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REMCO ROCK ENGINEERED MACHINERY CO. INC.

ROC'N

REMCO OPERATORS COUNCIL NEWSLETTER

Manufactured Sand Production Invigorates California Quarry

Fine crushing hard basaltic rock for making asphalt sand and C33 sand for ready-mix concrete is a tough job. This is what now makes up about 30% of the overall production at BoDean Company's Mark West Quarry near Santa Rosa, CA. "That's business we never had before," says Director of Production Bill Reid. "And we're planning to expand our production capabilities to meet growing market demands. Adding manufactured sand to our product mix is one of the best business decisions we've ever made. It kind of evolved over time."

The quarry was opened in 1910 and run by various operators until BoDean purchased it in 1989 and updated and replaced the quarry's existing equipment and systems. For several years, the quarry successfully produced base rock and two sizes of drain rock. At that point, making sand was 10 to 15 years in BoDean's future, but never far from their minds.

"When we first took over the quarry, it was very vertical, with large faces," Reid said. "The quarry is located on a steep hillside. We were mining rock 400 feet above our plant. We had to do a lot of benching—that is, cutting flat ledges into the hillside to form what we called 'work benches' where we could drill and blast the basaltic rock. When we finished with an area, we would drop down to a lower level and cut a new work bench.

"As we came down the hillside, we ran into some water, clay and broken up rocks from time to time. We had to learn how to handle that to maximize our resource. But for the most part, we were crushing and screening relatively dry material. Over the years as we started thinking more and more about making sand, we knew disposal of clay and wash plant water would be a major problem because we have no room for settling ponds at our cramped vertical site."

The Mark West Quarry, equipped with a jaw crusher, horizontal impact crusher and dry screening system, was very successful at that time. Base rock and drain rock were their main markets. But market demands were volatile, changing yearly or even monthly. They saw the next shift in the aggregate industry moving towards asphaltic and concrete rock.

Also, Sonoma County, along with other counties in the State of California, was telling aggregates producers to stop taking alluvial gravels from rivers and streams. That further increased demand for certain types of crushed aggregates. The quarry's product mix at that time included drain rocks and base rocks.

Figure 1: *BoDean purchased their first REMco crusher for the Mark West Quarry in 1995: a Dual Drive SandMax 9000 VSI with two 250-HP, 1800-rpm electric motors, and a 37-in. 5-port rotor. It replaced a 44-in. Fine Head cone crusher. The original objective was to balance plant production while making the asphalt product more cubicle.*

Continued on next page 2

Figure 2: *In 2007 a second REMco Model 400 crusher was added as part of a plant expansion to produce cubicle concrete rock and C33 concrete sand. This required a REMco SandMax 400 Single Drive VSI crusher with one 400-hp, 1800-rpm electric motor and an updated 37-in. 5-port rotor.*

Enlarging the Quarry

In 1994-95 BoDean decided to enlarge the Mark West product line by including rock that could be used in asphalt and concrete products. "To fulfill all our fluctuating demands efficiently," Reid said, "we developed a system with swinging product gates that provided diversification with one simple plant. That took a lot of creative engineering and design. But it means we didn't have to change screens each time we changed product lines." While the fine crusher produced an abundance of the small 3/8" chip, it did not produce enough of the sand product. Both of these products were not being produced in the right shape—it was too long and flat. So the fine cone crusher was replaced with a REMco 9000 rock-on-rock vertical shaft impact crusher.

"The jaw-cone-VSI system with dry screening enabled us to produce our existing product mix plus the asphaltic material with a very good cubicle shape," Reid said. "This added to our product sales potential, and overall we had better quality products with greater durability and workability at lower production costs. Further, it added to our tph capabilities and cut maintenance time and expense significantly. Plus, we were a step closer to making sand.

"With this equipment and system we operated very successfully for a number of years," Reid said. "But since we were so dependent on contracts that can come and go, we decided to enter into the asphalt business ourselves, and purchased an asphalt plant nearby.

"At first we were buying sand for the plant from an outside local source, and that was working out. But the sand source began to dry up. Sand was becoming more expensive, and the supply was sporadic. We were at the mercy of our suppliers, some of whom were our competitors. So we knew we were going to have to take control of our own destiny and make sand.

