Broad Utilization of Copper Zeolitic Structures

In the last ten years Stabilization Technologies LLC has studied the difference between the chemistries of both Natural and Artificially produced zeolitic structures and ion exchange for use in both plastics, coatings and in construction. The conclusions reached from these studies both in production, analytical chemistry and end use show natural zeolites to be the most cost-benefit-performance.

We have produced and studied cerium, cesium, palladium, platinum, rhodium, silver, copper, zinc, sodium, potassium, gallium, iron, cobalt, nickel,samarium, gadolinium, europium, erbium and neodymium zeolitic chemistries. The economics and end use in plastics and coatings is superior to that of the more expensive synthetics used in the industry as catalysts.

For plastics in the area of Agricultural films as inhibitors for mold, fungus, algae buildup on the side walls of green houses in Latin America and S.E.Asia copper zeolites are excellent in their antimicrobial characteristics.

In gypsum board for industrial construction the addition of copper zeolites alone or in combination with other ion exchanged metals have shown excellent performance in inhibiting black mold formation.

Copper zeolites are commonly used today to mediate and control prompt oxides of nitrogen in diesel exhaust. Canisters of copper zeolite are inserted into holders at the exhaust vents of engines. The exhaust passes through the copper zeolite and out comes lower levels of nitrous oxides.

The use of copper based materials in hospitals and in areas where the control of bacteria and other microorganisms is growing. The oligodynamic effect of copper one of many elements that has a toxic metal ion effect on living cells like algae, molds, spores, fungi, viruses, prokaryotic and eukaryotic microganisms is well documented.

Elements with oligodynamic effect include copper, mercury, silver, iron, zinc, bismuth, aluminum, gallium, gold and platinum.

We have discovered that maximum utilization of the metal can be controlled to a greater extent in its utilization and performance by ion exchange in the cage of natural zeolites. Natural zeolites are more physically durable and require clean sources for proper use in any exchange.

Of particular interest today is copper over silver zeolites due to cost and environmental impact. The noteworthy benefits of copper show it inhibits:

- ***Actinomucor elegans*, *Aspergillus niger*, *Bacterium linens*, *Bacillus megaterium*, *Bacillus subtilis*, *Brevibacterium erythrogenes*, *Candida utilis*, *Penicillium chrysogenum*, *Rhizopus niveus*, *Saccharomyces mandshuricus*, and *Saccharomyces cerevisiae* in concentrations above 10 g/L**
- ***Candida utilis* (formerly, *Torulopsis utilis*) is completely inhibited at 0.04 g/L copper concentrations.**
- ***Tubercle bacillus* is inhibited by copper as simple cations or complex anions in concentrations from 0.02 to 0.2 g/L**
- ***Achromobacter fischeri* and *Photobacterium phosphoreum* growth is inhibited by metallic copper.**
- ***Paramecium caudatum* cell division is reduced by copper plates placed on Petri dish covers containing infusoria and nutrient media.**
- ***Poliovirus* is inactivated within 10 minutes of exposure to copper with ascorbic acid.**

Molecular mechanisms noted by various researchers include the following:

- **Copper complexes form radicals that inactivate viruses.**
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- **Copper may disrupt enzyme structures, and functions by binding to sulfur- or carboxylate-containing groups and amino groups of proteins.**
- **Copper may interfere with other essential elements, such as zinc and iron.**
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- **Copper facilitates deleterious activity in superoxide radicals. Repeated redox reactions on site-specific macromolecules generate OH- radicals, thereby causing "multiple hit damage" at target sites.**
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- **Copper can interact with lipids, causing their peroxidation and opening holes in the cell membranes, thereby compromising the integrity of cells. This can cause leakage of essential solutes, which in turn, can have a desiccating effect.**

