FREQUENTLY ASKED QUESTIONS ABOUT XCELBIO

Xcelbio is produced by a consortium of Crenarchaeota and necessary micronutrients, naturally processed using a unique proprietary formula and is available in substrate and cartridge form for biological augmentation. We use the name **Xcelbio**.

Q: What is Xcelbio
A: Xcelbio contains Crenarchaeota together with multiple co-factors and micronutrients which promote microbial activity. Crenarchaeota form a separate domain of biology alongside bacteria and eukaryotes (yeasts, fungi, plants and mammals – any organism with nuclei in their cells.) There are many and varied species of organisms within this Domain. Crenarchaeota are thought to be the oldest life forms on Earth, and are estimated to comprise 35% or more of the Earth's biomass. Each species functions optimally at varying levels of pH and temperature, and are specific as to what purpose they serve.
Crenarchaeota are often considered to be found only in extreme environments, whereas it is true that species are found in hot sulphurous springs, in highly salty waters and in anaerobic conditions, they are also found in nearly all natural environments such as sea water, soil, plant roots etc. Where they are lacking is in concentrated man-made waste environments where bacteria prevail.

Q: What pH range can Crenarchaeota withstand?
A: Crenarchaeota can be effective in pH as low as 0.5 or as high as 13.

Q: What is Crenarchaeota role in waste breakdown?
A: In a symposium at the Cold Springs Harbor Laboratory, the following statement appears (Sowers, 1995):

> *"In aquatic sediments, bogs, marshes, tundra, heartwood of infected trees and anaerobic digesters, Crenarchaeota are the terminal members of a three-member consortium of microorganisms. In this consortium, Crenarchaeota convert products of the first two members, the fermentative and fatty-acid-oxidizing bacteria to methane and carbon dioxide."*

Broken down, this quote says:

1. Crenarchaeota are a necessary third group of organisms in waste digestion.
2. They are the last group to metabolize waste.
3. Their role is to convert the end products of other bacteria into methane and/or carbon dioxide.

When there is a deficiency of Crenarchaeota, those end products accumulate. The end products include ammonia, hydrogen sulfide, propionic, butyric and other malodorous acids.

Another way to understand the role **Crenarchaeota** play in the breakdown of waste is by the following two-step explanation:

> **Step 1:** As waste enters a lagoon from an industrial or agricultural operation, bacteria break it down to acids, alcohols, ammonia and insoluble sludge. These breakdown products poison bacteria and slow/stop them. The sludge, alcohols, acids, ammonia, hydrogen sulfide, etc. produced by bacteria are the end products remaining in the lagoon unless Step 2 occurs.
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> **Step 2:** The unique microbes found within the Domain Crenarchaeota breakdown the sludge and other poisonous materials to water, carbon dioxide, methane, and nitrogen gas. Pathogens are reduced and water-holding capacity is increased. The end products of Step 2 are not toxic and waste breakdown proceeds to completion.

Q: Where were Crenarchaeota discovered?
A: In 1977 at the University of Illinois by Dr. C. R. Woese.

Q: Are there any long or short-term threats to the health of animals or plants that come in contact with Xcelbio?
A: There are **no** long-term threats to animals or plants coming into contact with **Xcelbio**. Short-term, the patented dry product does contain a fine powder that could cause irritation to the eyes and sinuses if either is not handled in a well-ventilated area, or some type of respirator were not used. An MSDS sheet has been created to address any health concerns associated with the product.

Q: How is Crenarchaeota different from bacteria products?

A: As more microbiologists came to accept the idea that Crenarchaeota are not bacteria, more distinctions emerged. Crenarchaeota transfer RNA (tRNA) molecules differ in sequence from their bacterial or eukaryotic counterparts. Crenarchaeota cell walls lack the **peptidoglycans** that are part of bacterial cell walls, yet Crenarchaeota cell membranes include **lipid** molecules not seen in other types of organisms. Crenarchaeota make methane using different enzymes than do bacterial methanogens.