"Further, we thought it was potentially very profitable," Reid said. "But we still had to solve the problem of disposing with wash plant water and clay waste. The rock we mine contains 15% to 20% clay, or cake as we call it. With no room for settling ponds, we had to find a good way to deal with the cake if we wanted to make sand. So we did our homework."

BoDean started checking out various solutions, including belt presses to move waste off site, but

Model	400 SandMax VSI
Max Feed Size	3" (75 mm)
Speed Range *	1000 - 1800 rpm / BC8
HP/KW Range	300 hp / 225 kw - 400 hp / 300 kw
Rotors	30-4-14; 33-4/5-14; 37-4/5-14
Chamber Type	Rock-on-Rock, Sand Type
Weight	30,000 lbs. / 13,608 kgs.

*Higher speed available with oil lube system.

Figure 3: *Typical REMco Model 400 SandMax application specifications.*

Continued on next page 4

Limted Time Offer

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nothing seemed quite right. Then they found a plate press system from Europe that enabled them to stack the cake and bring it back up the hillside. There it was mixed with overburden and placed in the reclamation project required for all quarries by California law.

"That was our 'aha' moment," Reid said. "At that point we knew we could make sand efficiently at this quarry site. We were jubilant! Our next challenge was to determine how to revise or add to our existing plant to produce the sand. Again, we went to REMco. They're the sand experts. We liked that they know all there is to know about cone crushers versus VSI crushing capabilities. In the process, we looked at a lot of numbers—a premium plant versus more economical plants—what would the payback be? We chose the premium plant, and the payback has been about four years."

"In addition to a wash plant, we installed a REMco 400 SandMax. The result has been everything we'd hoped for. We make top quality sand, including spec sand products, very efficiently in terms of production, capital cost, wear parts cost, and balancing production to meet market demands. Further, REMco gives a production guarantee on their equipment; so we went into sand making with great confidence. It's one of the wisest business decisions we've ever made at this quarry."

Crushing Circuit

Plant Superintendent Anthony Boyle explains the crushing circuit, consisting of a primary plant with a feeder and jaw, and a secondary plant with a cone crusher, a REMco SandMax, and three screens that combine to produce all the various aggregate products and sand needed for market demands.

Figure 4: *C33 spec manufactured sand.*

Figure 5: *(left to right) REMco General Manager Kevin Cadwalader, BoDean Director of Production Bill Reid, REMco Founder Damian Rodriguez and REMco Western Regional Manager Terrence Costa.*

Incoming material is deposited by front-end loaders onto a vibrating grizzly feeder and fed into the jaw crusher. From there, the crushed material goes to a surge pile with an underground reclaim tunnel, equipped with two belt feeders, to feed the secondary plant with a 7x20 three-deck screen. Here aggregate is separated out: the smallest is ½-inch minus. Everything else goes to the secondary cone or tertiary VSI. Then, it is collected on a common belt that feeds to a closed circuit system that consists of a 6x20 three-deck screen, a 6x20 two-deck screen, and the cone and VSI. From there, the material can go to individual stockpiles or to a blending belt. This blending belt feeds a stockpile/surge pile that feeds the wash plant.

Under the surge pile is a reclaim tunnel with a belt feeder that feeds a quality control screen that eliminates clumps. The material then goes to the blade mill (for agitating and scrubbing) and on to a 7x20 triple-deck horizontal screen. It then moves to stockpiles or back to the REMco 400 VSI and on to the blade mill in closed circuit. The smallest material goes to a sand pump to a cyclone to a dewatering screen to final stockpile as C33 spec sand at higher than 3.1 FM.

"We use a cyclone instead of the much larger sand screws because of our lack of space," Boyle said. "We found that the gradation consistency is beautiful. And with two VSIs in the system, we have all cubical product—nothing flat or elongated—and we've eliminated oversize and out-of-balance material."

After supplying their own asphalt plant with sand, BoDean still had an abundance of sand to sell to other markets. They determined that the best market for their purposes was ready-mix concrete, but producers resisted.

"They were so used to the super smooth alluvial sand that they felt manufactured sand wouldn't finish well," Reid said. "They thought it would leave marks, would be rough, would be unstable, and wouldn't pump well.

