Clinoptilolite Zeolite Research & Articles

This research is relevant to Coseva's Advanced Toxin Removal System:
a Clinoptilolite Zeolite suspension (mineral water)
heavy metals detox utilizing lab-synthesizing techniques
to produce the purest, smallest, most effect detox on the market.

http://www.autismone.org/content/dr-tracy-holdford-effects-environmental-toxins-and-safe-alternative-detoxification

ARTICLES containing scientific research

1. https://www.thewolfeclinic.com/wp/zeolite-natures-detoxifier/
"In fact, because it is one of the few negatively charged minerals in nature, zeolites act as magnets, safely drawing toxins into the crystalline structure, capturing them and removing them from the body."
"Zeolite molecules can be found in three main forms: fibrous, leafy or crystalline. The medical use of zeolite comes from the crystalline form as it contains high quantities of the mineral clinoptilolite"
"Interestingly, zeolite has industrially been used for water purification, air filters and in cigarette filters to reduce nicotine and tar."
"USING ZEOLITE MEDICALLY Zeolite is a multifaceted mineral that is used medically for an array of conditions and health challenges. The addition of a zeolite supplement in an individual's health regime will help to:
remove heavy metal toxicity
balance pH
bind and remove mycotoxins
act as an anti-diarrheal
aid in the prevention of cancer
act as a potent antioxidant
trap and remove pre-virus components
balance the immune system

In addition, zeolite works on the body to help with:
the circulatory system
kidney function
skin diseases
diabetes mellitus
periodontisis
endocrine glands
rheumatic disorders
neuro-psychosis

fungal infection
alcoholic hangovers"

2.
https://www.sott.net/article/315100-Zeolite-A-safe-natural-detox-used-in-Asia-for-over-800-years
"A pilot study by holistic physician Dr. Gabriel Cousens M.D., M.D.(H) tested toxicity levels in the liver, breast and brain of subjects before and after administering a short-term detox protocol — a controlled diet of green vegetable juice and NCD Zeolite, a formula derived from the clinoptilolite zeolite crystal (pictured above) that was initially developed by Dr. Cousens as a detox agent for prospective parents before conception. Promisingly, by the end of the 7 day test period, toxicity levels in the subjects showed the reduction of the tested toxic materials in the body by an average of 88%. In all, over 700 different chemicals were removed, including mercury, lead, depleted uranium, PFOA, teflon, herbicides, pesticides and xeno-estrogens. [source]"
(www.pureliquidzeolite.com/dr-gabriel-cousens-heavy-metal-removal-study-zeolite/)
"The overall percentage of removal of these toxins from these organs was 88%, leaving only 12% of the toxins in their systems overall. This included 91% removal from the liver, 88% removal from the breast, and 87% removal from the brain. In the 55 people tested the heavy metals, pesticides, and herbicide toxins, initially 801 toxins were found in the subjects' livers, 825 toxins in the breasts, 824 toxins in the brain. After the one-week protocol, just 73 toxins were left in the liver, 102 toxins left in the breast, and 111 toxins left in the brain"
"I am proposing a theoretical model for explaining the testimonials of the powerful, across-the-board healing effects of NCD (a purified zeolite) from such health problems as ADD/Hyperactivity, Addiction, Agent Orange Exposure, Arthritis, Autism, Cancer, Cysts and Tumors, Depression, DES Exposure, Diabetes, Fibromyalgia, Flu, Colds, and Respiratory Problems, Gastro-Intestinal Problems, Heavy Metal Poisoning, Hepatitis C, High Blood Pressure, HIV/AIDS, Kidney Stones, Lack of Mental Clarity, Pain, PMS/Menstrual Pain, Silicone Breast Implant Toxicity, Skin Conditions, Spider Bite, Toothache/Gum Disease, Varicose and Spider Veins, Viral and Other Infections, Yeast Infections."

3. http://vaccinepapers.org/nutrients-preventing-aluminum-toxicity/
"Aluminosilicates are nontoxic and almost biologically inert. So silica effectively detoxifies aluminum by converting it into aluminosilicate, which is eliminated by the kidneys. This reaction between silica and aluminum can occur inside the body, and is believed to be an important mechanism for aluminum detoxification for many animals (including snails for example"

4. https://www.globalhealingcenter.com/natural-health/detoxing-with-zeolites/
"One natural Zeolite, Clinoptilolite, was discovered to assist in removing toxic metal toxins through urination without depleting the body's store of essential electrolytes [2]. These studies are extremely encouraging, because they suggest Zeolites can help with alleviating accumulated toxic metals."

5.
https://www.omicsonline.org/proceedings/clinoptilotite-zeolite-a-fascinating-mineral-with-capabilities-to-rebalance-and-detoxify-the-body-towards-a-longer-activ-52754.html
Cached version:
http://cc.bingj.com/cache.aspx?q=https%3a%2f%2fwww.omicsonline.org%2fproceedings%2fclinoptilotite-zeolite-a-fascinating-mineral-with-capabilities-to-rebalance-and-detoxify-the-body-towards-a-longer-activ-52754.html

6. https://nutritionandmetabolism.biomedcentral.com/articles/10.1186/1743-7075-10-2
"Biological and therapeutic effects of ortho-silicic acid and some ortho-silicic acid-releasing compounds: New perspectives for therapy"

7. http://www.arltma.com/Articles/RetracingDoc.htm

8. https://www.life-enthusiast.com/articles/zeolite-for-autism

HUMAN TRIALS

1. https://www.ncbi.nlm.nih.gov/pubmed/?term=zeolite+leaky+gut Leaky gut
"CONCLUSIONS: Twelve weeks of zeolite supplementation exerted beneficial effects on intestinal wall integrity as indicated via decreased concentrations of the tight junction modulator zonulin. This was accompanied by mild anti-inflammatory effects in this cohort of aerobically trained subjects."

2.
https://www.dovepress.com/potentiated-clinoptilolite-artificially-enhanced-aluminosilicate-reduc-peer-reviewed-article-CEG Heavy metals detox
"Results: In the ENGORD study, patients who received the potentiated clinoptilolite reported a significant reduction (P≤0.05) in severity of symptoms including reduction in heartburn (44%), discomfort (54%), and pain (56%). Symptom-free days improved by 41% compared to the group who received placebo (not significant). This was over and above the benefits seen with the proton pump inhibitor. In the NSAID study, the reduction in gastric symptom severity was echoed in the group who received the potentiated clinoptilolite. Treatment with the potentiated clinoptilolite resulted in significant prevention (P≤0.05) of mucosal erosion severity as graded by the gastroenterologist.

3. https://www.ncbi.nlm.nih.gov/pubmed/20621793 fluoride/fluorine
"Human detoxification of perfluorinated compounds"

4. https://www.ncbi.nlm.nih.gov/pubmed/28605233 Lipid improvement
"These pilot results suggest that oral administration of clinoptilolite may improve lipid profile in individuals with dyslipidemia, which warrants further investigations"

5. https://neuro.psychiatryonline.org/doi/full/10.1176/appi.neuropsych.12010014 ADHD
"Increasing Performance in Children With ADHD By Trapping Lead With a Nano-Zeolite"

6. https://www.ncbi.nlm.nih.gov/pubmed/26084226 alcohol/ethanol
"Zeolites are microscopic minerals of volcanic origin, and the zeolite most commonly used in medicine is clinoptilolite. Over the years, clinoptilolite has been tested in several ways: as an antioxidant, as an adjuvant in anticancer therapy due to its ability to capture chemotoxins, as an antidiarrhoeal agent and as a chelating agent for heavy metals."
"Our study highlights and confirms the ability of clinoptilolite to decrease the absorption of ingested ethanol by reducing blood alcohol levels. This effect was statistically significant at a dose of 5 g."

