46.2

TOTAL PLATE COUNTS - 4 HOURS	6.9 x 10^7	6.0 x 10^6

Figure 1: Carbon mass balance study showing the formulations ability to metabolise twice as much carbon as the control, while producing 50% less biomass from the assimilated carbon. These results are further corroborated by an almost 10-fold lower amount of bacterial colony forming units during the total plate count. In addition, the process caused an approximately 5-fold increase in the formation of carbon dioxide.

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