

# ZEODEX INC.

ZEODEX PRODUCTS AND APPLICATIONS INCLUDE:

## ORGANO-MINERAL COLORANTS



What to Expect From Zeodex Colorants

- Non-warping colors
- No effect on recrystallization of polyolefins
- Heat stability
- Light stability
- Translucent bright Colors
- Cost benefits

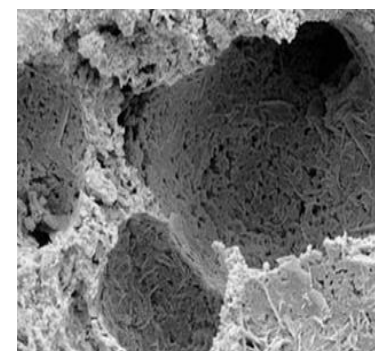
Zeodex Organomineral Pigments

## PESTICIDES



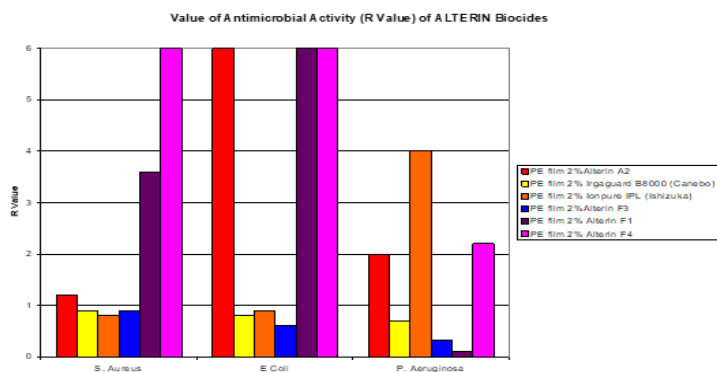
Corn stored in bags 9 months unprotected v 9 months protected

## WATER TREATMENT



SEM image of water filter pellet pores

## BIOCIDES



ZEODEX ALTERIN™ COPPER ZEOLITE

## ACTIVE PACKAGING ETHYLENE SCAVENGING



NECTARINES AS RECEIVED



AFTER 8 DAYS IN GREEN BAG v NO BAG

## UVITA SME™ SPECTRAL ENHANCERS AND UVITAGARD™ UV ABSORBERS IN AGRICULTURAL APPLICATIONS AND PLASTICS PACKAGING

### UVITA SME™ SPECTRAL MODIFIERS AND ENHANCERS

#### A New Approach to Ultraviolet Absorbers and Light Stabilization

Ultraviolet (UV) light is part of the electromagnetic spectrum between visible light and X-rays

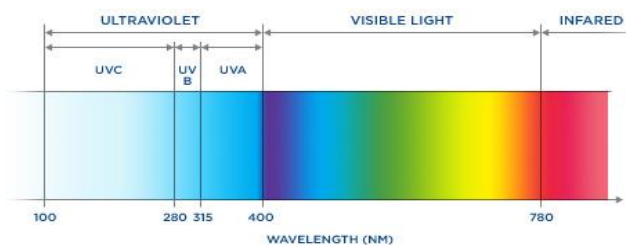


Figure 1

**Uvita SME™** Spectral Enhancers and **Uvitagard™** ultraviolet absorbers can provide control of insect vectors, and prevention of rancidity in stored food products such as seeds and oils.

**Uvita SME™** Spectral Enhancers and **Uvitagard™** ultraviolet absorbers meet the demand for improved performance and cost benefit in both coatings and plastics and provide a way to meet the current needs and trends in industry. They can be blended, melt compounded, or carried by liquid; their performance can be predicted and applied to both coatings and plastics applications. Increased stability of organic UVA and increases in absorptivity, without the need to design a new molecule, is an inexpensive and practical solution to a complex and growing global problem.

Spectral Enhancers work for hydroxy substituted benzophenones, benzotriazoles and monomeric and oligomeric hindered amine light stabilizers. The key is the type and ratio of spectral enhancer for each UVA family and type of chemistry from that family. The ability to increase absorbance and absorptivity and hyperchromicity increases overall performance of any system. The current Uvita data base allows for precise tailoring of additive systems. There is a need for broader absorbance for food packaging beyond 390 nm. Oils require 430-450 nm while absorbance up to 560 nm is required for storage of food products and seeds (see Figure 1).

