BI-CHEM® Freshen Technology

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Rethink Tomorrow

Technical Data Sheet

Odors are perceived due to the interaction of odor molecules with olfactory receptors in the nose. To cause odor compounds must be volatile to travel to the nose and must possess chemistry that stimulates olfactory receptors. Historically, odor control has usually involved the application of perfumes or odor maskants that do not eliminate odor but actually increase it by adding another less objectionable odor to overpower the malodor. Chemicals such as formaldehyde that interfere with the olfactory receptors may be used to deaden the odor response. In both cases, the odor compounds and any toxic effect they may have are not eliminated. Compounds that produce odor can be classified in 7 major categories (Figure 1).

CHEMISTRY	EXAMPLES	TYPICAL ODOR
Sulfides & mercaptans	Hydrogen Sulfide Methyl Mercaptan	Rotten eggs Rotting vegetables
Amines	Ammonia Ethyl-amine Cadaverine	Ammoniacal Rotting fish or meat Aged urine
Volatile fatty acids	Butyric acid Valeric acid	Perspiration Rancid butter
Aldehydes & ketones	Formalin Acetone	Fruity Rancid

Figure 1. *The chemistry of odors*

Another means of eliminating odors is to remove the source of the odor. The bioenzymatic action of *BI-CHEM Freshen Plus* breaks down or degrades organics, such as spilled foods, sweat, and urine, that are often the cause of malodors. These organics are converted to benign cellular components plus odorless carbon dioxide and water. Removal of organics prevents the return of the malodor. Once finished, the bioenzymatics lyse or reform inactive spores providing an effective odor control. This technology harnesses natural processes and is safe for the user and the environment.

BI-CHEM Freshen Plus technology combines the benefits of chemistry and biotechnology. Chemical surfactants and binding agents provide immediate cleaning and odor control while the bioenzymatics provide longer term residual effects of deeper cleaning and removal of the odor source.

Performance

Respirometry is often used to demonstrate the action of microbes. By measuring oxygen consumption, respirometry shows the breakdown and removal of numerous types of common organics known to cause odors (Figure 2).

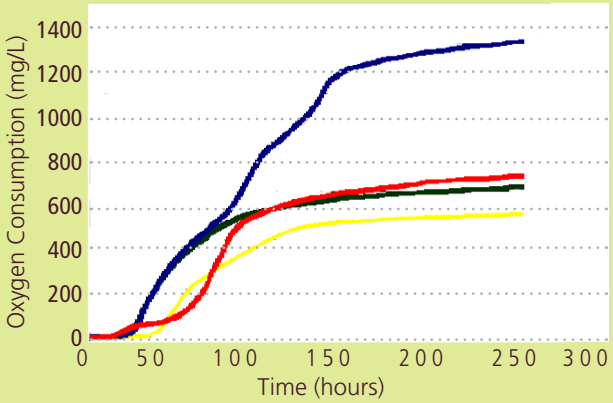

Figure 2. *Respirometry demonstrates bioenzymatic degradation of four common spill materials in aqueous solution. Each substrate was dosed into the test reactor at an amount determined to yield 750 mg/l total carbonaceous oxygen demand (tCOD).*

Bacterial growth also provides evidence of microbial breakdown of organics. In Figure 3 below, bioenzymatics in *BI-CHEM Freshen Plus* break down a number of common materials that can cause odors.

Degradation of various soils evidenced by oxygen consumption

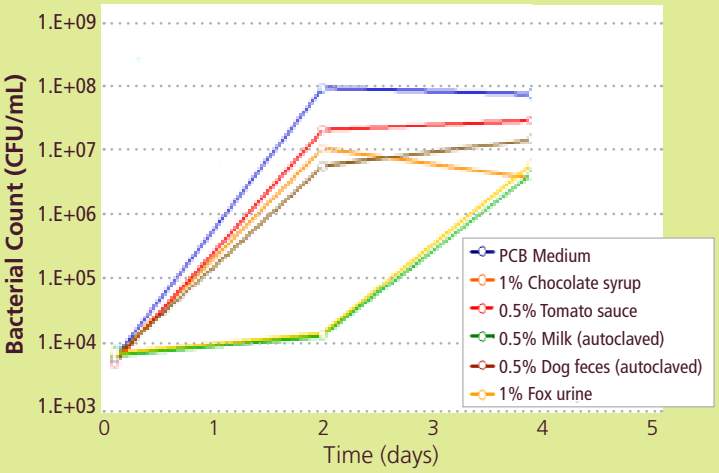

Figure 3. *Growth on common organics as sole source of carbon is compared to growth on an ideal microbial growth media (PCB).*