7. https://www.ncbi.nlm.nih.gov/pubmed/15310086 Immunity
"Dietary supplementation with the tribomechanically activated zeolite clinoptilolite in immunodeficiency: effects on the immune system"

8.
https://www.dovepress.com/clinical-evidence-supporting-the-use-of-an-activated-clinoptilolite-su-peer-reviewed-article-NDS Heavy metals detox
"Clinical evidence supporting the use of an activated clinoptilolite suspension as an agent to increase urinary excretion of toxic heavy metals"

9. https://www.ajol.info/index.php/safp/article/viewFile/152595/142181 IBS
"The effects of an artificially enhanced clinoptilolite in patients with irritable bowel syndrome"

10. https://zeolite.com/images/zeolitestudyek.pdf
ABSTRACT Background This case study was performed to evaluate the effectiveness of clinoptilolite zeolite (“zeolite” herein) as an oral chelating agent for heavy metals. Zeolite is a hydrated aluminosilicate with symmetrically stacked alumina and silica tetrahedra which result in an open and stable three dimensional honey comb structure with a negative charge. The negative charge within the pores is neutralized by positively charged ions (cations) such as calcium. Historically, zeolite has been used as a commercial absorbent, and more recently in the dietary supplement industry as a detoxifier. Methods Three different commercially available zeolite preparations for oral consumption were used: an oral spray, oral drops, and a powdered preparation. The chelating capabilities of the different zeolite preparations on 20 different heavy, and potentially toxic, metals were measured in urinary excretion in 20 human subjects. The excretion rates were compared to baseline (nonconsumption) measurements to ensure consistency. The safety was evaluated with pre and post testing of blood counts and chemistry, as well as liver and kidney function. Results It was possible to observe the capability of different zeolite preparations to increase the excretion of heavy metals from the human body in a safe manner. The effectiveness of three different zeolite preparations was observed. Conclusions When properly prepared as an oral supplement, zeolite can provide detoxification support to the

human body to rid itself of heavy and toxic metals with minimal or no side effects. This can include applications to address lead, mercury or radiation poisoning

ANIMAL TRIALS

1. https://www.ncbi.nlm.nih.gov/pubmed/26268084
"In zoothechnology and veterinary medicine zeolite improves the pets' fitness, removes radioactive elements, aflatoxines and poisons. Zeolite displays also antioxidant, whitening, hemostatic and anti-diarrhoic properties, projected in human care. However very scanty clinical studies have been run up to now in immunodeficiency, oncology after chemotherapy and radiotherapy as adjuvants."

2. https://www.ncbi.nlm.nih.gov/pubmed/22147334
"Modified natural clinoptilolite detoxifies small mammal's organism loaded with lead I. Lead disposition and kinetic model for lead bioaccumulation."

3. https://www.ncbi.nlm.nih.gov/pubmed/22144018
"Modified natural clinoptilolite detoxifies small mammal's organism loaded with lead II: genetic, cell, and physiological effects."

4. https://efsa.onlinelibrary.wiley.com/doi/pdf/10.2903/j.efsa.2013.3039
"The additive clinoptilolite of sedimentary origin contains at least 80 % clinoptilolite (hydrated calcium aluminosilicate) and a maximum of 20 % clay minerals. Regarding the limited database and partly controversial findings, the FEEDAP Panel concluded that 10 000 mg clinoptilolite/kg complete feed could be considered to be safe for all animal species. Clinoptilolite is essentially not absorbed and is excreted with the faeces. There is no evidence that clinoptilolite will be degraded during its passage through the gastrointestinal tract of target animals. The consumer is therefore not exposed to clinoptilolite as a result of its use in animal nutrition; consequently, no risk for the consumer will arise. With regard to the high dusting potential of the additive, and in the absence of data on its irritation and sensitisation potential, the FEEDAP Panel considers it prudent to treat the additive as an irritant to the skin and eyes, a dermal sensitiser and an inhalation toxicant. The use of clinoptilolite in animal nutrition does not pose a risk for the environment. Based on data on a large variety of compound feeds, the additive is considered to have the potential to be effective as an anticaking agent. No data were available to allow conclusions to be drawn on its efficacy as a pellet binder. However, as the physical properties required for an anticaking and a pellet-binding additive are similar, and the efficacy of clinoptilolite as an anticaking agent is proven, the FEEDAP Panel considers it likely that the additive also has the potential to be effective as a pellet binder"

5. https://www.omicsonline.org/open-access/zeolites-versus-lead-toxicity-jbb.1000209.pdf 5
"Abstract The workers in metal industry as well as the people inhabiting industrially polluted regions are Health hazard groups regarding the development of chronic heavy metal

intoxication. Different means could be used to correct, at least partly, the consequences of such intoxication. However, the best substances for treatment are those that can prevent the metals entering in the blood. In case, metals enter in the organism through the digestive tract, zeolites are the most suitable means for trapping of metal ions. The substantial role of the clinoptilolite as a factor essentially reducing Pb bioaccumulation is considered in an experiment with small mammals chronically exposed to lead. As a feed additive, clinoptilolites have been used so far in poultry and livestock to positively influence feces consistency, reduce diarrhea, bound mycotoxins and aflatoxins, and allow better performance of intestinal microflora. The present work is the first study of the effect of clinoptilolite, used as a food supplement, in conditions of Pb intoxication. Modified clinoptilolite KLS-10-MA was prepared and applied as food-additive in laboratory inbred ICR line mice, chosen as experimental animals. In the experiment the degree of the positive effect of this sorbent in the reduction of Pb bioaccumulation was explored. Evidences that clinoptilolite is practically non-toxic substance were presented. A mathematical model of Pb bioaccumulation in exposed and exposed-supplemented animals was proposed. Such investigations are important for human and veterinary medicine, pharmacy and for the explanation of some biological and chemical problems. The authors hope that the obtained results could help in further efforts to create drugs based on clinoptilolite sorbents. An application of such drugs could be of great importance for human and animals in regions that are industrially polluted with heavy metals, and particularly with Pb, in order to protect the organisms as well as the quality of the environment."