#### Controlling Insect Vectors in Greenhouse Crops

Insect photobiology shows that many of the insects that occupy greenhouses include aphids, mites, caterpillars, whiteflies, spider mites, leaf miners, gnats and slugs among many others. Copulation and larvae production and sight of the insect are influenced by UV and visible radiation. Little is known about the influence of infrared radiation. Insects are controlled at wavelengths from 290 to 600 nm depending on the species. Most of the six species found in greenhouses are susceptible to wavelengths from 365 to 500 nm, while wavelengths from 510 to 580 nm control whether insect eggs will mature; inhibition of a specific enzyme in the development stage at 540 - 575 nm is key to preventing development. Studies at the University of Barcelona, Florida State, Rutgers University, Arizona State, and New Mexico University all show a relationship between various wavelengths of light and photokinesis and phototaxis by the majority of pests in agricultural green houses.

## VISUAL SENSITIVITY OF HUMANS AND INSECTS

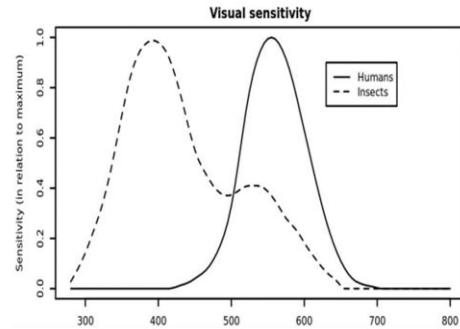


Figure 2

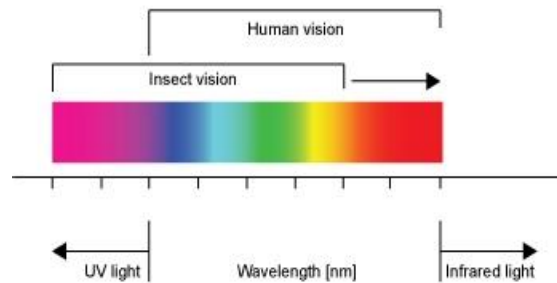


Figure 3

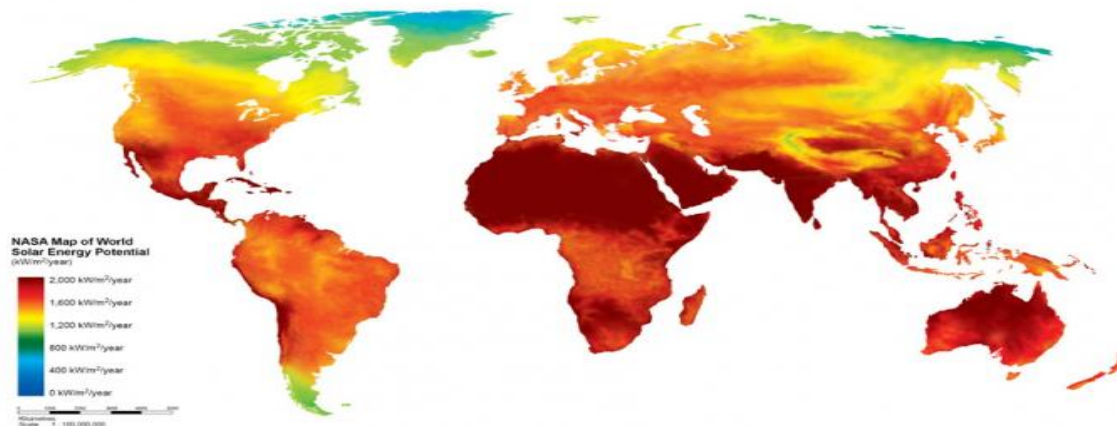
UVITA SME 3811 and Its Modifications 1 to 4 is the solution to broad blocking of these wavelengths.

Light attracts insects. Wavelength of light determines which type is attracted. Irradiance at the wavelength determines phototaxis. With current global technology, the UV organic used is fugitive and loses its potency over time. Key attractive wavelengths are beyond the 400 nm absorbance of most UV organics.

UVITA SME 3811 and its modifications 1 to 4 is the solution for all packaging and woven plastics to block out all electromagnetic radiation from 200 to 800 nm and in the near, mid, and far infrared.

