

**CACHE CREEK ZEOLITE DEPOSITS
PROJECT DEVELOPMENT**

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i. Introduction

This use of industrial minerals continues to grow around the world. The growth is in response to the worlds' need for more and more earth materials at the lowest possible costs. New and advanced technologies are currently being developed and utilized at a phenomenal rate and are affecting all aspects of life worldwide. The determinative technologies are contributing to a large portion of this impact. Determinative technologies are those technologies which measure, gauge, qualify, quantify and justify. Development of determinative technology is in response to a need to know and an increased awareness and sensitivity to the human environment.

The factors of increased human technical ability and environmental awareness have created an immense demand for socially and environmentally secure alternatives.

Natural zeolites can provide solutions to the need for secure alternatives in a myriad of uses and applications.

ii. Mission and Objectives

To profitably develop, produce and market natural zeolite products for animal husbandry, agricultural chemical, geotechnical and specialty markets in North America.

To focus on total quality in mining, processing, research and customer service.

iii. Goals

Innovation

To continually innovate the development of new applications for natural zeolite products and to aggressively market selected applications.

Total Quality

To strive for total quality in resource management, product offerings, customer service and the environment.

iv. Financial Rewards

To achieve levels of profitability which will allow attractive financial rewards and capital appreciation to all shareholders, partners and employees.

v. Citizenship

To operate with a sincere understanding of community and government interests by recognizing the importance of the corporate stewardship over natural resources and our environment.

vi. Natural Zeolites

Zeolites comprise a large group of hydrous aluminosilicates similar in chemical composition, geological association and mode of occurrence. Zeolites are constructed of an array of $(Al_2O_4)_5$ and $(Si_1O_4)_4$ - tetrahedra but, instead of being tight and compact, the zeolite structures are open and contain large cavities filled with water molecules. These cavities are interconnected by channels in one, two or three directions. Electrical neutrality is maintained by the metallic monovalent and divalent cations, such as Na^+ , K^+ , Ca^{2+} and Mg^{2+} , which occupy sites in the network of channels and voids and are surrounded by water molecules. Depending upon the nature of the individual zeolite, the size of the channels and voids vary significantly. Typical channel diameters vary from two to over seven angstroms.

These physical and ion exchange properties of zeolites allow for their use in a wide range of products from molecular sieve applications in refining, to industrial absorbents and animal bedding, as well as carriers for herbicides, pesticides and fertilizers.

Synthetic zeolites are manufactured for catalysis and molecular sieving. The manufactured chemical compounds are tailored for specific uses. These designer molecular sieves are expensive, both in production costs and consumer costs, ranging from a few hundred dollars a tonne to several thousand of dollars a tonne. Natural zeolites do not compete for the same markets.

Natural zeolites were first located in a Tertiary Basin, in the Princeton area of British Columbia, in the mid-1980's. Subsequent to that, zeolites were located in the Cache Creek Tertiary Basin, in the late 1980's.

vii. Cache Creek Natural Zeolites

The presence of zeolites in tuffs cannot be determined by field observations. This fact accounts for the only recent discovery of natural zeolites in Western Canada. The writer, in cooperation with Pilsum Master, a consulting geological chemist, and Dave Koop, of TerraMin Research Labs Ltd., developed a chemical field test utilizing a methylene blue cation exchange procedure, which successfully indicates the presence of zeolites in the field, enabling geologists to locate and map natural zeolite occurrences.

