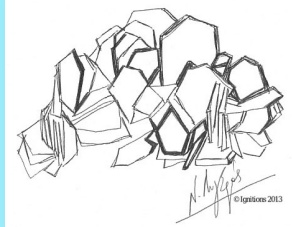


## The Necessity to Utilise Zeolite as a Rare Mineral with Numerous Purposes

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Translated from the Greek by Athena Kehagias

**Zeolites** are microporous, aluminosilicate minerals commonly used as commercial absorbents and catalysts. The term zeolite was originally coined in 1756 by the 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 absorbed



by the material. Based on this, he called the material *zeolite*, from the Greek ζέω (*zéō*), meaning "to boil" and λίθος (*lithos*), meaning "stone". The promotion of this **rare beneficial mineral**, especially when its mining is on the surface without any chemical usage, without the generation of waste, and with the ability of full area recovery at the end of the works. The exploitation of zeolite gives us many opportunities as far as the economic and environmental improvement in the region is concerned. <http://ellhnikos-zeolithos.blogspot.com.au>

The region of **Northern Municipality Region of EVROS** with resources of this mineral, is an exclusively agricultural and ranching area. Through the mining, the local producers could be allowed to meet the great potential of the zeolite, at first as fertilization solution of lower cost and then with water saving, since it has been proven that with the zeolite due to its capacity of water retention and release, the water needs are reduced to 1/3. The next consequence comes with the increase in production due again to the presence of the zeolite and the long-term clearance of soil from heavy metals and polluting elements and makes it appropriate to use for organic crops with higher profit for the producer, from the higher price of the products. This is something that finds application in animal husbandry, since the zeolite has many beneficial applications in animals, through feeding, but also through the facilities of the livestock units. Finally, the need for the transportation of the produced mineral gives an opportunity to develop the **port of Alexandroupolis**.

**Zeolites are characterized by the following properties:** (<http://www.lygeros.org/section.php?name=Zeolithe>)

- ✓ They dehydrate at a high level
- ✓ Low density and a large void volumes due to the dehydration
- ✓ Stability of crystalline structure
- ✓ Great ion exchange capacity
- ✓ Similarity of channels, molecular size
- ✓ Absorption Ability
- ✓ Catalysis ability

**Zeolites are widely used as adsorbent products:**

The water molecules fill the gaps of the mesh and form water spheres around the exchangeable cations. When the water is removed, molecules of small diameter are selectively adsorbed by the empty the channels, while the larger molecules are expelled. This capability of the zeolites, allows a large variety of materials to be withheld. The ability of zeolites to adsorb depends, primarily, on the range of channels and is a function of the number of oxygen atoms (6, 8, 10 or 12), which define the range. Thus, zeolites, whose rings comprise of 8-12 Tetrahedrons, it's possible to adsorb, except from simple cations, organic molecules also. That ability is determined by the amounts of water content when zeolites are fully hydrated. In some zeolites, the volume of these channels, which contains water, can reach 50% of their total volume. The exchangeable zeolite cations as loosely bound to their grid, it is easy to be exchanged or removed, if washed off with the solution of another ion. Their ability is called CAC, cation-exchange capacity- measured in milliequivalents of exchangeable ion per 100 gr of an adsorbent agent (meq / 100gr). Due to their structure, most zeolites do not undergo any significant change in their dimensions due to the ion-exchange, which however is followed by significant changes in the stability, the adsorptive behavior and qualities of the zeolites, in respect to their catalytic and other important natural abilities.



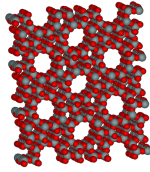
**Based on their behavior during dehydration, Zeolites are classified as:**

- **Zeolites**, which do not undergo noticeable structural changes during dehydration and to which with

increasing the temperature, the weight loss is gradual and continuous. This category includes the ***Clinoptilolite, Mordenite, Erionite and Chabazite*** as well as ***Synthetic Forms of zeolites***, which are chemically stable up to 700°C - 800°C.

- **Zeolites**, which undergo major structural changes during dehydration and to which weight loss is discontinuous at increasing temperature.

The catalytic abilities of zeolites depend on the internal cavities, where reactions can enter the cavities and undergo from the cavities as a product of catalytic size of incoming molecules, as well as the



upon the size of their surface pores, and the size of occur. The pore size determines which molecules catalysis and which molecules can be extracted reactions. We have, therefore, selectivity in the extract products of a reaction.

#### **In 30 positions in Evros there have been identified various types of zeolites:**

- Petrotta-Pentalofos (10 positions),
- Metaxades-Avdella (2)
- Dadia-Lefkimi (7)
- Kavisos-Feres-Aetochori (9)
- Samothrace (2).

Most positions are not of interest, due to small stocks, low quality and inclusion of fibrous zeolites. In 4 of the 10 sites of the Trigono municipality (Petrotta-Pentalofos) natural zeolite was found with quality ranging from 76% to 89%. The financial-investment interest lies in the position Rema Ntrista-Petrotta of the Trigono municipality, where stocks of high quality natural zeolite were found, identified as the Hellenic Natural Zeolite (HEL.PH.ZE). The Hellenic Natural Zeolite, with mineralogical composition of 89% of zeolite type HEU (clinoptilolite-evlanditi) + 3% mica + clay minerals, 4% feldspars, 2% cristobalite and 2% quartz, the chemical contains mainly SiO<sub>2</sub>, Al<sub>2</sub>O<sub>3</sub>, CaO, K<sub>2</sub>O, MgO and Na<sub>2</sub>O, its withholding capacity (ion exchange capacity) is 196 meq / 100g, while the oryktochimeia of zeolite type -HEU- is: Ca1.8K0.9Mg0.6Na0.5Al6.4Si29.6O72. 20H<sub>2</sub>.