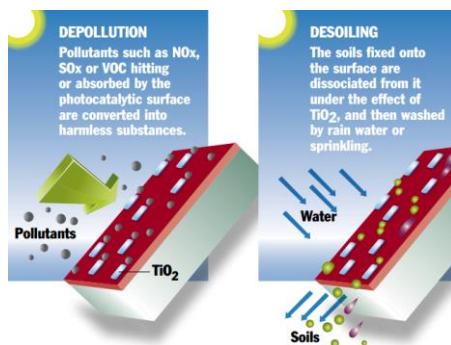
UVITA SME 3811 spectral enhancer delivers broad absorbance on a permanent basis, with no volatility, no migration and no extraction.

## CLIMATE CHANGE THE WORLD IS HEATING UP ULTRAVIOLET RADIATION IS INCREASING



## Photocatalysis Technology with New Functionalities to Improve Air Quality

Photocatalysis is a natural reaction occurring in presence of light, water and oxygen. The catalytic reaction may be accelerated by use of a catalyst (usually Titanium dioxide –  $\text{TiO}_2$ ) and it is activated by the energy of the UV light (“photo”).



Photocatalysts represent a special type of catalyst which utilizes photons as a source of energy to activate certain reactions. The super-hydrophilic properties of these materials, and their ability to decompose particular types of organic and inorganic molecules, have been exploited in numerous applications, including materials and coatings for residential and commercial construction, deodorizing products, automotive coatings, appliances, sterilization articles, and water treatment products, just to name a few.

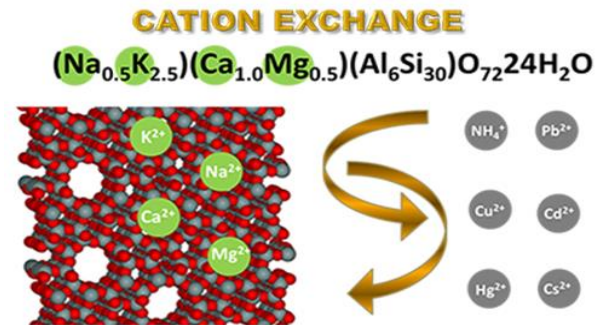
Titanium dioxide is a raw material widely used in various applications. It is the white pigment coloring most of the items we see and use in our daily life. Coatings, wall paints, plastics, and paper are just a few examples where  $\text{TiO}_2$  is used, to achieve white color as well as to reach the required level of opacity. Titanium dioxide is present not only in white colored materials, but it is a key component whenever opacity is needed. Specialty qualities of  $\text{TiO}_2$  are used in ceramics, in electronics, in cosmetics and even in drugs and foodstuffs, as well as in catalytic applications for industrial processes.

Photocatalytic  $\text{TiO}_2$  has specific properties and it is different from the pigmentary version. The morphology and the characteristics of its ultrafine particles are developed to achieve the best catalytic activity and to allow an optimal incorporation into a variety of matrices. Specific photocatalysts are developed for use in paints, coatings, cement-based materials or for direct application on surfaces (for example, on filtering media for air treatment units). When  $\text{TiO}_2$  is exposed to UV light, electron-hole pairs are generated, facilitating reduction and oxidation reactions through the formation of adsorbed free radicals on  $\text{TiO}_2$  surface. These radicals are extremely highly reactive species, and capable of degrading the pollutants hitting or absorbed onto the photocatalytic surface; the reaction of degradation converts harmful materials, such as nitrogen oxides, sulphur oxides, VOC (volatile organic compounds) into harmless substances. The catalyst is not consumed by this reaction, ensuring a continuous process during the service life of a photocatalytic surface.

ZETINOX™ combines ultrafine particles of titanium dioxide and Alterin clinoptilolite, a natural zeolite with a very high surface area. Research results have shown that the  $\text{TiO}_2$  particles loaded on zeolite are 50 nm or so, smaller than the pure one, and combine with zeolite via chemical force. The  $\text{TiO}_2$ -clinoptilolite performs more efficiently at low initial concentration and in the later period of the photocatalytic degradation (PCD) process, as compared with pure  $\text{TiO}_2$  nanopowders. Proprietary Zeodex surface treatments and compounding technology enhance and expand the range of applications for Zetinox™ pollution reduction.

## ZEOLITES

Zeolites are a large group of natural and synthetic hydrated aluminum silicates, characterized by complex three-dimensional structures with large, cage-like cavities, which can accommodate sodium, calcium, or other cations (positively charged atoms or atomic clusters), water molecules, and even small organic molecules. Ions and molecules in the cages can be removed or exchanged without destroying the aluminosilicate framework. The cage-shaped structure of zeolites produces a large internal and outer surface area for ion exchange and chemical reactions. The pores and tubes running through the zeolite mineral make up about 50% of the volume, and function as a superb molecular sieve; zeolites are naturally loaded with a negative charge and have a high ion exchange capability.