6. https://www.sciencedirect.com/science/article/pii/S1878029610002045
"Clinoptilolite Adsorption Capability of Ammonia in Pig Farm"

7. https://www.sciencedirect.com/science/article/pii/S0034528801905247
"Effect of in-feed inclusion of a natural zeolite (clinoptilolite) on certain vitamin, macro and trace element concentrations in the blood, liver and kidney tissues of sows"

8.
https://www.researchgate.net/publication/11905741Natural_zeolite_clinoptilolite_New_adjuvant_in_anticancer_therapy
"Mice & dogs Natural zeolite clinoptilolite: New adjuvant in anticancer therapy"

9. http://www.livestockscience.com/article/S1871-1413(09)00379-5/pdf
"Effect of dietary inclusion of clinoptilolite on antibody production by dairy cows vaccinated against Escherichia coli"

10. http://zeolitavida.eu/wp-content/uploads/2014/06/animalfeedpigs21.pdf
"Abstract Evidence is available for improved growth and reproductive performance of farm animals fed zeolite-supplemented diets. Zeolite-enriched diets may also have value in reducing the detrimental toxic effects of ingested mycotoxins. To assess this, the safety and efficacy of the long-term dietary use of a clinoptilolite-rich tuff (Cp) in sows were investigated in two experimental designs, in terms of potential undesirable effects on the animals' health and the

blood concentration of certain nutrients, as well as of any beneficial effect on their performance. In both studies the participating animals were assigned in two experimental groups (Cp-group and N-group), depending on the presence of Cp, at the inclusion rate of 2%, or not in their feed. The experimental diets were administered for a complete reproductive cycle. No adverse or side effects attributable to the use of Cp were noticed during the critical periods of pregnancy and lactation. Furthermore, no significant alteration in the serum concentration of certain vitamins (vitamins E and A) and mineral elements (inorganic P, K, Cu, Zn) was observed. The consumption of the Cp-enriched diet also proved to exert a promoting effect on sow's reproductive performance, since it resulted in larger litter sizes and piglets' body weights at both birth and weaning, additionally implying a protective role in ameliorating the toxic effects of the zearalenone which was found in considerable levels in pregnancy feed samples throughout the observation period. The overall results established the safety and efficacy criteria for the dietary use of Cp in sows.

11.
https://www.ncdinformation.com/Studies%20on%20Zeolite2_files/zeolite-sowsupplement.pdf

12. http://www.agromineral.org/en/download/Study_Pigs4.pdf
"A field study on the effect of in-feed inclusion of a natural zeolite (clinoptilolite) on health status and performance of sows/gilts and their litters "and reproductive performance of sows/gilts and performance of their litters, along with its compatibility with antibacterials (chlortetracycline, CTC) periodically used in medication programmes. Two hundred and forty sows/gilts and their litters were assigned to two main experimental groups and four subgroups, depending on the inclusion of NZ and CTC in their feed. During the trial, frequent sampling of pregnancy feed for mycotoxicological analysis revealed a high contamination level with zearalenone. No adverse or side effects attributed to NZ were noticed. Furthermore, the combined use of NZ and CTC revealed no clinically apparent interactive effect on the availability of the latter. Reproductive performance was significantly improved by the dietary inclusion of both NZ and CTC. The results also suggested that the beneficial effect of NZ could be additionally considered as an indicator of the amelioration of zearalenone exposure consequences. # 2002 Harcourt Publishers Ltd"

13. http://www.publish.csiro.au/an/an11347Diet
"supplementation with clinoptilolite improves energy status, reproductive efficiency and increases milk yield in dairy heifers"

14. https://www.agriculturejournals.cz/publicFiles/180289.pdf
"Blood selenium, copper, and zinc in dairy heifers during the transition period and effects of clinoptilolite administration "ABSTRACT: Selenium (Se), copper (Cu), and zinc (Zn) play important antioxidant role during the transition period of dairy cattle. However, there is limited information about their blood fluctuations during the entire transition period, especially in heifers. Furthermore, it is questionable whether the use of clinoptilolite, a natural zeolite, affects the availability of these trace elements during this period. The objective of the present study was to

monitor the blood concentrations of Se, Cu, and Zn during the transition period of dairy heifers and to investigate whether the dietary inclusion of clinoptilolite has any effect on them. Forty clinically healthy Holstein heifers were used in the experiment. They were randomly allocated in two equal groups (n = 20) formed according to their body condition score. The control group was fed only the basal ration whereas the daily feed of treatment group was supplemented with 200 g clinoptilolite. The experiment started 28 days before the expected day of calving and lasted until day 21 after parturition. Blood samples were taken at the onset of the experiment and then at weekly intervals until parturition, at the day of calving, and on days 7, 14, and 21. All samples were analyzed for blood Se and plasma Cu and Zn concentrations. The results indicate that the levels of Se, Cu, and Zn in blood change significantly ($P < 0.05$) throughout the transition period in dairy heifers and increase significantly ($P < 0.05$) immediately after calving. Furthermore, the dietary administration of clinoptilolite does not significantly affect their blood concentration ($P > 0.05$). Blood levels of Se, Cu, and Zn, although undergoing significant changes throughout the transition period in dairy heifers, remain practically stable until parturition and increase significantly immediately after calving. Clinoptilolite does not impair the dietary availability of the trace elements evaluated when added in heifers' rations during this period."

15.
https://academic.oup.com/ibdjournal/article-abstract/24/1/54/4757511?redirectedFrom=fulltext
Clinoptilolite in Dextran Sulphate Sodium-Induced Murine Colitis: Efficacy and Safety of a Microparticulate Preparation "Conclusion
Our observations confirm that a microparticulate preparation of clinoptilolite is safe and effective in a murine model of inflammatory bowel disease and supports the hypothesis that the adsorptive capacity of clinoptilolite is of potential therapeutic relevance"

16. https://www.ncbi.nlm.nih.gov/pubmed/22676421
"Influence of Zeolite on fatty acid composition and egg quality in Tunisian Laying Hens"

17. https://hrcak.srce.hr/file/277660
"More recently, biomedical applications of natural and synthetic zeolites have been established as detoxicants, antibacterial and antidiarrheal agents, vaccine and antitumor adjuvants, contrast in magnetic resonance and biosensors, and also for hemodialysis and hemoperfusion, diabetes mellitus/enzyme mimetic, delayed release drug delivery and bone formation/external application (32). Furthermore, zeolites have been successfully utilized for wound and surgical incision healing (31), including skin burns (41), for hemorrhage control (32) and dental treatment (26). However, recently it was recognized that previously observed positive biological effects of various colloidal silicic acids (various hydrated silica gels) as well as

of some zeolites, such as zeolite A and CPL might be partially ascribed to their ortho-silicic acid (OSA)-releasing property (26, 32, 42, 43). Namely, numerous biologically active silicon compounds such as some types of zeolites, particularly CPL, are major natural sources of the OSA as documented so far.

NURSING/GESTATING MAMMALS CLINICAL TRIALS

1. https://www.ncbi.nlm.nih.gov/pubmed/12002639/
Sow's milk improved with zeolite supplementation

2. https://www.ncbi.nlm.nih.gov/pubmed/19254146/
-> improved fat percentages in milk + improved milk hygiene

3. https://www.ncbi.nlm.nih.gov/pubmed/16997998/
-> no adverse long term effects

4. https://www.ncbi.nlm.nih.gov/m/pubmed/27413536/
-> reduced concentrations of aflatoxins in milk

5. https://www.ncbi.nlm.nih.gov/pubmed/12002638
A field study on the effect of in-feed inclusion of a natural zeolite (clinoptilolite) on health status and performance of sows/gilts and their litters.

6. http://www.publish.csiro.au/an/an11347
Diet supplementation with clinoptilolite improves energy status, reproductive efficiency and increases milk yield in dairy heifers

7. https://www.ncbi.nlm.nih.gov/pubmed/18343011

ENVIRONMENTAL TRIALS

1. http://wiredspace.wits.ac.za/handle/10539/11315
"Adsorption of cadmium, nickel and lead on modified natural zeolite"

2. https://www.sciencedirect.com/science/article/pii/S0301479707000254
Alkaline hydrothermal conversion of fly ash precipitates into zeolites 3: The removal of mercury and lead ions from wastewater

3. https://www.sciencedirect.com/science/article/pii/S0015188202802075

Zeolite sorbent that effectively removes mercury from flue gases

4. https://pubs.acs.org/doi/abs/10.1021/am201516q
Magnetic Self-Assembled Zeolite Clusters for Sensitive Detection and Rapid Removal of Mercury(II)

5. https://www.sciencedirect.com/science/article/abs/pii/S0892687504000585
The application of natural zeolites for mercury removal: from laboratory tests to industrial scale

6. https://www.sciencedirect.com/science/article/pii/S0957582016302786
Adsorption of heavy metals from wastewater graphic industry using clinoptilolite zeolite as adsorbent

7. https://www.ncbi.nlm.nih.gov/pubmed/15533402
The removal of heavy metal cations by natural zeolites.