- **Copper damages the respiratory chain in *Escherichia coli* cells. and is associated with impaired cellular metabolism.**
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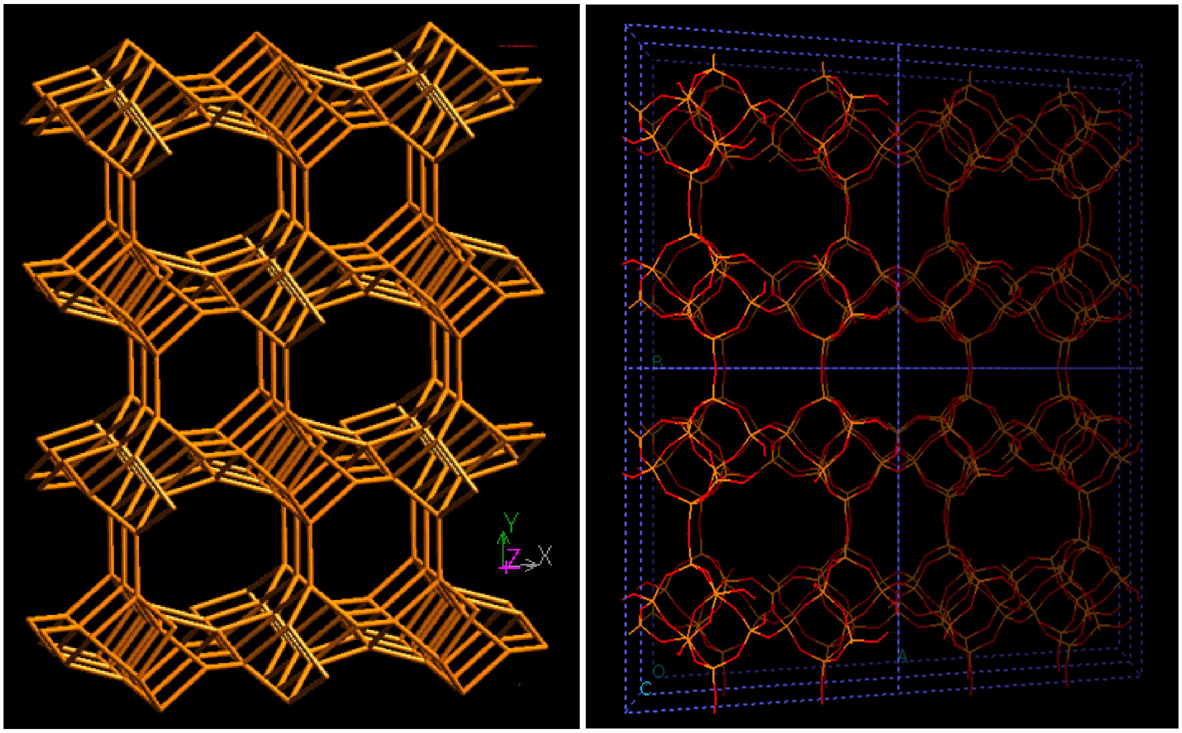
- **Faster corrosion correlates with faster inactivation of microorganisms. This may be due to increased availability of [cupric] ion, Cu2+, which is believed to be responsible for the antimicrobial action. In inactivation experiments on the flu strain, H1N1, which is nearly identical to the H5N1 avian strain and the 2009 H1N1 (swine flu) strain, researchers hypothesized that copper's antimicrobial action probably attacks the overall structure of the virus and therefore has a broad-spectrum effect.**

