PRODUCING A QUALITY SAND FOR INDUSTRY AND RECREATION

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In Michigan, industrial sand is mined from several sources for a variety of uses. The major source is the coastal dunes located along the western shore of the Lower Peninsula and along some of the shoreline in the Upper Peninsula.

For many years Michigan's dune sand has been consumed by the foundry and glass industries as well as sandblasting companies and the railroad for use as engine traction material. In 1977, much to everyones surprise, a recreation oriented industry began to utilize this mineral resource. Today, many golf courses throughout Michigan, Indiana, Illinois and Wisconsin are finding it ideally suited for use as a top dressing material.

A survey conducted by the Michigan Department of Natural Resources, in conjunction with The Sand Dune Management and Protection Act of 1976, revealed seven producers operating within the state. These seven producers extracted some 5,450,000 tons and controlled recoverable reserves totalling 256,765,000 tons. At present consumption rates, sand reserves will not be depleted until the year 2030.

However, Michigan is blessed with an abundance of very high quality deposits. Of the 65,000 acres of prime duneland within the state, sand companies own or control only 3,000 acres. Barring future legislation contrary to mining, we will continue to lead the nation in industrial sand production well into the twenty-first century.

Thousands of years of natural wind sorting has resulted in uniform deposits consisting of 95% pure sub-angular grain silica with the remaining 5% divided between oxides of aluminum, titanium, iron, calcium, and magnesium. Eliminating these impurities, or as we call them "beneficial non-silica particles", has presented sand producers with their greatest challenge. Some of us have met that challenge with new and sophisticated processing techniques while others have not. If you are concerned with the pH level of your top dressing and are considering using sand, by all means select a supplier that has!

Before going into the actual production of sand, I would like to speak briefly about a ploy used by most sand salesmen when questioned about impurity levels in their product. They like to speak in terms of pH levels and you should not fall victim to their deception.

As you know, calcium and magnesium carbonates have a substantial effect on pH values. However, some of these elements are not water soluble and will not influence pH readings. Because of this, the foundry industry developed an acid demand test which more accurately measure carbonate concentrations.

It is known that when equal amounts of a neutral distilled water, hydrochloric acid, and sodium hydroxide are mixed, the pH will remain neutral. If an equal portion of sand is added to the water/acid solution, the carbonates within the sand will consume a portion of the acid. By back titrating with sodium hydroxide to a neutral pH, the exact amount of acid consumed can be determined. This number is then referred to as the Acid Demand Value.

The nature of the test method is such that these values range between zero and fifty. An Acid Demand Value of zero would indicate that the sand had no reaction with the acid and for all practical purposes was neutral. On the other hand, an A.D.V. of fifty would indicate a very basic sand which consumed 100% of the acid. These two chemically different sands could very well have the same pH value. As an example, our sand in its raw state has a pH of approximately 8.5 and an acid demand

ranging between 35 and 45 meaning it consumed 70 to 90% of the acid. By processing this material we are able to reduce this consumption to less than 10% or an acid demand value below 5, yet the pH remains at approximately 8.5.

Don't let a clever salesman fool you by simply giving you an erroneous pH value for his product. Ask him to furnish you with the average acid demand value and remember, the higher the number, the higher the carbonate content.

I would like to make just one more point relevant to carbonate contents. You will not find a neutral Michigan dune sand. Even mother nature with her infinite wisdom could not produce a sand with an acid demand of less than two.

Now that I have completely confused you and betrayed my peers in the process, lets move on to the methods of producing a quality sand. The facility that I am going to talk about belongs to Construction Aggregates Corporation and is located in Ferrysburg. Just to set the record straight, Standard Sand is a subsidiary of Construction Aggregates.

Our mining operation in Ferrysburg consists of removing the sand by the use of either a front-end-loader or a crane. The raw material is unloaded into a nearby hopper and transported via conveyor to a surge pile.

The material is drawn from this surge pile at a rate of 300 tons per hours, diluted with water, and passed over a screen to remove the roots, stones, or other foreign matter. From the screen, the sand now in a slurry consisting of thirty percent solids is pumped to our four cyclones for primary washing. These cyclones are equiped to remove essentially all of the -140 particles. From the cyclones, the slurry can be routed to our dewatering devices or to our flotation plant for further processing.

I would like to concentrate on the flotation process simply because this is the material that we have sold to numerous golf courses.

