

## Bio-Augmentation Application Guide

# We offer the industry's most comprehensive range of products, supported by global product sourcing and fully integrated customer service capabilities.

Increasing demands for improved environmental protection have placed further demands upon the successful treatment of waste water. Biological methods have traditionally been used to meet the higher performance objectives required by effluent treatment engineers.

To further increase the capability of waste water systems it is possible to engineer the microbial

### Adapted Bacteria

The bacteria are typically single celled microscopic organisms capable of the breakdown of organic, and some inorganic, materials, as a means of gaining carbon and energy as food. Dried bacterial products are formed from specifically cultured bacteria that are preserved through air drying techniques.

To ensure consistent quality, the various strains and species are grown individually in pure form and

### Bio-Augmentation

Bio-augmentation is the process of supplementing the existing bacterial population with bacteria that are capable of higher rates of biodegradation or are capable of degrading compounds that have previously been considered nonbiodegradable.

The objective is not to replace existing bacteria but to supplement them for improved efficiency. In some

environment such that the natural process of degradation is enhanced. Biotechnology can be thought of as a low cost alternative to current procedures applied in the waste water process. Augmentation of existing biomasses can effect large performance increases, reducing costs, and may, in some cases, negate the requirement for capital cost engineering solutions.

preserved. Then, they are compounded together with buffering agents, and other synergists that allow the organisms to readily adapt themselves to the conditions of the treatment system. Individual organisms are carefully matched so that they will complement one another, and to ensure that they are fully compatible with existing bio-systems.

cases, such as bulking due to filamentous bacteria, replacement of the dominant organism is undertaken.

Should the bacterial cultures escape the waste treatment plant and be released into the local environment, they behave as normal, non-mutated bacteria.

## Bio-Augmentation Application Guide

### Using Adapted Bacteria

In order to effectively operate a biological waste water treatment system, it is necessary to consider the microbiology of the system as well as the equipment functions. A biological system operates on the principle of equipment assisting micro-organisms in the "stabilisation" or breakdown of

influent organics. Therefore, when considering system improvements, one should consider improving the effectiveness of the biomass by bio-augmentation. Changes in equipment or design are not always the total answer or the most cost-effective solution.

### Microbial Functions in Waste Water Treatment

The various microbial populations found in waste water treatment systems have specific functional responsibilities. Bacteria are responsible for the initial breakdown of the organic materials. Although the protozoa and rotifers effect a small percentage of organic removal, they are primarily responsible for sludge settle ability and water clarity. The presence and numbers of protozoa and rotifers is dependent on the size of the bacterial population and demonstrates a progression of the food chain.

By observing the predominance of the different types of protozoa or rotifers, it is possible to determine the growth phases of the bacteria and make operational changes for optimum water treatment and clarity. Thus, these higher life forms are referred to as indicator organisms. They are easily identified at relatively low magnification (400x) and give an indication of the condition of the biomass as well as the efficiency of the total system.

### Protozoa

When using wet slide microscopy, protozoa are easily recognised by their shape and mobility. All protozoa of significance in this respect are strict aerobes and are generally able to metabolize soluble organics. There are several common classes of protozoa typically found in activated sludge.

### Animals

Certain types of primitive animals also aid the activated sludge process.

- **Rotifers, small (<2mm long), free-living, un-segmented, aquatic animals**
- **Nematodes, small (<3mm long), un-segmented, free-living, 'worm'-like animals**

The relative amounts of protozoan forms within the biomass can indicate the age, condition and health of the bioprocess.

## Bio-Augmentation Application Guide

### Bacteria

Bacteria are the most important micro-organisms in waste water treatment. The efficiency of secondary treatment is dependent upon the rate of bacterial growth and metabolism of the organic materials present. Extracellular enzymes are of significant importance, especially in the assimilation of large molecules and toxic materials.

**1 Lag phase** - the lag phase represents the time required for the organisms to adjust to a new environment. This phase is not generally found in a system in continuous operation except as a response to a change in influent characteristics.

**2 Log Growth Phase or Initial Removal** - the log growth phase is characterised by too much food available for the organisms present. The rate of metabolism is high, a function of the ability of the organisms to process the food. The organisms are young and highly active. Many organisms are in cell division.

**3 Declining Growth Phase or Cell Material Synthesis** - the rate of growth and therefore the mass of the organisms decreases because of limited available food.

Cell reproduction is by binary fission whereby the cell divides in half. The major factor determining the growth phase of a bacterial population is the availability of nutrients, provided the conditions of temperature, oxygen, and pH are suitable. The generation time is the time required for cell division to occur:

**4 Cell Material Oxidation or Endogenous Phase** - the mass of organisms is decreasing because food is at a minimum. The death of some organisms (cell lysis) releases nutrients which are used by the remaining organisms for growth. Growth rate is generally a function of the concentration of substrate available and in a continuous flow system is inversely proportional to the sludge age. Although bacteria play the major role, other organisms take part in the assimilation and stabilisation of organic wastes. Their larger size, compared to bacteria, allows easy identification under a microscope. Because there is a definite succession of these organisms in relation to the condition and stability of the sludge, they serve as a means of monitoring the efficiency of the biological process. These organisms are of special significance in effluent clarity.

Knowledge *that delivers* >>>