8. https://www.ncbi.nlm.nih.gov/pubmed/18074286
Heavy metal removal from industrial wastewater by clinoptilolite

9. https://pdfs.semanticscholar.org/5316/d6e77f6c9f9ffd36350fb8701f158c84368b.pdf
HEAVY METAL REMOVAL WITH MEXICAN CLINOPTILOLITE: MULTI-COMPONENT IONIC EXCHANGE

10. https://pdfs.semanticscholar.org/8004/f2aea4487be3a71a450b5c327b67235a8949.pdf
"Results of this study indicated that zeolite was able to decrease the amount of uptake and transmission of lead and cadmium in plant and with decreasing the harmful effects of these elements cause to increase the growth traits, protein and uptake of nutrient in plant. So, zeolite can be used in order to decrease heavy metals uptake such as lead and cadmium and also improvement of growth of plants in polluted areas."

11.
http://ysu.am/files/8.%20HEAVY%20METAL%20ADSORPTION%20BY%20CLINOPTILOLITE%20FROM.pdf
HEAVY METAL ADSORPTION BY ARMENIAN NATURAL ZEOLITE FROM NATURAL AQUEOUS SOLUTIONS

12.
https://www.kmizeolite.com/wp-content/uploads/2016/12/Sprynskyy_Study-of-the-selection-mechanism.pdf

13. http://iopscience.iop.org/article/10.1088/1757-899X/200/1/012068/pdf
"The chemically untreated Barsana natural zeolite tuff used in the static and dynamic ion exchange processes leads to good results regarding the lead ions retention. For the dynamimc

exchange we can observe small differences between the two types of samples used for the experiment. The values obtained from the breaking curves show that the BT zeolite tuff sample is exhausted after 250 minutes, while the BN sample is still active in the ion exchange process, thus more efficient. This is due to the small potential (concentration) difference, the ion exchange process speed being lower, meaning the speed limitating stage becomes the ion exchange reaction. It is shown that for the static exchange experiments there are no significant differences between the two chosen samples (BT and BN). The Barsana Maramures natural zeolite with remarkable proprieties due to its clinoptilolite content, was pointed out by various studies conducted by [13], [14] and considered to be a natural material used for wastewater heavy metals ion retention by [9-12] and it led to very good results for ion exchange processes. Lead can be found in the environment on natural ways, but most of it comes as a result of human activities which lead to unwanted polluting processes that can have a serious impact on the health, the various effects of the lead intoxication on the human body being well known"

14. https://www.pjoes.com/pdf/25.1/Pol.J.Environ.Stud.Vol.25.No.1.251-257.pdf
Removing formaldehyde from wastewaters using Clinoptilolite zeolite

15. https://www.hindawi.com/journals/atox/2014/768706/
"Conclusion: The obtained results show that natural clinoptilolite should be used effectively for the extraction of paraquat from water solution and blood. The high extraction efficiency of paraquat from water solution and blood (98% and 82%, resp.) by availability and low cost clinoptilolite is close to the extraction efficiency obtained for Amberlite (98% and 82%, resp.). It seems that clinoptilolite could also be useful for gastrointestinal decontamination of paraquat."

ON SYNTHETIC CLINOPTILOLITE

1. https://www.ncbi.nlm.nih.gov/pubmed/28677630 on synthesizing clinoptilolite
"The modification of clinoptilolite has received noticeable attention from the research community, since modified forms have specific properties and therefore their area of application has been broadening. "

2. http://www.mdpi.com/1420-3049/22/7/1107/pdf
Synthesis and Modification of Clinoptilolite
"Clinoptilolite series minerals are the most common zeolites in nature and have been found in many areas all around the world, for instance, in Europe (Hungary, Italy, Romania, Slovakia, Slovenia,
Turkey, former Yugoslavia), in Russia and several states of the former Soviet Union (Georgia, Ukraine,
Azerbaijan), Asia (China, Iran, Japan, Korea), Africa (South Africa), Australia and New Zealand, and in
many countries of the Americas, such as Argentina, Cuba, Mexico and the United States.
Parent rocks

commonly contain over 50% of clinoptilolite, but contents over 80% are very widespread too [1]. Clinoptilolite belongs to the group heulandite (HEU), which possesses a two-dimensional structure [2]. HEU tetrahedral framework is formed from tetrahedral SiO4 and AlO4 units and contains three sets of intersecting channels. Two of the channels are parallel to the c-axis: A channels
are formed by strongly compressed ten-membered rings (aperture 3.1 7.6 Å) and B channels are
confined by eight-membered rings (aperture 3.6 4.6 Å). C channels are parallel to the a-axis and they
are also formed by eight-membered rings (aperture 2.6 4.7 Å). Clinoptilolite unit cells are monoclinic
with space group C2/m [3–5]. The general chemical formula is (Na,K)6Al6Si30O7220H2O [5,6] and the
Si/Al ratio of clinoptilolite may vary from 4.0 to 5.3 [7].

Noteworthy properties of clinoptilolite are strong adsorption, high ion exchange and excellent molecular sieving [8]. These properties have been largely applied in many fields including agriculture,
environment protection, pharmacy, petroleum technology, and construction [1]. In agriculture and horticulture, clinoptilolite has been used as a slow releasing carrier of fertilizers, insecticides,
pesticides, antibacterial agents, and growth stimulators [9]. This kind of material is frequently used in

Molecules 2017, 22, 1107; doi:10.3390/molecules22071107 www.mdpi.com/journal/molecules

environmental technology to remove heavy metals [10,11], dyes, and surfactants [12] from water or to
eliminate toxic gasses [13]. Moreover, clinoptilolite can be used for producing antidiarrheal [14] and
antiviral drugs [8], anticancer therapy [15], and drug carriers [16,17].

Although the mining of clinoptilolite from natural resources has been popular for many years, its artificial creation has been investigated in the last decades by many scientists due to the demand for
high quality and purity of clinoptilolite. Consequently, there is a significant number of studies focused
on the synthesis of clinoptilolite. Literature [18–32] demonstrates the efforts to synthesize from various
sources of chemicals and different techniques to obtain clinoptilolite with different compositions.

Clinoptilolite is used not only in its initial form but also in its modified form. In recent years, numerous studies [15,17,32–50] have contributed to the issue of clinoptilolite modification. It was
pointed out that the area of application could be intensively expanded by the functionalization of external as well as internal surfaces of clinoptilolite. The modification can be conducted by various

chemical reagents such as surfactants, organic compounds [33–43], and inorganic substances [51–62].
The modification process can be single steps like cation exchanging [51,61] or multiple steps including
cation exchanging, oxidizing, or reducing [55,58,59].
This paper presents details of the approaches that have been developed to synthesize clinoptilolite.
Attention is given to the crystallization condition including starting materials, temperature, time, and amount of seeds. The production process is described in detail and a brief review of the strategies that have been established to modify clinoptilolite by various reagents is given. Furthermore,
the applications of initial and modified forms of clinoptilolite are discussed."

