1010 72 Avenue NE, Calgary, Alberta, Canada T2E 8V9 • Tel: 403-250-8448 / 800-661-6100 • Fax: 403-444-0033 • Email: info@lubecorp.com

Heating/Cooling System Water Treatment (H/CS) exhibits an exclusive biodegradation stimulation capability

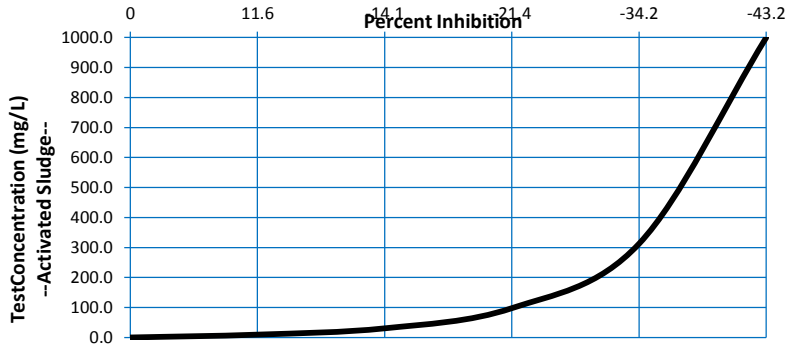
Extensive lab and field testing indicates that H/CS acts like a synthetic enzyme catalyst, without the limitations of temperature and pH associated with biological enzymes[1]. H/CS quickly catalyzes the degradation of hydrocarbons, sulphates, phosphates, nitrates, and other organic compounds, without itself being depleted and is under Canadian Government approval as environmentally safe.

Heating/Cooling System Water Treatment (H/CS) Benefits:

a) In situ bioremediation of contaminated and geothermal water.
b) Eliminates Phosphorus and Nitrates from the geothermal waters by utilising them as a source of energy in stimulating bacteria to increased aerobic respiration.
c) Sulphates and other organic compounds are also fully biodegradable utilising H/CS.
d) Dissolves calcium, magnesium and iron and keeps it in molecular suspension.
e) Promotes aerobic biodegradation of the slime and eliminates the stench.

ACTIVATED SLUDGE RESPIRATION INHIBITION TEST (OECD 209)
Absolutely Non-Toxic to wastewater treatment plant bacteria

Negative inhibition values represent stimulation (3h EC50[2])
that is to say: **BIODEGRADATION OF THE ACTIVATED SLUDGE**



BIODEGRADABILITY

Acute Aquatic
(US Fish and Wildlife, 1984)
Ecotoxicity Classification

Rainbow Trout OECD 203
LC50 = 148.3 mg/L
"Practically Non-Toxic"

Daphnia Toxicity OECD 202
EC50 = 36.8 mg/L
48 hr immobility

Selenastrum Toxicity OECD 201
EC50 = 31.5 mg/L
72 hr Cell number

Heating/Cooling System Water Treatment (H/CS) enables the conversion to carboxylic acids that biodegrade to a harmless reduction of carbon dioxide, water, and a tiny amount of cell biomass which is mostly innocuous protein.

Biodegradation of hydrocarbons and organic waste by bacteria and fungi[4] involve the oxidation of the substrate such as hydrocarbons, sulphates, phosphates, nitrates, etc. by oxygenases[2].

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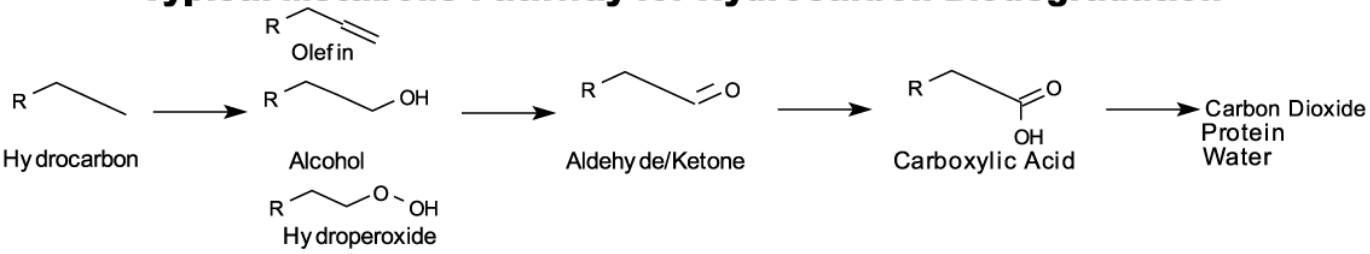
Biodegradation of hydrocarbons, sulphates, phosphates, nitrates, and organic compounds.

The biological degradation processes including hydrocarbons, sulphates, phosphates, nitrates, and other organic compounds is accomplished by continuous enzymatic activities of bacterial & fungal[4] cells involving the oxidation of the substrate by oxygenases[2].

Typical Metabolic Pathway for Hydrocarbon Biodegradation



Major Metabolic Pathways for Biodegradation of the organic compounds found in geothermal waters such as sulphates, phosphates, nitrates, hydrocarbons, and other organic compounds.

Initial steps in the biodegradation of organic compounds and hydrocarbons by bacteria and fungi[4] involve the oxidation of the substrate by oxygenases[2], for which molecular oxygen O_2 is required. (O_2 is dissolved air in the liquid solution. The substrate being geothermal or other contaminated waters.)

H/CS enables the combination of oxygen O_2 at the molecular level with the substrate, triggering the subsequent conversion of hydrocarbons, sulphates, phosphates, nitrates, and other organic compounds to carboxylic acids that are further biodegraded via ß-oxidation[3] to a harmless reduction of carbon dioxide, water, and miniscule of cell biomass (protein) and can be safely assimilated into the food chain.

NOTES:

[1]Biological enzymes are catalysts which act in a narrow operating range of temperature and pH. When these enzymes catalyze a redox reaction they are classified as oxygenases[2].

[2]Oxygenases: Enzymes that oxidize a substrate by transferring the oxygen from molecular oxygen O_2 to the substrate, that catalyze reactions in which O_2 is introduced into an acceptor molecule.

[3]ß-oxidation is the central metabolic pathway for the utilization of fatty acids from lipids in which two-carbon units are sequentially removed from the molecule with each turn of the cycle, resulting in the formation of acetate which enters the tricarboxylic acid cycle by which alkanes, hydrocarbons, sulphates, phosphates, nitrates, and other organic compounds are broken down and metabolized so that they can be used as a source of energy in aerobic respiration. (Aromatic hydrocarbon rings generally are hydroxylated to form diols; the rings are then cleaved with the formation of catechols which are subsequently degraded to intermediates of the tricarboxylic acid cycle.)

[4]Fungi and bacteria form intermediates with differing stereochemistries. Fungi, like mammalian enzyme systems, form *trans*-diols, whereas bacteria almost always form *cis*-diols (many *trans*-diols are potent carcinogens whereas *cis*-diols are not biologically active). Since bacteria are the dominant hydrocarbon degraders, the biodegradation of aromatic hydrocarbons results in detoxification and does not produce potential carcinogens.

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