The combination of a very porous structure and high ion exchange capacity means that the zeolites are able to capture and completely bind many kinds of gases and odors, water and moisture, petrochemical substances, low level radioactive elements, ammonium, toxins, heavy metals and many other liquid pollutants. Some of the more common natural mineral zeolites are analcime, chabazite, clinoptilolite, heulandite, natrolite, phillipsite, and stilbite.

The term zeolite was originally coined in 1756 by Swedish mineralogist Axel Fredrik Cronstedt, who observed that upon rapidly heating the material stilbite, it produced large amounts of steam from water that had been adsorbed by the material. Based on this, he called the material zeolite, from the Greek ζέω (*zéō*), meaning "to boil" and λίθος (*lithos*), meaning "stone". Millions of years ago, zeolites were formed due to a chemical reaction between the ash and lava erupting from volcanos and water in lakes and seas. Depending upon the temperature, geological location, and the water to ash ratio, each type of zeolite has its own unique specifications.

To date, about fifty natural zeolite types have been identified, each with different compositions, and more than one hundred and fifty types have been synthesized. Natural zeolites are highly rigid under dehydration as well as under various aggressive physical conditions, and the molecular sieving and other physico-chemical properties of the zeolites can be managed by thermal or chemical treatment. These properties have resulted in their wide utilization in industry, agriculture, medicine, environmental protection and other fields. Synthesized analogues of the natural zeolites do not have the ability to withstand aggressive physical conditions and are usually applied in different technological processes. The low output price, and the subsurface location of massive deposits of natural zeolites throughout the world, make them significantly more available for a wide range of applications across many business sectors.

## I. EXECUTIVE SUMMARY

Zeodex Inc. is a technology leader in the manufacturing and commercial applications of innovative products based on clinoptilolite, a natural zeolite. Zeodex Inc. distributes its products globally, and is dedicated to the principle of "first, do no harm" to people and the environment; Zeodex Inc. is committed to environmental responsibility in all our business activities and is vigilant in protecting the environment across all its operations.

