

Domain Archaea



Oppenheimer
Biotechnology Inc.

The greatest difference between Oppenheimer products and those of our competitors is that our products are not only made of "bacteria" but include a more versatile microbe group called "Archaea".

Archaea are a diverse group of organisms with their own unique type of DNA, different from bacteria. In many cases, they have developed mechanisms to protect them from hostile environments.

Archaea are found everywhere and make up an estimated 35% or more of our planet's life. Both are microorganisms and were formerly lumped in the same kingdom, but Archaea have since been given their own separate kingdom. Bacteria usually work under narrow conditions and will only work on one specific contaminant.

The Archaea in our formula can tolerate much harsher environmental conditions and degrade a wide variety of hydrocarbons. These microbes recycle simple, complex and chlorinated hydrocarbons into natural compounds. Crude oil is one such example.

Why are Archaea Important?

- Exist solely to recycle.
- Extremely versatile - breakdown a wide variety of materials including fossil fuel hydrocarbons.
- Extremophiles - thrive in extreme environments where other life forms cannot exist.
- Are found everywhere and make up an estimated 35% or more of our planet's life.
- Theorized to represent the majority of soil microbes.

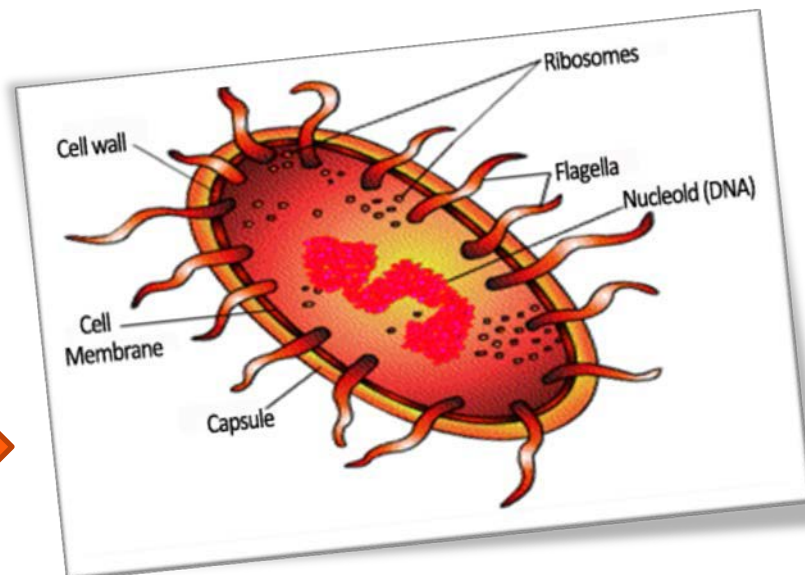
What are microbes?

Microorganisms (microbes) are organisms that are too small to be seen by the naked human eye and have evolved a variety of enzymes to break down contaminants, using them as an energy (food) source.

The role of a microbe is to recycle the 7 million organic molecules of life. They are the greatest natural waste disposal workforce on the planet.

What do they look like?

- Archaea look like bacteria, microscopic and without a nucleus.
- They control their genes like a plant, animal, or human.
- They are prokaryotes with no membrane-bound organelles (this means no nucleus, no mitochondria, no chloroplasts).



These microbes have been selected for their affinity for hydrocarbons – both biochemically and physically.

For enhanced activity related to microbial-substrate contact, only hydrophobic cells are selected. The Formula[®] has a wide range of metabolic functions and possesses an increased salt / temperature tolerance. We cultivate the microbes in a secret process, and use oil as the sole carbon source to exclude potential pathogens to man and plants.

The cells are dried by a proprietary process and concentrated in an inert powder base, providing a concentrate that is easy to handle and ship. In this state the microbes are dormant.

These mixed cultures are capable of oxidizing almost simultaneously the wide variety of the potential 300,000 natural HC molecules that may have up to 60 carbon atoms.

The communities of microbes have the ability to effectively recycle a wide range of compounds by converting them into non-toxic components.

What is the Oppenheimer Formula?

The formula essentially consists of a multitude of naturally occurring communities of aerobic and micro-aero-philic microorganisms that have been selected from worldwide soil and water sources.

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Formula - Highlights

- Highly concentrated (10^{11}) 100 billion cells per gram
- Naturally occurring
- 5-year shelf life
- Organic/Non-toxic/Non-corrosive
- Aerobic/Facultative
- Dry, gray powder
- **NOT** genetically, or altered/freeze dried engineered or modified microbes
- Activated either fresh Crude oil is one such example. or salt water
- Temperature range 32F-120F
- pH tolerance 5.5-10.0
- **NOT** genetically or altered or freeze dried engineered or modified microbes

The cultures are routinely analyzed by an independent laboratory for potential dangerous microorganisms and are certified to be human, plant and animal pathogen free.

How do microbes work?

- Enzymes released by the microbes break the contaminant/organic matter down into digestible pieces.
- The contaminant/organic matter is consumed as food by the microbes and ends up as a soil amendment.
- The remains of the hydrocarbons, such as carbon dioxide and water, are harmless to soil.

Oppenheimer microbes employ the concept of aerobic co-metabolism by multiple strains of microorganisms, primarily the Archibacteria, selected from the natural environment for their collective ability to degrade hydrocarbon molecules.

These microbes are active in normal soil and water biogeochemical cycling of both inorganic and organic compounds - specifically hydrocarbons and chlorinated hydrocarbons - back to their primary elements, carbon dioxide and water through an intermediary of organic acids and pyruvic acid cycle.

What do microbes need to work?

For biodegradation to occur in the subsurface environment, the following basic requirements must be met:

- *Energy source and carbon source* – organic carbon is utilized both as an energy source by releasing electrons during transformation and it is used by the cell for maintenance and growth.
- *Electron acceptor* – the electrons released by the carbon transformation must be taken up by some other chemical.
- *Nutrients* – for bacterial growth to occur certain nutrients are needed (e.g., nitrogen, phosphorous, potassium, and many trace elements).
- *Appropriate environmental conditions* – microbial activity is dependent upon many environmental conditions such as:

- ✓ temperature
- ✓ carbon
- ✓ salinity (<25%)
- ✓ pH (5-10)
- ✓ pressure
- ✓ concentration of pollutants
- ✓ temperature (32F-120F)
- ✓ water (>10%)
- ✓ oxygen (>3)
- ✓ space
- ✓ presence of inhibitors

How do microbes locate the material they are degrading and recycling?

Our microbes were selected by their ability to stay with hydrocarbons. As the hydrocarbon move in soil and water, the microbes will move as well. It will move on water surfaces and be diffused in water. Aquifer movement will spread the microbes. However, when nutrients and substrate (e.g., hydrocarbons) are depleted, the product will reduce in number. As the product consists of natural soil and water organisms, they will return to background levels.

Normally this would be towards the contaminant. Movement is thus controlled by the pollution substrate so widespread movement to other areas would not be anticipated. The environments of origin and application are interchangeable. Bioremediation deals with soils and water. Microbes are ubiquitous being transported in the air, water, and by living organisms.

What happens when the microbes run out of food?

When nutrients and food (energy source) are depleted, the microbes will reduce in number. As our product consists of natural soil and water organisms, they will return to normal background levels.

Basically the hydrocarbons are degraded to fatty acids, which can be used as food by water and soil organisms, and then into environmentally benign components like carbon, carbon dioxide, base elements and water. Once the hydrocarbon contamination is degraded the microbes die and can be used as a food source by aquatic and terrestrial organisms.