#### **APPLICATIONS IN AGRICULTURE:**

As an 100% natural product it can be used in organic farming. Its beneficial effects are permanent, since it does not degrades as other soil improvers (<http://zeolado.gr/en/>).

- ✓ Improvement of food quality and taste.
- ✓ It releases slowly and naturally nutrients in the root system of young plants, thus increasing strength and performance.
- ✓ The mixing of zeolite to agricultural soils improves the nutritional quality of the soil. It brings impressive results to the growth of the plant, it reduces the diseases of the root system, increasing the production and the quality of agricultural products.
- ✓ Its use to agriculture, except for the qualitative improvement of the fruit, it offers increased production by 30% - 55% in wheat, 33% in rice, 50% in corn, 17% in cotton, 73% to grapes, 48% - 52 % to tomato, 45% to kiwi and 25% increase in flowering of carnations.
- ✓ With the use of less fertilizers and water, a good soil management is promoted and also the reduction of pollution from leaching of fertilizers into the ground.
- ✓ It can be used as a substrate, which helps the development of hydroponic crops, in horticulture, floriculture, aromatic species in Mediterranean conditions and it gives products of high quantity and quality.
- ✓ It captures and regulates all valuable nutrients such as potassium, magnesium, calcium and elements which it releases slowly as required.
- ✓ Absorbs and traps toxic contaminants.
- ✓ It helps to balance the pH of the soil.
- ✓ Improves ventilation.
- ✓ Provides an excellent platform for microbiological activity.
- ✓ Promotes a balance of alkalic metals.
- ✓ Reduces the cost of fertilizers and pesticides.
- ✓ Relieves compact soils.
- ✓ Improves soil structure, making it more loose so the plants grow much better.
- ✓ Has the capacity to retain water, and reduce water loss.
- ✓ Reduces the occurrence of dry spots.

- ✓ Promotes uniformity in production.
- ✓ It kills the pathogens.
- ✓ Reduces or eliminates odors.
- ✓ Reduces flies and kills weed seeds.

#### **APPLICATIONS IN ANIMAL HUSBANDRY:**

- ✓ Protects animals from enteric diseases, combating diarrheas.
- ✓ It reduces food consumption.
- ✓ It reduces medication use on animals.
- ✓ Reduces mortality of young animals and contributes to their development.
- ✓ It withholds ammonia generated during the digestion of food, while it is releasing potassium which is regulating the acidity of the stomach, a factor that allows the absorption of minerals and nutrients.
- ✓ It withholds and removes through the digestive tract of toxins and allergens of foods.
- ✓ Improves the immune system of animals.
- ✓ Helps to increase milk production and meat quality. In cow milk production an increase of 17% was noted.
- ✓ Helps odor control, especially of ammonia and hydrogen sulfide in maintenance areas and animal food storage units.
- ✓ Works as means to improve the conditions of animals in breeding chambers.
- ✓ In poultry there is an increase in egg production and a 7% increase in their weight.
- ✓ In breeding goats added by 2.5% in their diet resulted in weight gain, birth to triplets and quadruplet births and significant increase of fat content in their milk.

The European Union, in accordance with directive 70/524 / EEC (Commission Regulation (EC) No 1810/2005) has officially approved the use of clinoptilolite of sedimentary origin as binding and anticoagulant additive in foods for, birds, cattle, pigs and salmon.

#### **APPLICATIONS FOR ENVIRONMENTAL MANAGEMENT:**

- ✓ Improvement of quality of drinking water.
- ✓ Used in cleaning various types of wastewater (urban, industrial, agricultural, radioactive waste).
- ✓ Assists in the development and multiplication of many aquatic organisms.
- ✓ In lake waters, but also in other bodies of water, it adjusts the pH of the water to neutral, enriches water in oxygen, reduces bacteria, improves the welfare and development of organisms and plants.
- ✓ Capture and removal of cyanobacteria.
- ✓ Capture and removal of hexavalent chromium.
- ✓ Capture and removal of heavy metals and radioactive nucleotides from the ground.
- ✓ Removal of radioactive isotopes from nuclear waste.
- ✓ Cleaning and drying of gases.
- ✓ Management of mining waste and return the land to agricultural use.
- ✓ The solid mine waste and mainly, the basin control, prevents the leaching of metals with rainwater.
- ✓ Capture and release of heat from solar radiation in air-conditioning systems and water heating systems.
- ✓ Recovery of SO<sub>2</sub> in the flue gas chemical industry.
- ✓ Removal of arsenic from groundwater.

#### **APPLICATIONS FOR THE HYDROCARBONS INDUSTRY:**

- ✓ As a catalyst in petroleum refining.
- ✓ As detergents for cleaning petrochemical pipelines.
- ✓ As catalysts in the production of liquid fuels with high octane content.
- ✓ For the production and purification of natural gas.
- ✓ Removal of mercury steam from natural gas.
- ✓ Separation of propane - ethylene.
- ✓ Drying alcohols and hydrocarbon mixtures.
- ✓ Desulphurization and removal of mercaptans from oils, kerosene and other units in distillate oil.
- ✓ Dehydration of chlorinated hydrocarbons refrigeration cycles.
- ✓ The separation of gaseous compounds such as CO<sub>2</sub>, CH<sub>4</sub> and SO<sub>2</sub>.