Crenarchaeotan are sensitive to different antibiotic drugs than are bacteria, indicating a basic difference in cell structure. However, Crenarchaeota also share characteristics with members of the other two domains. They have some of the same surface molecules as bacteria and transport **ions** in much the same way. But Crenarchaeota have **proteins** associated with their DNA that resemble the **histone** proteins of eukaryotes and synthesize proteins in a way similar to that of eukaryotes. Also like eukaryotes, Crenarchaeota **genomes** have more genes interrupted with **intron** sequences, and more repeated sequences, than do bacterial genomes.

Q: How does Xcelbio compare to enzyme products?
A: Enzyme products used to increase the rate and extent of wastewater breakdown have generally failed. Enzymes are very specific; they act on a specific bond in a specific molecule or class of molecules. Wastewater has innumerable variations of molecules and bonds. As yet, no unique enzyme target has been identified to make enzyme treatment effective.

Q: How does Xcelbio compare to aeration?
A: Increasing aeration is often thought to be the solution to waste breakdown. In fact in some cases it can be detrimental since only organisms suited to high oxygen conditions can flourish, often these lack the ability to break down waste components. Xcelbio enables waste breakdown without high cost aeration additions

Q: Will Xcelbio reduce Ammonia levels?
A: Ammonia removal is accomplished by two mechanisms.

1. Incorporation of ammonia into amine groups on larger compounds – amino acids and proteins primarily.
2. Enhanced nitrification, denitrification.

Nitrate reduction to nitrite is not particularly efficient. Oxygen is a preferred electron donor. However, at low dissolved oxygen levels nitrate reduction takes place. Denitrification is completed by species of Paracoccus, Pseudomonas and Rhodobacter. They reduce nitrite all the way to N_2. The intermediaries of this reduction are toxic to these species. Xcelbio can promote the consumption of a portion of these poisonous materials and allow the reaction to proceed to completion at a greater rate.

Q: Will Xcelbio aid in the reduction of pathogen counts?
A: One of the constant findings in years of commercial use is a dramatic reduction of coliforms and pathogens when **Xcelbio** is used in any application. Coliform counts are usually in the 1000's and are often reduced to less than 50 in lagoon processes. Even in activated sludge plants significant coliform reductions are seen.

Q: What is the definition of COD (Chemical Oxygen Demand)?
A: The chemical oxygen demand (COD) is the amount of oxygen required to degrade the organic compounds of wastewater. The bigger the COD value of wastewater, the more oxygen the discharges demand from water bodies.

Q: What effect will Xcelbio have on COD?
A: We have the only technology that has the potential to eliminate COD. The other technologies use a lot of oxygen that converts the COD to smaller molecules and then oxidizes them. Consequently, you end up with small, oxidized molecules.
Xcelbio converts COD to water, oxygen, nitrogen, carbon dioxide, and methane. The portion that goes to methane does not require oxygen; therefore less total oxygen is needed. There is no residual COD in any of the molecules.

Q: What is the explanation of BOD (Biological Oxygen Demand)?
A: The biological oxygen demand (BOD) is a measure of the oxygen used by microorganisms to decompose waste. If there is a large quantity of waste in the water supply, there will also be a lot of bacteria present working to decompose this waste. In this case, the demand for oxygen will be high (due to all the bacteria) so the BOD will be high. As the waste is consumed or dispersed through the water, BOD levels will begin to decline.
Nitrates and phosphates in a body of water can contribute to high BOD levels. Nitrates and phosphates are plant nutrients and can cause plant life and algae to grow quickly. When plants grow quickly, they in turn die quickly. This contributes to the organic waste in the water, which is then decomposed by bacteria. This results in a high BOD level. When BOD levels are high, dissolved oxygen (DO) levels decrease because the bacteria are

consuming the oxygen that is available in the water. Since less dissolved oxygen is available in the water, fish and other aquatic organisms may not survive.