Three field trips were made to the Princeton and Cache Creek areas from April to June 1991, resulting in the following observations:

- a) The zeolitized materials in the Cache Creek outcrop in four locations. The deposits have been divided into two distinct groups, hereafter referred to as Group A and Group B. Group A is subdivided into A and A1. Group A is zeolitized tuffs which are grey to light grey, competent with 10% - 10% porosity, with a minimum thickness of six to eight meters. Group A1 is zeolitized tuffs which are light to dark green, lithified tuffs, competent with 6% - 12% porosity, with a minimum thickness of five to seven meters and occurs below Group A, the contact being sharp. Relative percentages of zeolitization between the groups has not yet been determined. Analysis by the British Columbia Department of Energy, Mines and Resources has identified the zeolite as clinoptilolite, with minor heulandite.
- b) Group B is zeolitized tuffs rhyolite, shale and siltstone, light to dark brown and grey to dark green, bedded, friable, containing minor fossil organics and occurs with a minimum thickness of 50-70 meters. The zeolite in Group B is heulandite, stilbite and clinoptilolite.
- c) Visual estimates indicate in excess of 500,000 tonnes of Group A, in excess of 300,000 tonnes of Group A1 and 1.5 - 2 million tonnes of Group B. More than sufficient reserves exist to provide materials, for existing markets being examined, for more than 15 years.

viii. Location

The Cache Creek deposits are ideally located, within 1000 meters of the TransCanada Highway or secondary highways. Two of the deposits are within four kilometers of rail siding, the remaining two within 12 kilometers of rail siding. The deposits occur at approximately 500 - 700 metres, in elevation. The topography is gently rolling hills. All deposits occur within 300 meters of trails. Any road construction will require minimal disturbances. Land use is currently for grazing and the writer estimates, is 100 acres per cow month, or more. Vegetation is sagebrush, cactus, native dryland grasses and flowers.

Climatic conditions are extremely hot and dry, in the summer months, and dry and cool during the winter months. The area, undoubtedly, has a high annual net loss to evaporation. Several rattlesnakes were observed closely during geological examinations. Signs of deer, squirrels, coyotes and dogs were observed on game trails intersecting the areas.

ix. Quarry

The mining of Group A entails use of explosives to lift and break the material to crusher size as it is indurated and lithified. Ore removal would be accomplished by front end loaders.

The mining of Group A1 is the same, however, A1 is overlaid by six to seven meters of Group A.

The mining of Group B can be accomplished by dozers or excavators and front end loaders without the use of explosives. Group B is friable on its bedding planes. Both Groups A and B have a hardness of between two to three mohs, as such, they can be considered soft for mining.

Mining and recovery costs are low a distinct advantage and requirement for industrial mineral production.

x. Processing

Processing of the zeolites is standard crushing and sizing of the material. Moisture contents are maintained at, or below, 1% for all packaged products. Air drying, as required, is done at the mine sites.

Jaw crushing, followed by cone crushing, reduces the material for sizing. As a majority of the products are powders or granules, a return circuit for the oversize is required.

Sizing can be accomplished by double or triple decker screens. Production rates are high with, low wear on the crushers or screens, by virtue of the relatively soft nature of the material. No special considerations are required for the processing of the material, except for insuring the crushed granules and powders are kept dry for packaging. No further processing, peptizing or blending is currently being considered.

The products are produced and sold on their natural characteristics of cation exchange, absorbency, adsorbency and molecular sieve characteristics.

xi. Packaging

Packaging is dependent upon product niches. The higher value, lower volume consumer products are sold in 15 to 20 kg bags. These product types are barn deodorizers, cat litters, industrial absorbents and agricultural food additives. The lower value, higher volume products, such as herbicide/pesticide carriers, are sold in one tonne bags, truck load lots and railcars. Available contract packaging in bags is used for the establishment of consumer product lines, again obviating the need for a captive packaging facility. Contract packaging is available in Vancouver and Calgary.

Bulk sales of material in one tonne bags, 25 tonne truck loads and 100 tonne rail car shipments can be accommodated at the loadout facilities.

xii. Market Size

Mountain Minerals can supply products and services to a myriad of industry and consumer groups. Those groups currently consume hundreds of thousand of tonnes, worth hundreds of millions of dollars of chemical carriers, extenders, feed and soil supplements, barn deodorizers, cat litters and industrial absorbents.

xiii. Marketing

On a strategic level, a variety of industry specific products is produced from the three groups of zeolitized materials. Specific product testing is developed in concert with end users. Discussions with potential clients, to identify their individual product requirements, is ongoing.