3. https://minerals.usgs.gov/mineralofthemonth/zeolites.pdf
"There is little competition between natural zeolites and synthetic zeolites. The high cost of synthetic zeolites precludes their use for most natural zeolite applications. Conversely, stringent product specifications prevent the large-scale use of natural zeolites for most synthetic zeolite applications"

4. https://www.sciencedirect.com/science/article/pii/S0141391001001628 plastics polymer

5. https://link.springer.com/article/10.1007/s12665-013-2676-5
Removal of textile dyes from aqueous solution by conducting polymer modified clinoptilolite

ON NANO-SIZED ZEOLITE AND SURFACE AREA

1. http://www.wtec.org/loyola/nano/final/ch4.pdf
"Zeolitic Materials
Aluminosilicates (e.g., zeolites) are crystalline porous nanostructures with long range crystalline order with pore sizes which can be varied from about 4 Å to 15 Å in conventional zeolites. Figure 4.5 shows a 3-dimensional (e.g., MFI) zeolite cage structure together with a depiction of the straight and ziz-zag channels and a 2-dimensional zeolite with channels only in 2 directions. The vertices in the stick drawing denote position of the O atoms in the crystalline lattice. This particular zeolite has 10 atoms in the zeolite “window.” The size of the window is determined by the number of oxygens in the ring. Table 4.1 gives approximate window dimensions for zeolites as a function of the number of oxygens in the ring."

2. http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.862.1792&rep=rep1&type=pdf
CONCLUSIONS Nano-sized LTA zeolite particles were successfully synthesized by means of a controlled hydrothermal crystallization technique using organic precursors of Si and Al as well as organic template. The XRD pattern and FT-IR spectrum were ascertained the formation of high purity zeolite LTA phase. The SEM micrograph indicated that the LTA zeolite particle were

in range of 60-170 nm with uniform morphology and narrow distribution size. EDXS analysis determined that the Si/Al ratio of the as-synthesized LTA zeolite was 1.66 showing the positive effect of TMAOH organic template in increasing the Si/Al ratio. As a results of increasing the Si/A; ratio from 1 to 1.66, the thermal and chemical stability of the product will be enhanced remarkable. The BET plot showed the surface area of the sample was relatively high (i.e. 421 m2/g). The nano LTA sample showed mesoporosity. There was a steep jump and a large desorption loop in the isotherm. The hysteresis loop of zeolite appeared at a high relative pressure (P / P0 = 0.9-1.0) and it reflected intercrystalline voids in the packing of the smaller crystals.

3.
https://www.tandfonline.com/doi/full/10.1080/00103624.2014.956934?scroll=top&needAccess=true
Nanostructured Natural Zeolite: Surface Area, Meso-pore and Volume Distribution, and Morphology

4. https://www.nytimes.com/2007/11/07/business/businessspecial3/07nano.html
In a recent New York Times article (published November 7, 2007) titled: “Aiding the Environment, a Nanostep at a Time”, author Barnaby J. Feder in his comments describing the importance of having effectively large surface areas on the active ingredients of products stated: “Six ounces of nanoscale particles does the job of one ton of micron-size particles because of their vastly increased surface area and the greater ease with which they move…”

5. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4385093/
"Immobilization of biological material is a problem of prime importance for the biosensor creation. Successful immobilization directly influences key characteristics of biosensors (activity of biological material, linear working range, sensitivity to substrate, reproducibility and operational stability of signals, duration of storage, etc.). Therefore, selection of main parameters of the immobilization process is an essential challenge in the development of biosensors. In particular, an improvement of the methods of biomembrane immobilization onto the sensing element is an important task. One of the trends for solving this problem is an application of adjuvant substances (that are carriers of biomaterial, stabilizing agents, mediators, etc.) during immobilization process.
In the literature, there are various reports about physical adsorption of enzyme on the transducer solid substrates with some supporting materials such as sol-gels [1,2], polymeric membranes [3,4] and microcapsules [5,6], nanotubes [7,8], and zeolites [9-12]. The goal of this work was to study the controlled influence of zeolite crystals on the function of potentiometric biosensors."

6. http://pubs.rsc.org/en/content/articlehtml/2017/ra/c6ra28844h
"Nano ZSM-12 zeolite, with a huge external surface area and lower ratio of Brönsted to Lewis acids, exhibited high activity and selectivity for the direct transformation of methanol into

multi-methylbenzenes with molecule sizes that were larger than the 1-D pore of ZSM-12, via the production of xylene inside the pore and complete external surface methylation"

7. http://pubs.rsc.org/-/content/articlelanding/2015/nj/c5nj01631b/unauth#!divAbstract
"Raw and aspartic acid (ASP)-modified clinoptilolite (in both nano (NCP) and micronized (MCP) dimensions) were studied for their removal of heavy metal cations. The raw and modified samples were characterized by XRD, SEM, BET, TEM, FT-IR, TG and energy dispersive X-ray spectroscopy (EDX). Both raw and modified NCP showed better activity than the corresponding MCP for removal of the tested heavy metals, especially copper cations. The best activity was obtained by NCP modified in ASP solution at pH 6. The removal of Cu(II) ions increased during 300 min contact time. The kinetic isotherms showed that the adsorption kinetic could be well described by the pseudo-second-order rate equation. The Dubinin–Radushkevich and Langmuir isotherms indicated monolayer sorption of Cu(II) on the surface of the adsorbent via a chemical sorption phenomenon. The negative ΔG confirmed an exothermic and spontaneous removal process."

8. https://pdfs.semanticscholar.org/eb54/7b49f0dc7f585334458fef9503a67350cf30.pdf
"In the resent years, magnetic adsorbents are widely used for removing the organic contaminants [1], heavy metals [2] and biomolecules [3]. Among the magnetic nanoparticles, iron oxide nanoparticles have been greatly interested because of their unique properties. Co-precipitation [4] and electrochemical [5] synthesis methods are the most important methods formagnetic nanoparticles ... synthesize.To prevent unwanted oxidation and aggregation of particles, however, some compounds are used to protect and coat thesenanoparticles.The most commonlyusedcompound is silica, carbon, various polymers, and zeolites [6, 7]. Zeolites constitute a large family of alumina silicate minerals, including natural and synthetic types [8]. One of the most important natural zeolites isclinoptilolite,which is widely used to adsorb heavy cations and gases, remove radioactive materials from contaminated soils and ammonium from urban wastewater [9, 10]. Use of magnetic adsorbents makes easier separation processing and there is no need for filtration that are common like centrifuging [11]. A common method to synthesize magnetic zeolites is reflux process, however, with disadvantages, in cluding prolonged time and large volumes of organic solvents. The purpose of the present work is preparation of clinoptilolite/iron oxide magnetic nanocomposite. In this study, iron oxide nanoparticles was synthesized by electrochemical method and clinoptilolite is added to the electrochemical cell during the synthesis of iron oxide nanoparticles, therefore nanocomposite can be synthesized in a single-step process. The major advantages of this method are its simplicity, low cost, and no need fororganic solvents"

9. https://www.nanopartikel.info/en/nanoinfo/materials/zeolites/material-information-zeolites
"Properties and Applications
Zeolites were discovered in 1756 by Axel Frederick Cronstedt. They belong to the group of crystalline aluminosilicates and consist of the basic building blocks of silicate [SiO4]- and aluminates [AlO4]- tetrahedrons. The aluminum and silicon atoms are bonded by oxygen atoms.

