

MINERAL TECHNOLOGY



Zeolite Overview

Zeolites were formed from ancient volcanic ash flows settling in neighbouring seas and lakes. This unique group of naturally-occurring minerals has important basic physical and chemical properties and is often referred to as 'molecular sieves'. Zeolites simply lock & hold many positive ions, absorb a multitude of environmental contaminants and also serve as a catalyst for various processes.

Adsorption - Zeolites are used to adsorb a variety of materials. This includes applications in drying, purification, and separation. They can remove water to very low partial pressures and are very effective desiccants, with a capacity of up to more than 25% of their weight in water. They can remove volatile organic chemicals from air streams, separate isomers and mixtures of gases.

Catalysis - Zeolites can be shape-selective catalysts either by transition state selectivity or by exclusion of competing reactants on the basis of molecular diameter. Zeolites can also be acid catalysts and can be used as supports for active metals or re-

agents. They have also been used as oxidation catalysts. The main industrial application areas are: petroleum refining, synfuels production, and petrochemical production. Synthetic zeolites are the most important catalysts in petrochemical refineries.

Ion Exchange - The largest volume use for zeolites is in detergent formulations where they have replaced phosphates as water-softening agents. They do this by exchanging the sodium in the zeolite for the calcium and magnesium present in the water.

These unique features have a huge upside benefit in market potential (technological & economic) in the industrial, agricultural, environmental, oilfield and commercial markets.

Cation Exchange Capacity (CEC) - The CEC of a mineral is simply its capacity for a chemical reaction to occur. The chemical reaction on zeolite takes place on the outer surface of the mineral molecule. During the chemical reaction in zeolite there is an exchange of positive ions.

Background

Currently, the world's annual zeolite production is 4 million tons. Of this quantity, 2.6 million tons are allotted for the Chinese market for building their infrastructure (the concrete industry). By comparison, 40,000 tons of zeolite (only 1% of the world's current production) is produced in North America - natural zeolite is used in many parts of the world but is only fairly new to North America. Eastern Europe, Western Europe, Australia, and Asia are world leaders in supplying the world's growing demand of zeolite and only recently has North America realized zeolites potential for current and future markets.

Zeolite and the Environment

Zeolite contributes to a cleaner, safer environment in a great number of ways. In fact nearly every application of zeolite has been driven by environmental concerns, or plays a significant role in reducing toxic waste and energy consumption.

Differences in Zeolite Suppliers

The zeolite industry is as competitive within itself as are most innovative technologies. Within the zeolite community it is well understood that specific zeolite sources are better suited for their respective 'niche' applications. One important factor to determine a natural zeolites' quality is the percentage and quantity of a primary mineral within the zeolite matrix - called 'clinoptilolite'. Clinoptilolite is the specific mineral that provides extremely high CEC properties on the zeolite surface. The highly porous zeolite matrix provides the absorption qualities.

Clinoptilolite has a cage-like structure consisting of SiO₄ and AlO₄ tetrahedra joined by shared oxygen atoms. The negative charges of the AlO₄ units are balanced by the presence of exchangeable cations - notably calcium, magnesium, potassium and sodium. These ions can be readily displaced by other

substances such as heavy metals and ammonium ions. This phenomenon is known as cation exchange, and it is the very high cation exchange capacity of clinoptilolite which provides many of its very useful properties.

While zeolite as a whole is likely very beneficial for your application - there are premium and sub-par quality zeolite suppliers so use caution when sourcing your zeolite.

etermined that zeolite products are: Non-Toxic, Non Corrosive, Non Flammable, Stable, Not Caustic, Non Irritating, Not a sensitizer in oral, dermal, and ocular as per Federal Hazardous Substances Act (15 CFR 1500).

The zeolites crystallized in the environment where deposited over periods ranging from thousands to millions of years in either shallow marine or non-marine basins in volcanic terrains. Zeolitic tuffs commonly resist weathering.

- √ Premium zeolite deposits are estimated to have zeolite content above 60%, and some may reach over 80%.
- √ End-uses for natural zeolites are used for effluent treatment, mine waste management, pet litter, barn deodorizers, soil conditioners, aquaculture, animal feed additive and construction materials. Higher-priced synthetic zeolites dominate in manufacturing, oil industry / chemical applications and detergent industry.
- √ Natural zeolites are used in ion-exchange and adsorption applications like odor control and slurry gas control.

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