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## THE TECHNOLOGY, PERFORMANCE AND APPLICATION OF LIQUID PREFORMED MULTI-ENZYME WATER CLEANERS FOR RECREATIONAL WATER SYSTEMS

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***The recreational water industry recognizes the viability and performance superiority of preformed enzyme products for environmentally safe, enhanced cleaning/purification of pool, spa, hot tub and other human-use waters. Enzyme product technology, performance characteristics and application methodologies are described herein to give an in-depth understanding of the benefits, and the limitations, of enzyme based recreational water treatment processes.***

### THE TECHNOLOGY

The scientific community has recognized for a number of years that certain enzyme entities, which are non-living chemical species, have a profound effect on the rate and completeness of organic compound bio-oxidation reactions by functioning as catalytic agents. It is believed that these reactions are driven by selected enzymes which function to hydrolyze (or break apart) chemical bonds of organic contaminants to produce far more easily and rapidly oxidized organic structures. Inasmuch as the enzymes do not function as oxidants, it is necessary for the system under treatment to be exposed to primary oxidation mechanisms such as chlorine, bromine or simply oxygen-containing water, or the newer alternative methodologies including, among others, the generation of hydroxyl radicals, monatomic, diatomic (molecular) or triatomic (ozone) oxygen, hydrogen peroxide and copper or copper-silver ionization.

The production of liquid multi-enzyme water cleaning products, several of which are now available to the recreational water market, is accomplished through a closely controlled fermentation process utilizing selected organic materials and other ingredients designed to enhance ultimate performance characteristics of the contained enzymes. At completion of the fermentation cycle, a concentrated liquid is recovered that contains not only a number of enzyme species but also a variety of surface active compounds, both formed during fermentation and specifically added thereafter, which aid in micro-emulsification of organic residues in treated waters to accelerate enzyme catalysis.

In the case of Orenda enzyme products, the concentrate recovered from the fermentation process is subsequently chemically enhanced to ensure an indefinite shelf-life, synergistically improve product performance, and diluted to use concentrations for packaging.

### PRODUCT PERFORMANCE

For at least the past twenty years, it has been recognized that certain multi-enzyme products will accelerate the bio-oxidation of organic residues in recreational waters, more efficiently removing these contaminants than any other applied water chemistry. From suntan lotions and exuded body

oils, to human excrement, to unburned jet fuel commonly found in pool waters situated in airport flight paths, effectively formulated and applied enzyme water cleaner products will rapidly and completely remove these residues, usually well within a week's period of time, leaving a sparkling, nearly optically clear water.

Enzyme based water cleaning products are not replacements for primary sanitizers such as the halogens - chlorine or bromine - or the newer alternative methodologies. Enzyme products applied in accordance with manufacturers' recommendations will, however, reduce the demand on, and therefore the use of, primary halogen sanitizers. This phenomena results from the substantial reduction or elimination of numerous reaction by-products of chlorine and bromine with organic residues. Many of the so-formed chloramines (and to a lesser extent, bromamines) are less than human-friendly and leading causes of eye irritation and other allergenic reactions. In most residential water systems, the application of enzyme water clarifiers will permit reductions of sanitizer residual concentrations by virtue of near-elimination of organic residues and subsequent chloramine/bromamine compound formation. Commercial pool and spa installations, because of generally much higher bather loads, have greater sanitizer requirements and legislated minimum halogen concentrations, and may not realistically achieve significant sanitizer reductions.

Algae formation is a routinely noxious problem with many pool and spa systems. Most commonly found algae (green, blue-green, yellow, etc.) extract their food requirements mostly from organic materials (nutrients such as nitrates and phosphates) in the water. Enzyme water cleaners routinely applied to these systems, by rapidly and completely catalyzing the bio-oxidation of organic residues and the nutrients they provide, will - and do - prevent continued growth of existing algae deposits and development of new algae colonies without concurrent use of regulated algaecides.

As an integral part of the organic residue bio-oxidation process, enzyme products will effectively remove and prevent further deposition of oily, greasy materials - commonly known as the "scum line" - on pool and spa sides at the water line. In most cases, scum line removal will occur within days of initial enzyme treatment.

## **PRODUCT APPLICATION**

Enzyme water cleaning products currently on the market are liquid materials conveniently packaged for both residential and commercial use applications. In general, and with the understanding that more concentrated products are commonly available, enzyme formulations have typical recommended maintenance treatment ratios of about one fluid ounce of product to every 1,000 - 2,000 gallons of water contained in the pool system.

Spa waters, usually more heavily fouled with organics because of higher bather-to-water volume ratios and elevated temperatures which enhance body oil exudation and living organism growth, generally are treated at a nominal rate of one ounce of product to every 300 - 500 gallons of water.

Liquid enzyme products may be added to the pool or spa water at any convenient location. Typically, the required volume of product is manually added to the water around the perimeter of the system, or by proportional injection at a convenient point in the water recirculation piping. Depending upon the contaminant loading of the water at the time of initial treatment, some limited foaming may occur during product addition. While this natural phenomena of the technology is non-harmful and will dissipate in a matter of minutes, Orenda incorporates a de-foaming agent in all enzyme products to minimize foam generation and user concern.

Enzyme products are generally formulated to be applied to pool and spa waters on a weekly basis, inasmuch as the active enzymes are themselves subject to bio-oxidation processes in the water phase. Even though an active residual concentration of product may remain beyond the seven day period, weekly dosing avoids the possibility of insufficient product in the system to sustain suitable performance.

The application of enzyme water clarifiers for winterization of pools has been shown to be of significant benefit to water quality and clarity at Spring opening. Depending upon the type of pool or spa covering employed, solid or open-mesh, enzyme products are typically added at a rate five to ten times the usual maintenance dose at the time of pool closing with recirculation to ensure distribution of the product throughout the remaining water. This procedure will greatly reduce the buildup of organic residues in the water during the winter months and the labor/chemical expense at system opening to attain suitable water quality.

Contrary to water treatment principals usually applicable with other chemistries, it is most often true that enzyme products cannot be overdosed - *more is better* - within the economic constraints of the system under treatment. Conversely, under treatment (or the use of enzyme formulations with marginal active ingredient concentrations) will lead directly to inadequate product performance and the eventual discontinuation of product use, to the detriment of the user, distributor/dealer and manufacturer.

## **ENVIRONMENTAL CONSIDERATIONS**

Commercially available enzyme water cleaning products are regarded as nonallergenic and nonirritating to sensitive skin and eye membranes, and are nontoxic if ingested in their usual as-received concentrations. More than twenty years of widespread use, coupled with various toxicology, skin and eye sensitivity tests in the early years of product use, ensure that these products, when used as recommended by the manufacturer, are entirely safe for human contact in pool and spa water environments. As with all chemical products, however, the user should be completely familiar with product Material Safety Data Sheet instructions and label directions for safe and efficient use.

Enzyme products are fully biodegradable and, in the case of limited spills of several gallons or less, may be flushed with water directly to sanitary sewer systems. Larger volume spills should usually be recovered by vacuum or absorbent methods and disposed of by land fill or incineration procedures in accordance with local, state and federal regulations.

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