This results in a structure of low density with numerous pores and channels [1]. There are around 200 synthesised and natural types of zeolites.
Due to the micro- to nano-scaled pores and channels, zeolites have a large inner surface area, which makes them well suited as a catalyst in chemical processes. Because of the negative matrix loading zeolites absorb positively charged ions. Therefore, zeolites are used as ion exchangers, as a filter for separating chemical substances or as a water softener in detergents (substituting polyphosphate) and used for flue gas desulfurization. Zeolites are used as odour absorbers in cat litter, to remove ammonia from soil and water and for the cleaning of radioactive waste water. In swimming pools they act as water cleaning filters.
Nanosized zeolite powders are applied for keeping the water of aquariums and fish ponds clean. In Fukushima tests are underway to decontaminate sea water and soil by means of zeolites. Because of their low density of 2-2,5 g/cm ³ they are used as filler for plastics, rubber, paper or asphalt and as an additive in adhesives.
In agriculture, zeolites are added to fertilizers to deliver nutrients such as potassium and nitrogen to the plant as necessary.
In cosmetics zeolites were used to bind moisture or to odour neutralization. As dietary supplement nano-zeolites are said to enhance absorption of minerals in the body or to absorb toxins such as heavy metals or radicals...
Although having been known for a long time, zeolites have been used intensive only in recent decades, with more new applications being developed.
Zeolites are not self-inflammable as nanometer-sized powders. The mixture of zeolites and air (dust) under the influence of an ignition source is not flammable, so there is no possibility of dust explosion"

10. https://link.springer.com/article/10.1134%2FS2070205117040086
Synthesis of Zeolite/Magnetite Nanocomposite and a Fast Experimental Determination of Its Specific Surface Area

11.
http://openaccess.iyte.edu.tr:8080/bitstream/handle/11147/6322/6322.pdf?sequence=1&isAllowed=y
Clinoptilolite surface area

12. https://www.nano.gov/nanotech-101/special
"Nanoscale particles are not new in either nature or science. However, the recent leaps in areas such as microscopy have given scientists new tools to understand and take advantage of phenomena that occur naturally when matter is organized at the nanoscale. In essence, these phenomena are based on "quantum effects" and other simple physical effects such as expanded surface area (more on these below). In addition, the fact that a majority of biological processes occur at the nanoscale gives scientists models and templates to imagine and construct new processes that can enhance their work in medicine, imaging, computing, printing, chemical catalysis, materials synthesis, and many other fields. Nanotechnology is not simply working at ever smaller dimensions; rather, working at the nanoscale enables scientists to utilize

the unique physical, chemical, mechanical, and optical properties of materials that naturally occur at that scale"

13. https://pdfs.semanticscholar.org/5299/7763cd1b5d30516028542d51342fd51c928c.pdf
"NANOPARTICLES OF ACTIVATED NATURAL ZEOLITE ON TEXTILES FOR PROTECTION AND THERAPY* Activated natural zeolite clinoptilolite is microporous hydrated aluminosilicates crystals with well-defined structures containing AlO 4 and SiO 4 tetrahedral linked through the common oxygen atoms. It is to point out that zeolites act as strong adsorbents and ion-exchangers but having many other useful properties. Due to its cationexchange ability, zeolites have catalytic properties and, for that, multiple uses in medicine and industry, agriculture, water purification and detergents. Zeolites are nontoxic substance, excellent for UVR and microbes protection, for proteins and small molecules such as glucose adsorption. In this paper its positive effect on t he metabolism of living organisms and its anticancerogenic, antiviral, antimetastatic and antioxidant effect. The activity of natural zeolite as natural immunostimulator was presented as well as its help in healing wounds. Therefore, the present paper is an attempt to modify cotton (by mercerization) and polyester (by alkaline hydrolysis) fabrics for summer clothing with addition of natural zeo lite nanoparticles for achieving UV and antibacterial protective textile

14.
https://www.researchgate.net/publication/244322759_Catalytic_properties_of_nano-sized_ZSM-5_aggregates
"Catalytic properties of nano-sized ZSM-5 aggregates
Nano-ZSM-5 (NZ) with well-defined porosity was synthesized by organic silica method. The material exhibited more than a twofold increase in pore volume when compared to the normal ZSM-5 (HZ). The increase in pore volume is observed in the entire range of the pores with diameter from 5Å to 1500Å. The order of increase in volume is macropores (>500Å)>micropores (up to 20Å)>mesopores (20–500Å). Although macropore and mesopore formation is responsible for the major increase in the pore volume, significant increase in zeolitic pore volume was also observed in NZ. Both the ZSM-5 materials were tested for esterification of cyclohexanol with acetic acid under autogeneous pressure conditions where NZ showed better activity (69% conversion)
Catalytic properties of nano-sized ZSM-5 aggregates. Available from:
https://www.researchgate.net/publication/244322759_Catalytic_properties_of_nano-sized_ZSM-5_aggregates [accessed Apr 24 2018]."

CLINOPTILOLITE ANTIBIOTIC, ANTIFUNGAL, ANTIVIRAL

1. https://www.ncbi.nlm.nih.gov/pubmed/9183028
Antifungal effect of zeolite-incorporated tissue conditioner against Candida albicans growth and/or acid production

2.
https://www.researchgate.net/profile/Selami_Demirci/publication/258637112_Antimicrobial_Properties_of_Zeolite-X_and_Zeolite-A_Ion-Exchanged_with_Silver_Copper_and_Zinc_Against_a_Broad_Range_of_Microorganisms/links/0c960528cab7260fb9000000/Antimicrobial-Properties-of-Zeolite-X-and-Zeolite-A-Ion-Exchanged-with-Silver-Copper-and-Zinc-Against-a-Broad-Range-of-Microorganisms.pdf
The ion loading capacity of the zeolites was examined and compared with the antimicrobial characteristics against a broad range of microorganisms including bacteria, yeast, and mold."

3. http://www.formatex.info/microbiology6/book/379-384.pdf
Assessment of Zeolites as Antimicrobial Fragrance Carriers

4. http://www.ingentaconnect.com/contentone/ben/cgc/2015/00000002/00000004/art00005
Antimicrobial Properties of Ag-Exchanged Natural and Synthetic Zeolites: a Short Review
"Inorganic antimicrobial agents have attracted increasing attention as they can overcome the shortcomings of organic antimicrobial agents, such as low heat resistance, high decomposability, and short life expectancy. Typical examples of inorganic antimicrobial agents are titania, zinc oxide, silver, and metal-exchanged zeolites. Silver- or zinc-ion-exchanged synthetic zeolites are known to exhibit antimicrobial activities in which zeolites are used as a carrier for silver or zinc oxide. The particle size and color shade of synthetic zeolites can be well controlled compared to those of natural zeolites. Even though natural zeolites exhibit limitations with respect to the color and have relatively lower cationexchange capacity than that of synthetic zeolites, they can be effective as antimicrobial agents after active metal exchange. The antimicrobial activity and deodorization effects are compared; further, the possibility of the decomposition of volatile organic compounds by incorporating photocatalytic materials in the antimicrobial agent of cation-exchanged zeolite was investigated for the application to textiles. Various applications of biomedicine, food package, textile, and building interior materials in the form of coatings, films, and polymer composites were also summarized"