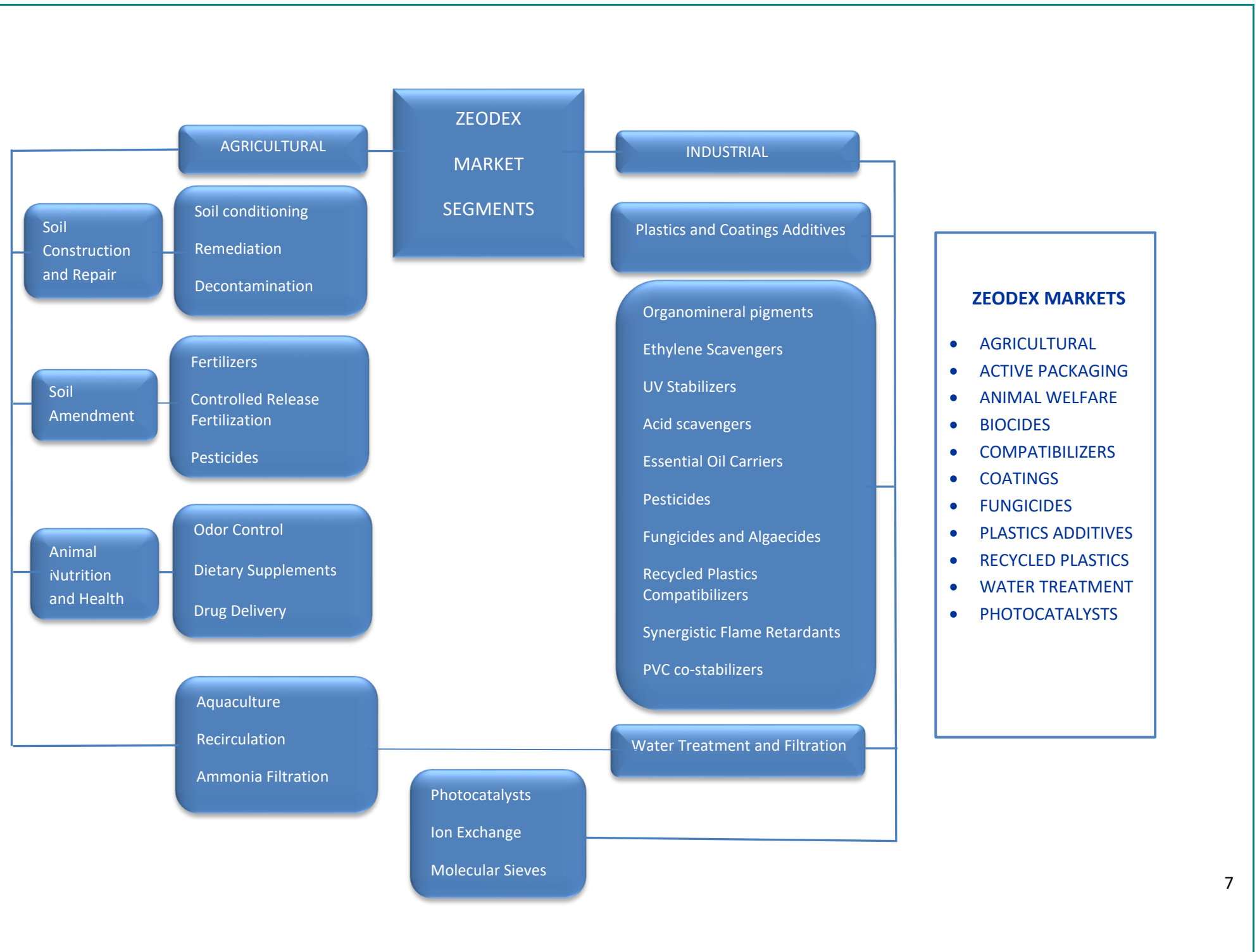
### THE STRATEGY

- There are large existing and emerging global markets for Zeodex products and technology, in agriculture; animal welfare; plastics additives; paint and coatings; water treatment; UV stabilizers, selective light spectrum control and blocking additives; and advanced photocatalysts for pollution reduction.
- Zeodex will focus on business in markets where our innovative, high value-added products, have distinct advantages based on performance and cost.
- Advanced milling and comminution equipment operation will be used, ensuring quality control and continuity of operations. Unique combinations of selected minerals and proprietary surface treatments will expand the range of new products based on existing Zeodex technology.
- Intellectual property will continue be protected by strictly controlling access to information, and patents will be filed where warranted.
- Our aim is to increase shareholder value, and to invest part of the profits to ensure rapid growth, entering all major markets as financial, manufacturing, and feedstock resources become available.

### ZEODEX PRODUCTS

- There are existing applications and customers for Zeodex in:
  - Advanced specialty products, which will exploit the benefits of controlled particle size and high quality of Zeodex products compared to existing commercial products.
  - Organomineral pigments; ultra-violet stabilizers for clear thin plastic films and moldings, synergistic flame retardants, essential oils carriers, pesticides, algaecides, fungicides and biocides, active packaging applications, photocatalysts, UV stabilizers and unique spectral modifiers and enhancers.
  - Other products: ethylene gas scavengers, acetaldehyde odor scavengers for PET packaging, recycled plastics compatibilizers, including PVC; wood and fiber-filled plastics; odor reduction in rubber-plastics composites; unique combination pellets for water treatment.





## II. COMPANY OVERVIEW

- Zeodex innovative additives and technologies are based on the use of clinoptilolite, a natural zeolite mineral, and other specialty minerals and proprietary surface treatments. Extensive research and development work yielded successful commercial applications, in plastics additives, biocides, organomineral colorants, agriculture, horticulture, water treatment products, titanium dioxide photocatalysts, and odor control.
- Zeodex products are manufactured and supplied in North America, Europe, and China, by Endex International Inc.,
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### ZEODEX INC.

Zeodex Inc. is the operating company name for the group comprised of the following companies:

Company	Contact name and title	Location
• Endex International Inc.	Gerard Mooney, President, CEO	N. America and UK
• Protol Comar	Stephen Conley, Director	UK
• Stabilization Technologies LLC	Joseph Webster, President, CEO	USA

### ZEODEX TECHNOLOGY

Zeodex Inc. products are high performance and cost effective inorganic mineral and organomineral products. The manufacturing processes are proprietary, and there is no known direct competition in the types of products we produce.

- Zeodex products have no major direct competitors because of the unique technology used to produce and modify them. By positioning Zeodex in specialized target markets, we do not compete in the low valued added, low technology markets. Instead, we concentrate on high-value added products, where market demand exists for our unique, cost competitive technology.