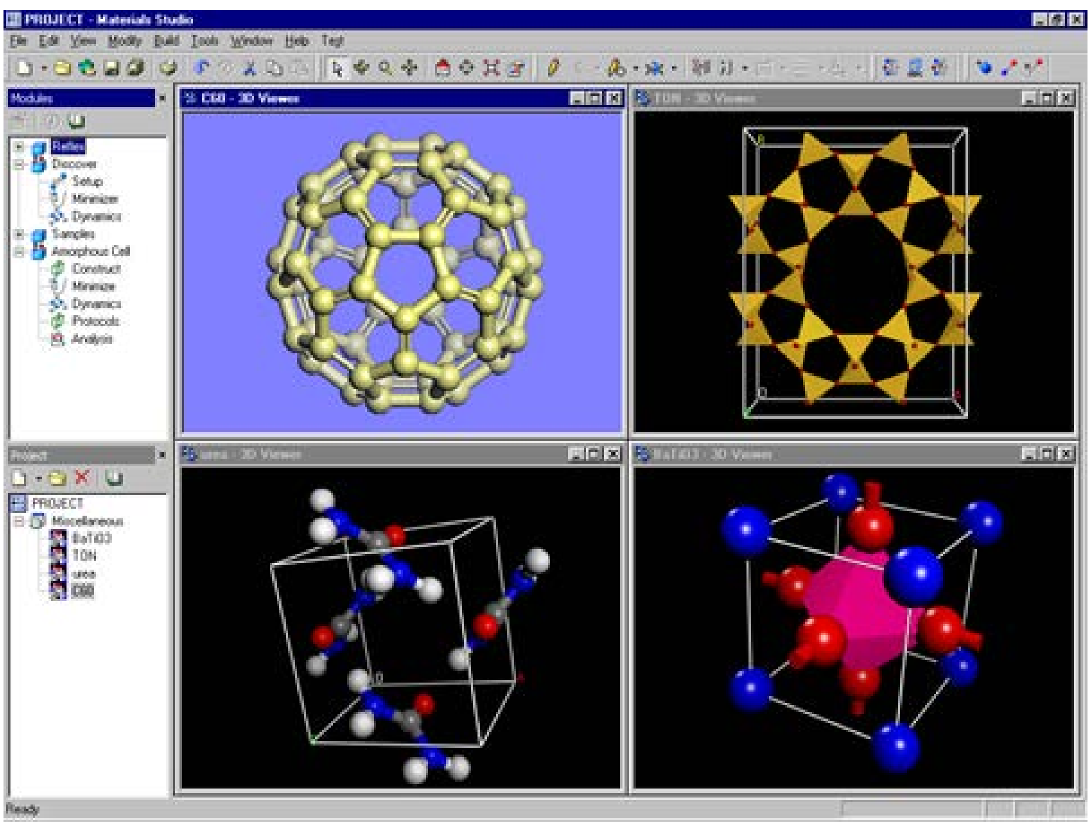
Our own research shows in the plastic film arena alone one of the biggest potential was found to control of molds, fungus and algae slime and build-up. The broader spectrum of molds and fungus and algae inhibited versus other metal exchanges makes copper more suited for these applications. However, there are cases where synergistic combination of copper zeolites and other additives are noteworthy.

The second biggest area is in construction building materials like gypsum board to inhibit mold build up. Control over dosage and handling as a copper exchanged zeolite makes manufacturing easier and performance more consistent. The new analytical methods developed in the last two years now allows for consistent predictable result of final loadings in the plastic film or part.