5. https://patents.google.com/patent/US4938958/en17
Antibiotic zeolite patent

6. https://academic.oup.com/femspd/article/43/2/105/604210 on Viruses needing metals to survive
"Metal ions are integral part of some viral proteins and play an important role in their survival and pathogenesis. Zinc, magnesium and copper are the commonest metal ion that binds with viral proteins. Metal ions participate in maturation of genomic RNA, activation and catalytic mechanisms, reverse transcription, initial integration process and protection of newly synthesized DNA, inhibition of proton translocation (M2 protein), minus- and plus-strand transfer, enhance nucleic acid annealing, activation of transcription, integration of viral DNA into specific sites and act as a chaperone of nucleic acid. Metal ions are also required for nucleocapsid protein-transactivation response (TAR)–RNA interactions. In certain situations more than one metal ion is required e.g. RNA cleavage by RNase H. This review underscores

the importance of metal ions in the survival and pathogenesis of a large group of viruses and studies on structural basis for metal binding should prove useful in the early design and development of viral inhibitors."

ON REMOVING CARCINOGENS (Cigarettes & Smoked Foods)

1.
https://acnfp.food.gov.uk/sites/default/files/mnt/drupal_data/sources/files/multimedia/pdfs/opinclinoptilolite.pdf
The zeolite reduced the levels of benzo[a]pyrene, a type of PAH that the International Agency for Research on Cancer classifies as a known human carcinogen, by 93%. Concentrations of several other PAHs also dropped, many by more than 70%, said Parker at a symposium organized by the Division of Agricultural & Food Chemistry

2. http://www.asianjournalofchemistry.co.in/User/ViewFreeArticle.aspx?ArticleID=19_3_11
Studies on the Potential of Natural Zeolites and Modified Natural Zeolites Towards the Removal of Heavy Metals from Smoke Cigarette

3.
https://www.chemistryworld.com/news/zeolite-filters-out-carcinogens-to-make-tastier-smoked-foods/3008877.article
Zeolite filters out carcinogens to make tastier smoked foods

4. http://medicinabiomolecular.com.br/biblioteca/pdfs/Cancer/ca-4689.pdf
Cleaning carcinogenic nitrosamines with zeolite

5. https://www.sciencedirect.com/science/article/pii/S1387181103003342
Removing nitrosamines from mainstream smoke of cigarettes by zeolites

ON ZEOLITES BEING FULLY EXCRETED FROM THE BODY

http://www.toxaprevent.co.uk/%3Cnolink%3E/absorption-study-dr-nikolia-daskaloff
The study showed that activated clinoptilolite (MAC) is not absorbed in the human digestive tract and thus, again, completely excreted. MAC spent the majority of time in the gastrointestinal tract. Thus, MAC can exert its effect and absorb heavy metals and toxins here. In the experiment, the time between ingestion and excretion was approximately 24 hours. There was no radiation measured in the thyroid, lungs or kidneys, which would have indicated the absorption of MAC

PROPERTIES OF CLINOPTILOLITE ZEOLITE

1. http://library.iyte.edu.tr/tezler/doktora/kimyamuh/T000899.pdf
Cr (VI) REMOVAL WITH NATURAL, SURFACTANT MODIFIED AND BACTERIA LOADED ZEOLITES

2. http://www.minsocam.org/ammin/AM75/AM75_522.pdf
Crystal structures of a natural and a Cs-exchanged clinoptilolite

3.
https://www.researchgate.net/publication/257594252_Investigation_of_structural_properties_of_clinoptilolite_rich_zeolites_in_simulated_digestion_conditions_and_their_cytotoxicity_against_Caco-2_cells_in_vitro
The Clinoptilolite crystal is nearly indestructible: "Clinoptilolite's unique crystalline structure and extraordinary properties are present, regardless of the particle size. This structure never breaks down under extreme pressures, requires temperatures that melt glass to break down and it cannot be chemically changed except under extremely caustic or acid conditions. Degradation over time is impossible without one of the above conditions being present." The digestive system is not an extremely caustic or acidic system, in terms of acidity, it is fairly mild. (from http://zeoinc.com/resources/about-zeolites/zeolite-structure/)

4.
"https://l.facebook.com/l.php?u=https%3A%2F%2Fwww.ncbi.nlm.nih.gov%2Fpmc%2Farticles%2FPMC3546016%2F
For the best info on zeolites in the article, scroll down to the "Zeolites as a source of ortho-silicic acid" section :) "Zeolites are a class of aluminosilicates of general formula $(Mn+)x/n[(AlO2)x(SiO2)y·mH2O$, wherein M represents a positively charged metal ion such as sodium (Na+), potassium (K+), magnesium (Mg2+), or calcium (Ca2+). Zeolites are crystalline aluminosilicates with open 3D framework structures built of SiO4 and AlO4 tetrahedra linked to each other by sharing all the oxygen atoms to form regular intra-crystalline cavities and channels of molecular dimensions [92]. The positively charged metal ions (e.g. Na+, K+, Ca2+, Mg2+) are positioned in these cavities of aluminosilicate skeleton which are termed as micro- (2–20 Å), meso- (20–50 Å), and macro-(50–100 Å) -pores. These ions are readily exchangeable in contact with aqueous solution of other positively charged ions (e.g. heavy metal ions like Hg2+). This structural characteristic of zeolites is the base of their ion (cation)-exchange property"

5.
http://www.springer.com/cda/content/document/cda_downloaddocument/9789811014024-c2.pdf?SGWID=0-0-45-1567418-p179978113
A comprehensive discussion on various properties of zeolites viz., physical, chemical, ion exchange and adsorption properties, mineralogical and morphological characteristics, thermal characteristics, characteristics of zeolites in acidic medium,

crystal structure, framework of zeolitic crystals and surface properties is presented in the following.

6. "https://www.ncbi.nlm.nih.gov/m/pubmed/29240918/?i=5
Zeolites consist of more than 65 natural species. They are microporous crystalline soil containing silica and aluminum (Christidis et al. 2003, Filippidis et al. 2015). Their structure is a tetrahedra built of $(SiO4)4-$ and $(AlO4)5-$ linked by oxygen atoms (de Smedt et al. 2015). Natural zeolites (zeolitic rocks containing one or more natural zeolite species) have been extensively used in industry as separation agents, absorbents, ion exchangers, and fillers in paints and plastics (Colella and Mumpton 2000) as well as in environmental applications—mainly the removal of heavy metals and ammonium from fresh water and wastewaters (Tsitsishvili et al. 1992; Filippidis and Kantiranis 2007; Filippidis et al. 2008, 2015, 2016; Kantiranis et al. 2011; Papastergios et al. 2017).
In agriculture, natural zeolites have been used to improve soil properties because they reduce the leaching of nutrients and fertilizers, reinforce the root-system of the plants, and increase nutrient uptake and water holding capacity (Colella and Mumpton 2000; Bish and Ming 2001; Filippidis 2010, 2016, Hatzigiannakis et al. 2016). However, they are used as food additives in domestic animals because they effectively absorb mycotoxins and remove the bad odors in animal stables (Filippidis 2010, de Smedt et al. 2015). They have also been used for remediation of polluted soils and as carriers of fertilizers (Rehakova et al. 2004, Filippidis 2016). They can enhance the soil microbial population, promote plant growth, and increase metals in the aerial part of plants (Ramesh et al. 2010, Filippidis 2016). One zeolite with numerous industrial, environmental, agricultural, and water applications is the HEU-type zeolite (clinoptilolite-heulandite). It has lath-tabular crystals and contains micro-nano-pores in a framework of channels with 10- and 8-member rings. The ring dimensions are 7.5 × 3.1 Å, 4.6 × 3.6 Å, and 4.7 × 2.8 Å (Baerlocher et al. 2001; Mitchell et al. 2012; Filippidis 2010, 2016).