The strategic marketing goals are to attain sales and margin objectives through focusing on replacing existing products in barn deodorizers, animal bedding and industrial absorbents. Tactically, sales efforts are concentrated in areas where a freight advantage over competitors exists.

The exact requirements of the consumer vary by industry and by customer. While they may have very specific needs, these five purchasing factors affect the purchase:

1. **Workability** Does the product work to produce the desired result.
2. **Price & Packaging (appearance):** Can the purchaser reduce his costs without appearing to lower quality (packaging).
3. **Delivery:** On time, in appropriate quantities, on short notice.
4. **Product Consistency:** The ability to supply the same product with every purchase.
5. **Product Support:** The ability of the supplier to supply quality and technical service, on short notice to ensure workability.

xiv. Distribution

Direct Sales and Packaged Products

To consumer and retail outlets on all products. Sales representatives are on a base salary, plus commissions, or commission format that takes into account the missionary saleswork, which dominates the early years of product introductions, to replace existing products and then new products for new markets.

Direct Sales and Bulk Products

The customer base, that will purchase bulk products, are those industries that require industrial fillers and extenders, such as the AgChem companies for use in herbicides, pesticides and fertilizer products.

The true buyers and decision makers regarding such purchases, are often chief technicians, formulators and research directors.

Product salesmen, servicing this sector, must be highly qualified technically and supported by analytical facilities.

In most instances, bulk sales are quotation and, hence, a management function.

xv. Sales Promotion

As the zeolite containing materials are natural industrial that are sold to niche markets, or as an ingredient to manufacture other products, mass market promotions are not used. The sales promotions strategy relies upon four areas to aid the sales approach:

1. **Advertising**

Advertising is through the print media - black and white magazine advertisements. The ads are in specialty and industrial publications vehicles such as "Horse Magazine" and "Industrial Minerals News". No electronic media use is contemplated.

2. **Brochures/Support Vehicles**

These are used extensively. They form the basis of direct mail campaigns to identify buyers and decision makers in key industries. The brochures and support vehicles accomplish four tasks:

- ◆ Present the benefits to the customer.
- ◆ Introduce the company, products and concept.
- ◆ Answer basic specification and product questions.
- ◆ Introduce the service and technical support program.

3. Trade Shows

Industry specific trade shows will be attended. The goals of trade show participation are for customer awareness and sales lead generation.

4. Product Support

The previous three promotional tactics generate leads and create customer recognition. The most effective and important portion of the promotional strategy is the personal selling program. Apart from the obvious goal of sales generation, the support tactic has two goals: to provide product information and continuing support, and service on a technical basis, to the customer.

It is the technical support and service from the initial customer contact, through continuing use, that is the most important portion of the sales and promotion strategy.

xvi. Application Development

Natural zeolites perform their function as products through zeolite type, cation exchange, porosity, permeability, concentrations, grain size, accessories minerals and size of molecular channel diameters. Product development requires a clear understanding of the variety of the mechanism at work.

Continuing innovation and application development is the key to the success of the project. Methodologies and references to understand and elucidate the use of the Cache Creek zeolitized materials for product development are being developed.

xvii. Conclusions

Development of the Cache Creek deposits represents a unique opportunity. Few industrial mineral projects have the key aspects of the Cache Creek natural zeolites:

- ◆ Location to market on main east/west transportation corridor
- ◆ Visible reserves
- ◆ Access to deposits on, or near, existing roads and trails
- ◆ Low cost quarrying
- ◆ Low cost processing
- ◆ Ease of handling and packaging
- ◆ Minimal environmental impact
- ◆ Benign material, completely non-toxic
- ◆ Functional and adaptable material for existing markets and new markets
- ◆ Opportunity for significant, sustainable economic gain