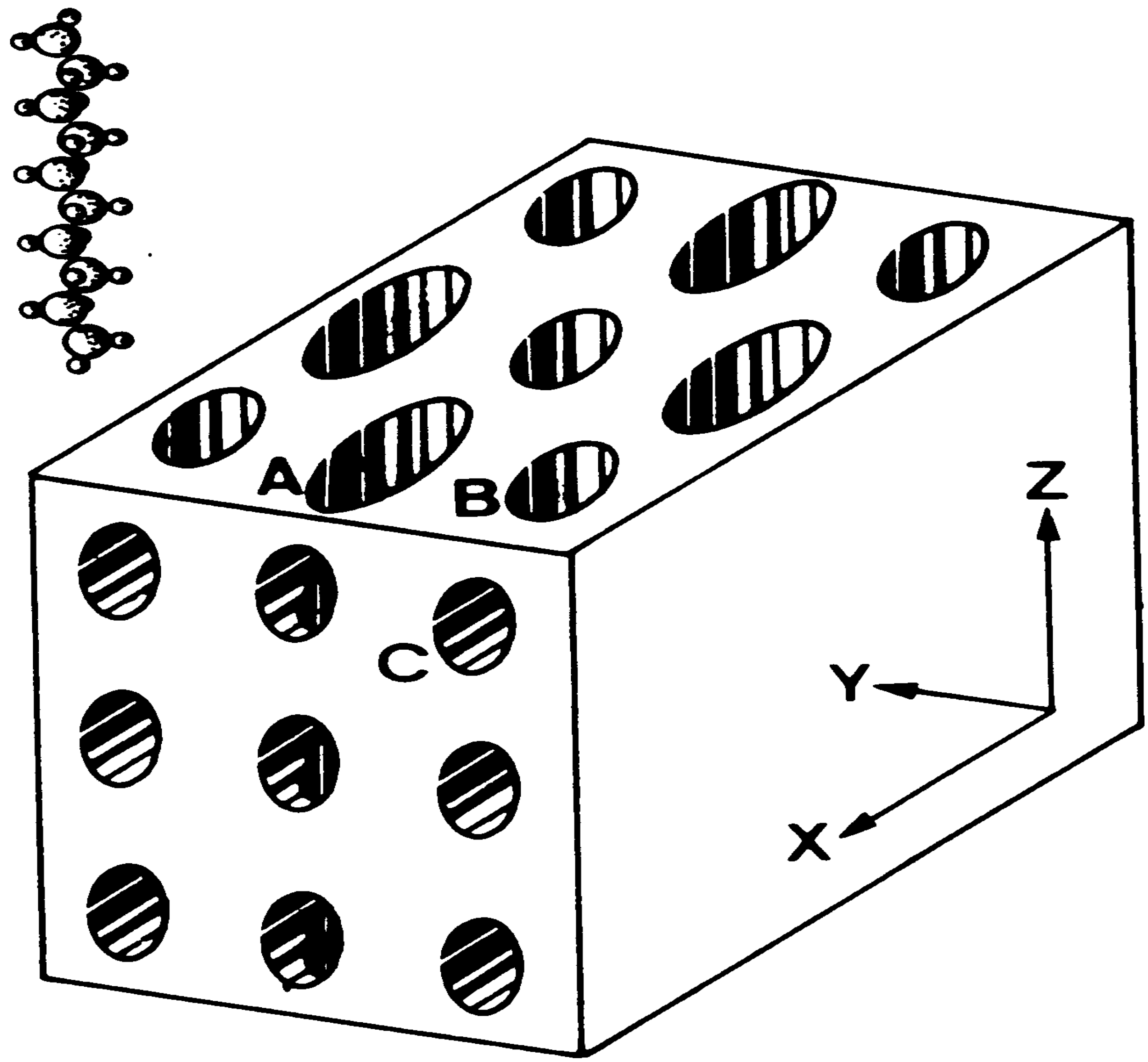


Natural zeolites 3D structure of cage and rotation around the z axis.

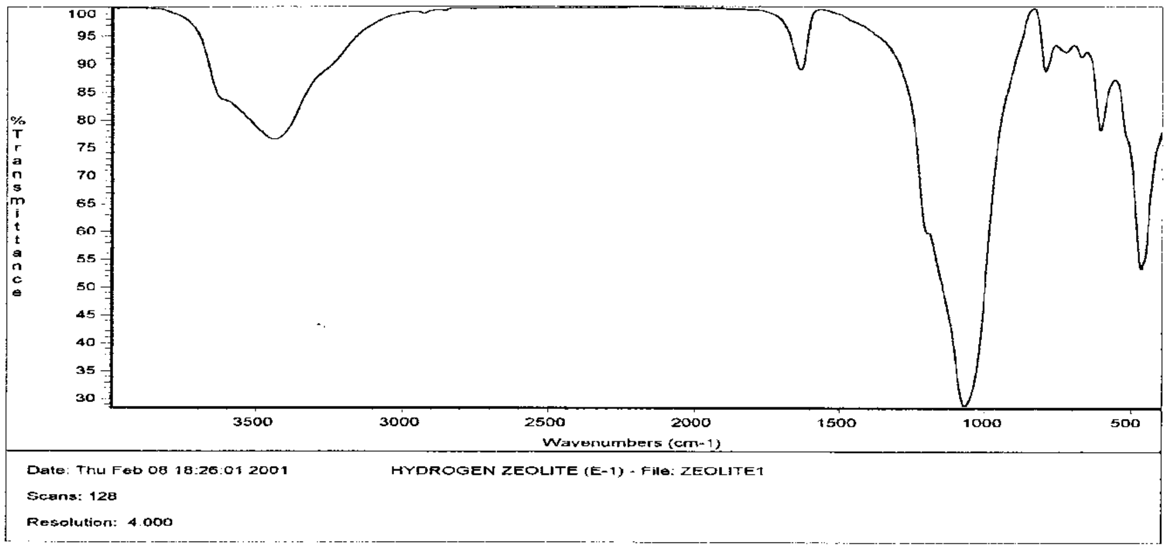
Modeling of Exchange Structures:



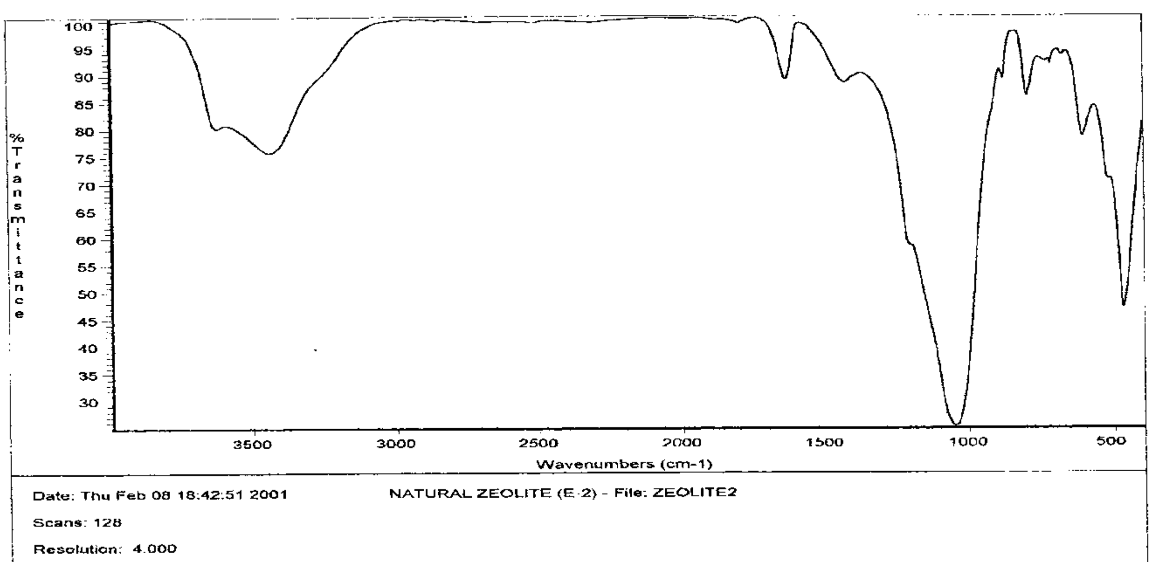
Pore Volume of Natural Zeolite versus Molecular size of Polyolefin:



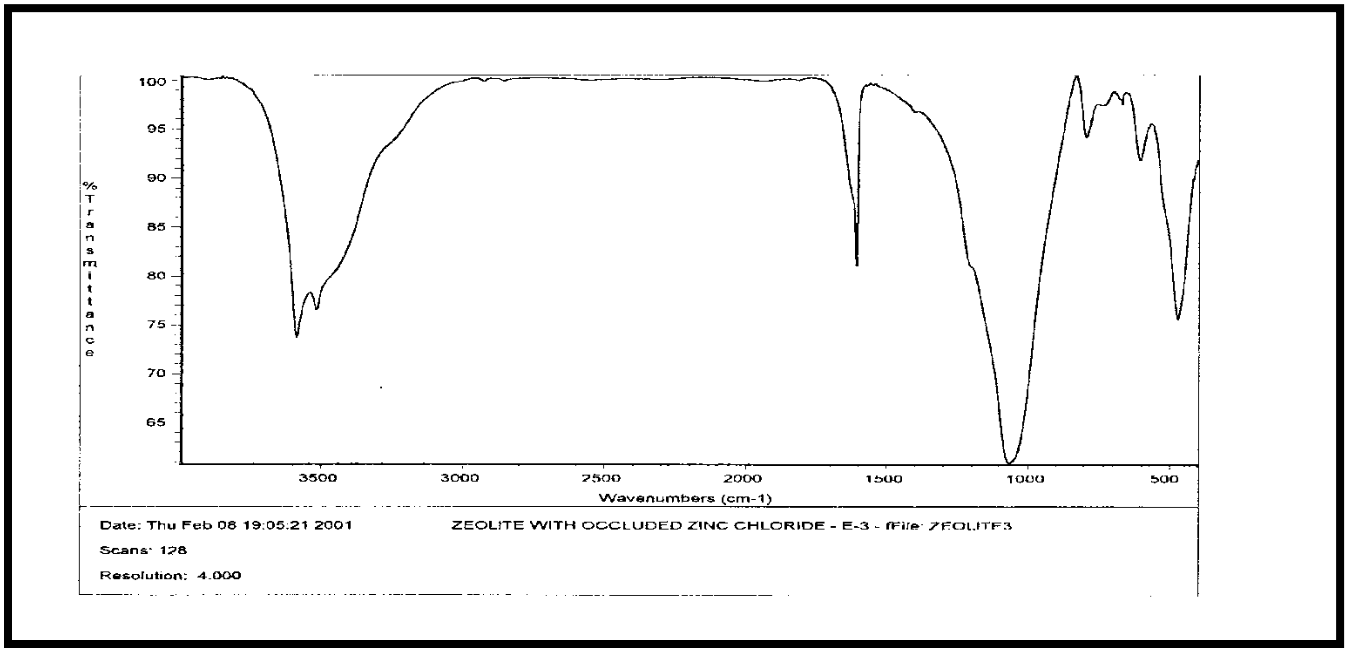
Infrared Spectra of Hydrogen Zeolite produced by Stabilization Technologies LLC



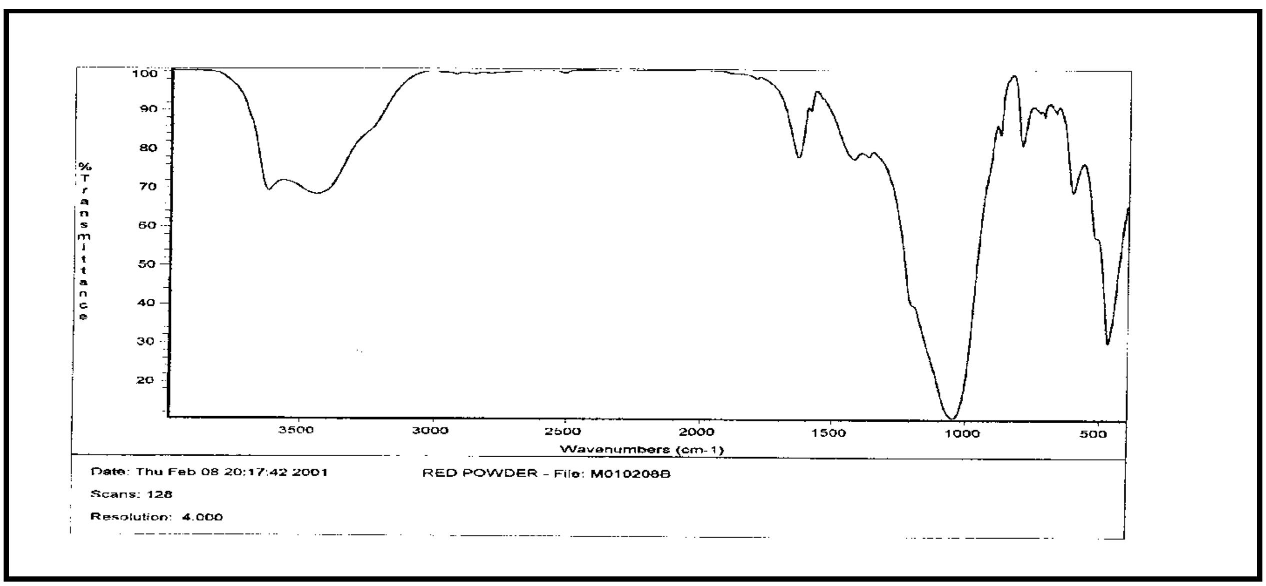
Natural Zeolite Used in Study:



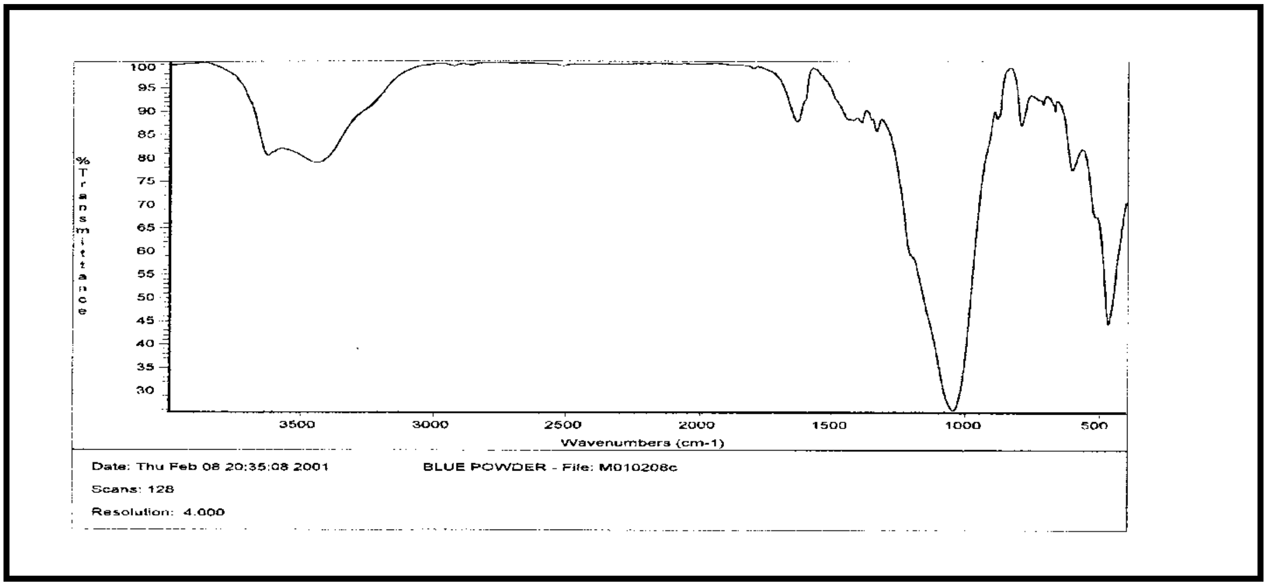
Zinc Exchanged Zeolite:



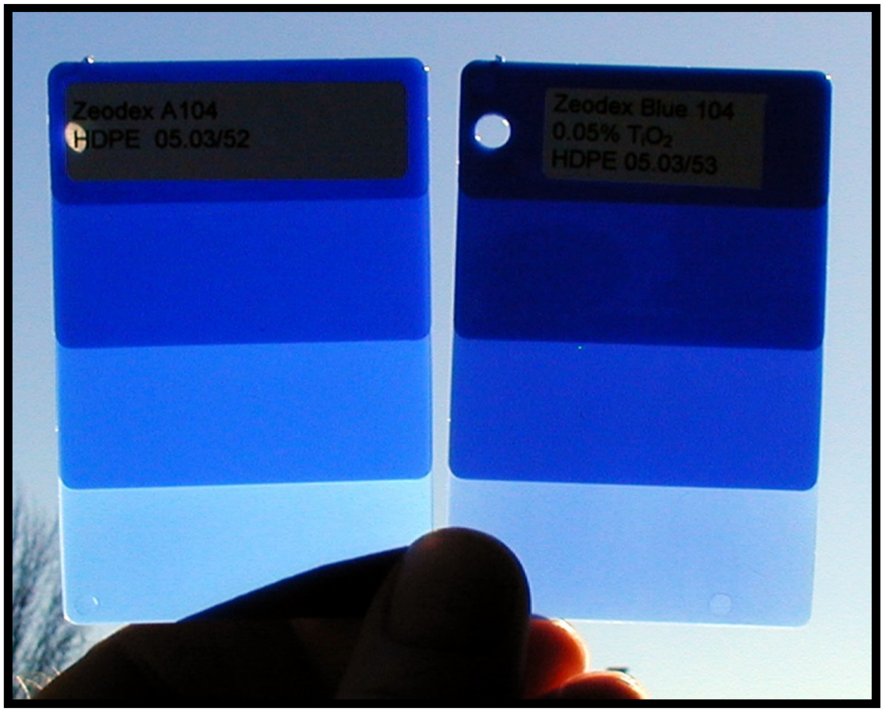
OMPF Red Colored Zeolite:



OMPF Blue Colored Zeolite:



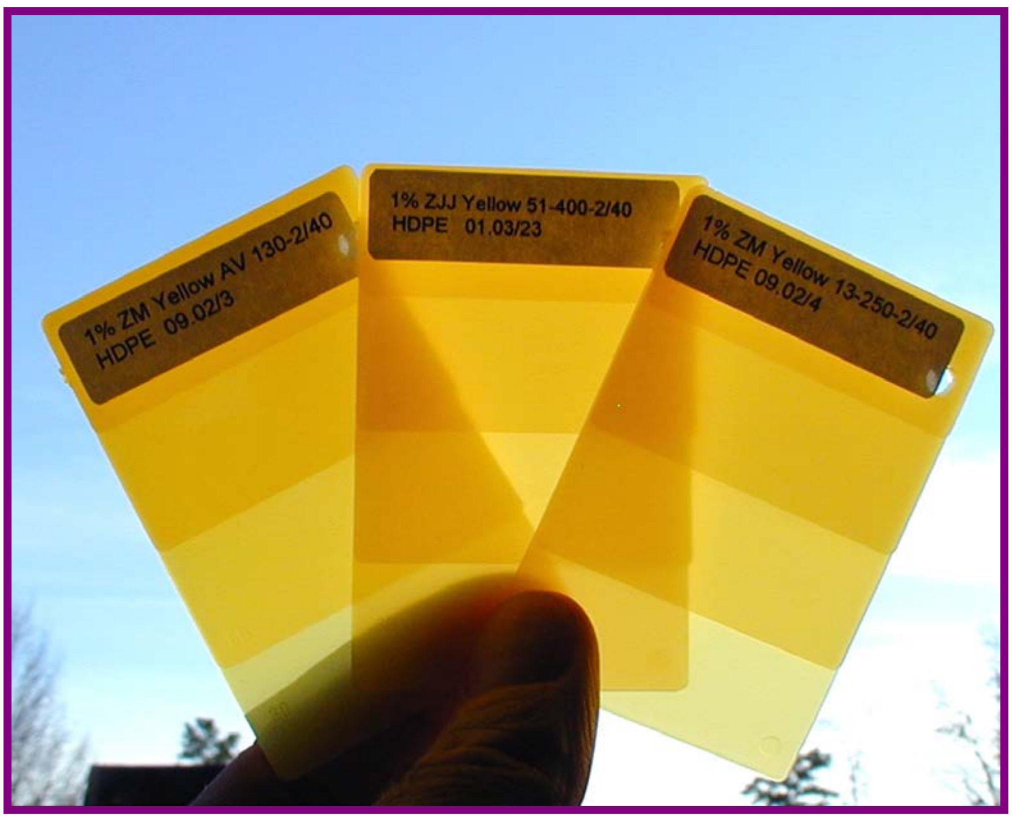
VARIOUS COLORS FROM OMPF (ORGANO-PIGMENT FILLER ZEOLITES)



200 ppm final color from OMPF Blue Zeolite in HDPE injection molded plaques

INJECTION MOLDED BLUE SODA CAN HOLDER WITH OMPF:

200 ppm final color from Red OMPF in HDPE injection molded plaque



YELLOW OMPF in HDPE Injection molded step chip

COPPER ZEOLITE PRODUCTION:

Copper zeolite production wet cake prior to drying

Final Dried Version of Copper Zeolite:

Photos indoors with outdoor light.

Outdoor direct Sunlight on sample.

Free flowing with upper particle size distribution from 8 microns to 22 microns depending on starting material used.

Joe Webster