- Zeodex composite and hybrid products have been developed to take advantage of the very high surface area and fine particle size of Alterin™ clinoptilolite. Proprietary surface activation and modification methods, plus extensive laboratory and customer testing, has created a wide range of specialty products for the agriculture, horticulture, plastics additives, and water treatment markets.
- Zeodex proprietary intellectual property gives us significant advantages over our competitors, including the selection of specific additives and activation and ion-exchange processes in zeolite and their applications.
- We are already supplying and working with key customers. These customers include industry leaders in plastic packaging, extruded and molded plastics, recycled plastics, and water treatment plants.
- We have experienced marketing personnel with the ability to attract new customers at a low cost in international markets. We have many influential contacts in companies which are technology leaders in our target markets.
- We plan to add other natural zeolite structures our product range, such as chabazite and mordenite, and to exploit their properties using the same methods developed for Zeodex clinoptilolite technology.
- Zeolites are a large group of natural and synthetic hydrated aluminum silicates, characterized by complex three-dimensional structures with large, cage-like cavities, which can accommodate sodium, calcium, or other cations (positively charged atoms or atomic clusters), water molecules, and even small organic molecules. Ions and molecules in the cages can be removed or exchanged without destroying the aluminosilicate framework.
- There are about fifty natural zeolites; although some natural zeolites occur in large amounts, they offer a limited range of atomic structures and properties. Zeodex has concentrated on clinoptilolite, the most versatile of the natural zeolites, and will add other natural zeolites to exploit their individual properties using Zeodex technology.
- Synthetic zeolites were first produced in the 1950s, and to date more than 100 different zeolites have been made. They have a wider range of properties and larger cavities than their natural counterparts, but they are generally much more expensive than natural zeolite, and have much lower structural strength which causes them to break down in the high shear conditions of plastics processing.
- Natural zeolites are processed from natural ore bodies; synthetic zeolites are manufactured from energy consuming chemicals. Natural zeolites do not break down in mildly acidic environments, whereas synthetic zeolites do; the natural zeolite structure has more acid resistant silica to hold its structure together.
- The word "zeolite" comes from the Greek for "boiling stone," because of the observation that zeolites release water when heated. As their compositions are not fixed, they are examples of nonstoichiometric compounds.

### **Alterin MNZ™**

There are emerging markets for agricultural films, sheet, and several allied applications. Use of Alterin MNZ™ (Modified Natural Zeolite) as a carrier makes it possible to incorporate high levels of essential oils into thermoplastics, as natural pesticides, algacides, fungicides and biocides. Alterin MNZ™ also imparts greater heat stability for thermal processing and enables prolonged release of the additives from the finished products. Alterin MNZ™ can also be used in active food packaging as aldehyde, ethylene and oxygen scavengers, and to extend the freshness of fruit, vegetables, and flowers. Plastic protective packaging containing zeolite and essential oils can be used to protect the contents, replacing the chemicals used at present. Polypropylene bags for shipping of grains, cereals, and rice have considerable potential for Alterin MNZ™, and have been used in trials to incorporate essential oils, such as cedar oil and wintergreen, into the plastic to provide protection against various pests. A major global producer of food storage containers will soon introduce a new product which incorporates Alterin MNZ™ and an essential oil pesticide, to prevent weevil infestation of rice.

### **Zeocolor™ organomineral colorants and fillers**

There is a very large market for colorants and pigments in thermoplastics, paints and coatings and Zeocolor OMP™ technology has been extensively developed and tested in a wide range of these applications. Once the funding is in place to begin manufacturing these on a commercial scale we will exploit the many advantages offered by Zeocolor OMP™ detailed below in this document.

### **Water Treatment applications**

We have developed proprietary technology to produce very large surface area pelletized composites of Zeodex MNZ™ and other minerals, which are used to remove fertilizers such as phosphates and nitrates from water which have been tested and successfully used in several small UK water treatment plants.

### **UVITA SME™ Spectral Modifiers and Enhancers**

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### **ZETINOX™ Photocatalysis Technology**

Photocatalysts represent a special type of catalyst which utilizes photons as a source of energy to activate certain reactions. The super-hydrophilic properties of these materials, and their ability to decompose different types of organic and inorganic molecules, can be exploited in many new commercial applications, including materials and coatings for residential and commercial construction, deodorizing products, automotive coatings, appliances, sterilization articles, and water treatment products, to name just a few.