We built our flotation plant in 1975 for the specific purpose of eliminating the "beneficial non-silica particles" that I referred to earlier.

As simply and as briefly as it can be explained, the flotation process or more specifically froth flotation, involves chemical treatment of a sand pulp to create conditions favorable for the attachment of carbonate particles to tiny air bubbles. These air bubbles are carried to the surface of the pulp and form a stabilized froth which is skimmed off while the sand remains submerged.

Sand flotation is a very sophisticated process and there are a number of critical steps involved. First of all, the cyclones must remove all of the silt and clay which even in small quantities can have a disastrous effect on the flotation process. In addition, the cyclones must deliver a slurry consisting of 75 to 80% solids to our first conditioning tank.

At the point of the cyclone underflow an anionic fatty acid is metered in at a predetermined rate, generally between 1/4 and 1/2 pound per ton, and the very critical conditioning process begins.

Conditioning is the heart of the flotation process since it is the fatty acid which produces the hydrophobic film on the carbonate particles. Numberous lab experiments showed that we would need a minimum of five minutes retention time to effectively disperse the fatty acid throughout the entire load. To accomplish this we installed two nine foot by nine foot tanks complete with double 36" propellers. We calculated that each tank would have a 2 1/2 minute retention time at 350 tons per hour. This was not the case. In 1977 we added a third conditioning tank to the system and now have a total retention time of six minutes at a feed rate of 300 tons per hour.

Once the slurry is conditioned, it is fed into the first of four 500 cubic foot flotation cells where make-up water is added to reduce the solids to 35%. Intense agitation and aeration occurs in the mixing zone at the bottom of these cells. It's

within this portion of the cell that contact between the conditioned pulp and controlled air is made. The carbonatized air bubbles are lifted hydraulically by the recirculated pulp in the middle of the cell. At this point a calm separation zone is created which permits the flotable particles to separate from those that will not float and a froth is formed on the surface. This froth is then skimmed off and the finished product is pumped to our roto-scoops and sand screw for dewatering.

This in a nutshell is the flotation process which is the most effective way of reducing the carbonate content of a sand. There are other less complicated and less expensive methods, but quite frankly they don't begin to compare to a well run flotation operation.

From the dewatering devices the sand is conveyed to a radial stacker for stockpiling over one of three tunnels. By stockpiling the coarse material over one tunnel and the fine material over the other two, we are able to blend to adjust the screen distribution, fineness, and acid demand to meet our customers specifications.

Our stockpile consists of 42,000 tons which can be loaded in trucks or onto lake freighters for shipment to ports in Canada, New York, Illinois, or Wisconsin.

I saved any mention of quality control for last because it is the main thrust of our operation and something we're quite proud of.

Our program begins with prior testing of the sand dunes to determine what type of material we will have available for mining. A number of samples are extracted throughout the year with test results recorded on a large topographical map. From this data, which includes screen distribution, fineness, clay content, and acid demand values, we're able to formulate a mining plan condusive to meeting customer specifications. I might add that each of our major customers have completely different desires with respect to the quality of their sand. Therefore, we must base our production schedule on a very strict shipping schedule.

Additional samples are collected at both the prescreen for the raw material and the finished product belt. These representative grab type samples are taken during each hour or every 300 tons of production and results are compared to measure both plant efficiency and finished product quality.

The results of the finished product samples are then recorded on an inventory control sheet which is used to design a loading plan for both truck and vessel shipments.

Each load shipped is also sampled either by the truck load or every 3,000 tons in the case of boat loads. These results are recorded and mailed to the customers. On boat loads which generally run between 18,000 and 27,000 tons, we have a policy of saving a composite sample for future reference. This small sample has saved us thousands of dollars on a number of occasions. These boats, in addition to hauling sand, also haul coal and salt throughout the Great Lakes and have a nasty habit of contaminating our sand. There is no headache more severe than 27,000 tons of contaminated lake sand.

Our operation which produces 650,000 tons per year is simple by comparison to other producers who separate the sand by grain size and then blend various sizes together to produce a number of different sized products. We have never felt compelled to do this because it is extremely difficult to reproduce a consistent product time after time and secondly, we've been quite successful with out present operation.

In closing, I'd just like to say that most of the sand producers are very quality conscious and ship reasonable consistent products. Not all of them have the type of sand you are looking for nor do they have the additional capacity to meet your demand. A number of them ship their entire production to one or two customers and fortunately for all of us, the bad apple in our bushel falls into this category.