7. http://www.iza-online.org/natural/Datasheets/Clinoptilolite/clinoptilolite.htm
"The origin and use of the name clinoptilolite has a convoluted history. The type locality is on the ridge trending several kilometers northeast of Hoodoo Peak just outside the eastern boundary of Yellowstone National Park, Park County, Wyoming, USA, where the mineral occurs cavities in decomposed basalt breccia. The crystals were first identified by Pirsson (1890) as mordenite, based solely on chemical analysis. The platy habit and optical properties led Schaller (1923, 1932) to conclude that it was a monoclinic dimorph of ptilolite, a finely fibrous mineral described and named by Cross and Eakins (1886) for material occurring at Table Mountain, Colorado, USA and later shown to be mordenite. Schaller, therefore, named these crystals clinoptilolite, even though the morphology was very similar to heulandite. Based on X-ray diffraction data Hey and Bannister (1934) determined that the Hoodoo Peak material and heulandite are isostructural and recommended that the term clinoptilolite not be used.
Mason and Sand (1960) proposed a new definition for clinoptilolite, based on alkali-dominant and high Si/Al compositions. Mumpton (1960) simultaneously suggested that the name be applied to those samples that remained stable following overnight heating to 350°C. This method works particularly well for the fined-grained replacements of vitric tuff. During the

following years the compositional gap observed by Mason and Sand (1960) was filled by the analysis of many newly discovered samples. Even so, the subcommittee reviewing the nomenclature of the zeolite group (Coombs et al. 1997) chose to retain the two mineral names, and proposed to keep both the heulandite and clinoptilolite names and to separate them based on the framework composition at Si/Al = 4.0. For a discussion of this nomenclature problem and some guidance in distinguishing between heulandite and clinoptilolite, see Bish and Boak (2001).
Both names were also raised to series status to include several species based on the dominant cation content. The clinoptilolite series comprises three species. Clinoptilolite-K is the new name for the original material from the ridge east of Hoodoo Peak, Wyoming. Clinoptilolite-Nais a new name for Na dominant crystals with the suggested type example from the Barstow formation, San Bernardino County, California, USA, and clinoptilolite-Cafor Ca dominant samples with type examples from Kuruma Pass, Fukushima Prefecture, Japan"

8. http://toxinclear.com/wp-content/uploads/2014/04/White_Paper_PureBody.pdf
"A BRIEF HISTORY OF ZEOLITE: B.C.: Used in Roman Aqua Ducts
1760's: Rediscovered by a Swedish mineralogist
1960's: Mentioned in scientific circles in Europe and U.S.
1970's: Used for wastewater ammonia removal
1980's: Used to clarify pool water in Europe and then in USA; used in Chernobyl radioactivity removal
1990's: Used in agriculture and with cattle and poultry and began to be sold as a supplement for detoxifying the human body
2000's: Many companies are now marketing clinoptilolite zeolite in numerous products"

9. https://pdfs.semanticscholar.org/ab34/a079053b5d822141f5137c2deaedafc16449.pdf
A comparative study of ion exchange kinetics in zinc/lead- modified zeolite-clinoptilolite systems.

10. http://www.scielo.org.za/scielo.php?script=sci_arttext
The influence of pH on the adsorption of lead by Na-clinoptilolite: Kinetic and equilibrium studies
"The objectives of this study were, firstly, to establish the mechanism by which modified clinoptilolite (in Na form) adsorbs lead ions and, secondly, to assess the extent of influence of pH on the adsorption capacity. To this end, the experimental data have been fitted by adsorption isotherms, thermodynamic and kinetic models. Based on the standard errors obtained during experiments, it was determined that the accuracy of prediction of the isotherm models considered for adsorption decreases in the order: Dubinin-Raduschkevich (4.63%, average normalised standard deviation error); Langmuir (7.90%); and Freundlich (15.98%). For the kinetic models, the accuracy of prediction decreases in the order: intra-particle Weber-Morris (with an average normalised standard deviation error of 5.53%); heterogeneous diffusion (5.67%); pseudo-second order kinetic model (10.47%); diffusion through the particle surface (41.73%); and the pseudo-first kinetic model (47.51%). The mechanism of adsorption of lead ions by Na-clinoptilolite was found to occur in a monolayer and heterogeneous surface. The pH of contact solutions played an important role owing to competition by hydrogen ions. As the pH

of the solution decreased, the maximum monolayer adsorption capacity established theoretically, based on the Langmuir isotherm, also decreased. Thus, if, for instance, the pH decreases from 4 to 1, the maximum adsorption capacity decreases from 0.3569 to 0.1604 mol-kg-1. At high pH of the contact solution, the adsorption process occurs by ion exchange and at low pH; i.e., it is physical. The variation of the Gibbs free energy demonstrates that adsorption occurs spontaneously. The process was also observed to occur at a higher rate at low acidity. Diffusion through the internal structure of macro- and micropores is the stage taking place with the lowest speed during the adsorption process and plays an important role in the mechanism of adsorption. The intra-particle diffusion coefficient depends on pH, which can modify the shape and concentrations of the hydrated metal complexes in solutions, thus affecting the adsorption process. The decrease of pH from 4 to 1 resulted in a decrease of the intra-particle diffusion coefficient from 4.0610-11 to 1.9610-11 m2min-1. The film diffusion coefficients were found to be 10 times larger than the intra-particle coefficients, suggesting that diffusion to the external surface cannot be the rate-limiting step in the adsorption mechanism."

OTHER RELEVANT RESEARCH

http://toxinclear.com/wp-content/uploads/2014/04/White_Paper_PureBody.pdf
micron sized, micronized zeolite from Dr Holdford

https://pubs.acs.org/doi/full/10.1021/jacs.5b06134
Description of the Interface between Silica and Alumina in Aluminosilicates through Dynamic Nuclear Polarization Surface-Enhanced NMR Spectroscopy and First-Principles Calculation

https://organicpowerfoods.com/health-topics/what-is-zeolite-health-benefits

https://www.ncbi.nlm.nih.gov/pubmed/28232497
There is some evidence that high levels of cadmium, iron and lead are associated with MS. This study found high levels of lead in the gray matter of MS brains...

http://www.rebprotocol.net/august2007/Q%20
INFORMATION ABOUT TOXINS AND LIQUID ZEOLITES (clinoptilolite)

https://www.ncbi.nlm.nih.gov/pubmed/22026121 On polysorbat80 weak molecular structure

https://www.thoughtco.com/element-charges-chart-603986 Chart of common charges

https://www.greatplainslaboratory.com/candida-and-yeast-overgrowth/

link.springer.com/article/ 10.1134/S2070205117040025 microwave EMF and Clinoptilolite

http://zeolitavida.eu/wp-content/uploads/2014/06/medicalstudy.pdf
Interaction studies between drugs and a purified natural zeolite