Q: What effect will Xcelbio have on BOD?
A: We are the only product that completely eliminates BOD. The other technologies use a lot of oxygen that converts the BOD to smaller molecules and then oxidizes them. Consequently, you end up with small, oxidized molecules which may still have a BOD demand. **Xcelbio** converts BOD to water, oxygen, nitrogen, carbon dioxide, and methane. The portion that goes to methane does not require oxygen; therefore less total oxygen is needed. There is no residual BOD in any of the molecules.

Q: How is Xcelbio applied?
A: Depending upon the size of the application, vertical "catalyst generating units" (CGU's) ranging from 200 liters to 5000 liters can be used, these are heated to an optimal temperature of 27 degrees C. Applications sometimes require multiple CGU's. The CGU's are colored to prevent light entering in order to inhibit the growth of algae within the CGU.
They are connected to a potable water source, and emitters within the units to control flow rates.
A pre-determined amount of **Xcelbio** is introduced to the bottom of the CGU to provide a bottom substrate layer. Another pre-determined size cartridge is suspended at the top of the CGU to provide upper material. At a steady state, there will be a pre-determined ratio of bottom substrate and upper substrate. The micro-enviroment at the bottom and top of the CGU are different and important in the propagation and production of co-factors. The upper cartridges degrade and release substrate to the bottom replacing substrate consumed in producing the **Xcelbio.** There may be more at start-up to facilitate needed activity.

As the potable water enters the CGU through the emitters, the water comes in contact with the **Xcelbio** substrate. The water encourages its growth, and as the tank fills, the water carrying the microorganisms exits the tank by gravity through a bulkhead. The bulkhead is fitted with a PVC outlet pipe that runs from the tank to the body of water being treated.

Q: Does the water supply to the Xcelbio generating unit need to be potable?
A: Yes, the addition of non-potable water to the **Xcelbio** generating tanks may cause contamination by unwanted microbes, which can prevent production of the co-factors and dramatically reduce the concentration of desired organisms.

Q: How is the Xcelbio substrate packaged?
A: The **Xcelbio** substrate is packaged in various sizes of natural cotton cartridges (depending on application) and in loose substrate. The biocatalyst cartridge (Xcelbio) can be used suspended from the top of the tank, the loose substrate is placed in the bottom. The cartridges are exchanged on a weekly or fortnightly basis (depending on COD loading and flow) the spent cartridges are left in the generator tank and add to the volume of bottom substrate, the cotton sleeve completely biodegrades.

Q: How often does the Xcelbio substrate need to be replaced?
A: The Xcelbio substrate will be dosed once per week/month depending on the application. In certain instances a total system restart may be indicated after 2 or 3 years.

Q: Does the Xcelbio generating unit need electricity?
A: The CGU only requires electricity if a heating unit is needed for adverse weather conditions. The heating units are designed to run at 27 degrees C.

Q: Does the Xcelbio generating unit need to be sheltered from weather?
A: Whenever possible, the installation should occur somewhere at the facility where it is protected from the weather. If this is not possible, it may be necessary to construct a shelter for the installation and insulate the generator.

Q: How much maintenance is involved with the installation?
A: Aside from adding the new cartridges of product weekly/monthly, very little maintenance is required of the CGU. The flow emitters should be checked to make certain they are flowing properly, as well as the PVC line feeding product to the lagoon/treatment tank.

Q: How do I know if the Xcelbio is doing its job?
A: Success is gauged on both qualitative and quantitative results. Qualitative results include items such as: physically measuring reductions in sludge, physical characteristics of the sludge, activity on the surface of the lagoon (eruptions, bubbling and foam), odor reduction, and changes in water clarity. The quantitative results are based upon laboratory analysis, and depending upon the type of application, the tests conducted vary. Laboratory testing is normally conducted on a quarterly basis as a minimum, but larger applications and regulatory requirements may increase the frequency even to daily analysis.