The most effective means of eliminating odors long term is to remove the source of the odor by bioenzymatic technology. However, bioenzymatic action is not immediate and most odor situations require both immediate relief and long-term efficacy. Chemistry is utilized in *BI-CHEM Freshen Plus* to provide immediate odor control by binding odor molecules.

The chemistry in *BI-CHEM Freshen Plus* provides relief in 5 to 30 seconds for most applications. It utilizes safer "green" components that are compatible with bioenzymatics for long-term shelf-life and are also safe for users and the environment. The resulting product provides odor control equal or superior to the leading brands on the market today.

In laboratory studies, *BI-CHEM Freshen Plus* was challenged by the major classes of odors including ammonia and amines, sulfides, and volatile fatty acids. Although in some tests we were able to assay odor compounds such as ammonia or sulfide, odor panels of approximately a dozen subjects were also utilized to compare blind samples (Figure 4).

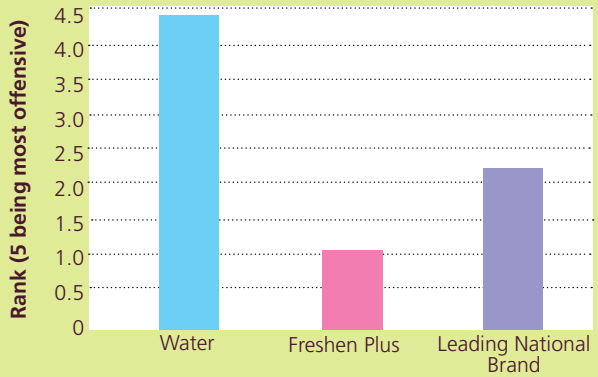

Figure 4. *Odor panel testing demonstrates BI-CHEM Freshen Plus controls volatile fatty acid odor (represented by butyric acid) better than the leading brand. Such odors include perspiration, garbage and odors asociated with anaerobic environments.*

In an unfair comparison, *BI-CHEM Freshen Plus* without fragrance was almost as effective as the leading brand with fragrance when tested on butyric acid, the odor associated with sweat or garbage (Figure 5).

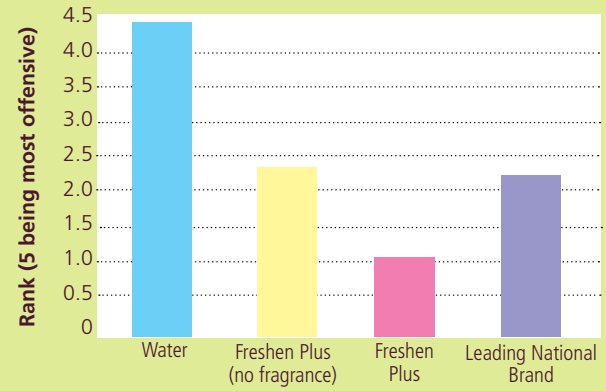

Figure 5. *BI-CHEM Freshen Plus tests almost as effective as the leading brand when tested on butyric acid.*

To allow the use of chemical analysis to validate odor control by *BI-CHEM Freshen Plus*, solutions of odor compounds were made at concentrations much greater excess than one would expect to encounter in the environment. *BI-CHEM Freshen Plus* was still able to demonstrate 46 - 92% reduction in these compounds (Figure 6).

BI-CHEM Freshen Plus technology reduces odorous materials in the headspace over highly concentrated solutions from 42 - 96%

Compound	Concentration	% Reduction vs Control
Hydrogen Sulfide	8 ppm	92%
Ammonia	525 ppm	46%
Dimethylamine	309 ppm	46%
Trimethylamine	330 ppm	49%

Figure 6. *Nine ml solutions of odorous compounds in individual test tubes with screw caps were combined with 2 ml aliquots of BI-CHEM Freshen Plus. After two hours the concentrations of the odorous compounds in the headspace of each test tube were measured compared to water.*

Removal of smoke odor was also tested resulting in *BI-CHEM Freshen Plus* performance superior to the leading brand (Figure 7).

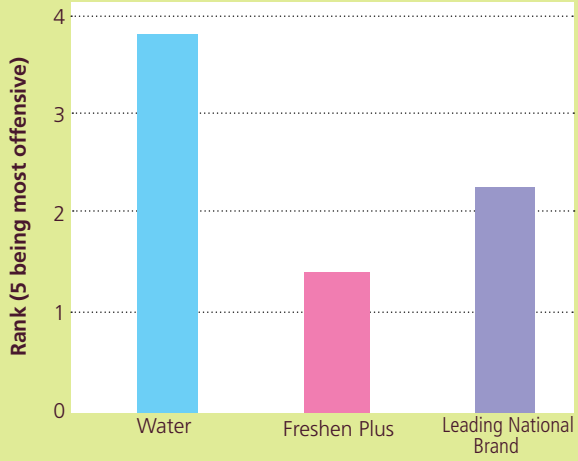

Figure 7. *Smoke was pulled through absorbent material which was then placed in a covered petri dish. A measured quantity of product was then sprayed on the absorbent material. A test panel then ranked the remaining odor concluding that BI-CHEM Freshen Plus removes smoke odor better than the leading brand.*

In another test, *BI-CHEM Freshen Plus* was tested against cat urine (Figure 8).

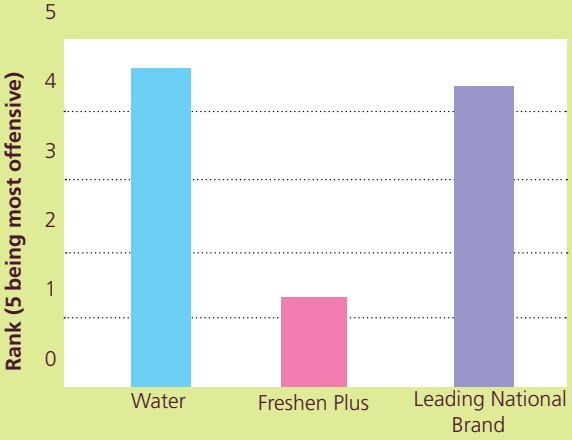

Figure 8. *10 ml of cat urine plus 2 ml of product was aged 6 days in a test tube. A test panel confirmed a very significant improvement in the mixture treated with BI-CHEM Freshen Plus vs. the control in which 2 mls of water replaced the test product.*

An experiment was run to demonstrate long-term ability of *BI-CHEM Freshen Plus* to control odors (Figure 9).

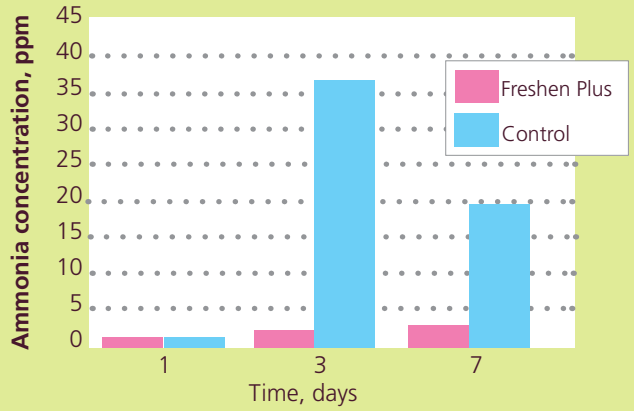

Figure 9. *Absorbent material was sprayed with fresh cat urine. Product was sprayed on the surface and material was stored at room temperature for one week. Chemical analysis of the head-space gas above the mixture on days 1, 3, and 7 proves that the combined action of bioenzymatics and chemistry prevents the development of ammonia odor.*

With the benefits of fast action from chemistry and the long-term effects of biotechnology, *BI-CHEM Freshen Plus* is a superior odor control technology. It captures and destroys the odors, instead of simply covering them up.

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Revised 08/28/07 2005-48736-02

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