"We pointed out that manufactured sand was being used all over the world," Reid continued, "But they still resisted. We tried several ready-mix suppliers, but to no avail. So we did our own test pours, using the concrete for our own equipment footings, and that worked very, very well. We offered to give sand to concrete companies to try out, but they didn't want it. It was like they had a mental block."

"We saw that as a chance to go into the cement business ourselves; so we became affiliated with a ready-mix concrete company. That was in 2010, and it has been a great opportunity for us. The only difference we see between concrete made with alluvial sand and manufactured sand is a little bit of our natural stone color once it dries. Otherwise, there's no difference. Manufactured sand is at least as good as natural sand, sometimes better. And what's more it's available when natural sand is in short supply or is too expensive. The ready-mix companies we're partnering with are selling concrete for finishing and everything else: bridges, overpasses, buildings and so on. The strength is high, and there have been no issues.

"A lot of times problems are lead-ins to opportunities," Reid said, and pointed out some examples:

> "As electric costs soared, we experimented with solar power in our offices in 2007. That worked well; so we installed solar panels on our reclaimed hillside to power the entire quarry. That has saved us a lot of money and has ecological benefits. Now other California aggregate companies are trying solar and/or wind power
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> "We don't have room for settling ponds; so we found a neat, efficient way to use waste material as part of the reclamation process. It's far better than messy, mucky, hazardous settling ponds, and it will save us money over time.
>
> "Same with manufactured sand. You ask the great majority of quarry operators and they'll say it can't be done successfully. Well, we're doing it very successfully. And it's a huge market. But usually it can't be done with a quarry's existing standard crushing equipment like primary jaws and cones or primary horizontal impactors and cones. We found the VSI to be the solution.
>
> "We're selling all the sand we can make. Currently our run time is 65 hours a week with about 700 tph from the jaw crusher, 500 tph from the cone and VSI combined, and about 80 tph from the SandMax. We can only run the sand plant long enough to digest our waste mud. So we're planning to expand our reclaimed water system to double our run time.

"To any quarryman who thinks making sand is a can of worms, I'd say it's more like a can of opportunity. Just do your homework, talk to manufactured sand experts, then make the investment and reap the profits you're not getting now. It's a big market. There's room for us all."

By: Carl Emigh (As seen in Rock Products, 04/2016)

Figure 6: *The Mark West Quarry is powered almost entirely with solar panels installed on the reclaimed hillside above the plant.*

Talk TECH TIP

AVOID CRUSHER FAILURES THIS WINTER/SPRING

Cold weather can create havoc on any machine; your REMco VSI is not immune to winter's cold. Being that your crusher is all steel, the cold overnight temperatures linger on in the machine even when the air temperature begins to warm. Whether you are operating a grease lubricated machine or an oil lubricated unit, any drop in temperature can be detrimental to your daily production goals.

Users with Oil Lubrication System

The oil lubricated machines are designed to operate under variable temperature conditions. The system includes temperature monitors and controls that provide protection for proper lubrication to the crusher. A silicon, imbedded heater is part of the standard oil lube system. This is located on the outside bottom of the tank. This is effective when the air temperature is consistently below 45°F or less. The oil heater's function is automatic as it is controlled by a preset thermostatic device located in the return line or oil tank, depending on the model year of your crusher.

Normal Temperature Conditions - Above 45°F

While the morning air temperature at time of crusher start up may be below this, the crusher may not start due to lack of oil flow to the crusher caused by the higher viscosity of the cold oil and a greater amount of by-pass when the oil pressure exceeds 70-75psi. The oil tank heater is set to 60°F and when the power is turned on, it will raise the oil temperature in the 40-gallon tank, reducing the oil pressure and increasing flow to the crusher.

Depending on the actual ambient temperature, it may take 30 to 45 minutes for the oil in the tank to heat up to 60°F. Under these circumstances, it is advisable to allow the oil heater to operate by turning on the electrical power to the system approximately one hour before the crusher is put into service. When the air temperature at the time of start-up is 60°F or higher, the crusher should start without any delay waiting for the oil tank to warm up. This is based on using the correct viscosity and specification lubricant.

Cold Temperature Conditions: Below 45°F

The time to heat the oil in the tank may extend well beyond one hour. Care should be taken to not attempt to run the crusher with a temperature of less than 60°F in the tank or to defeat the temperature control or flow control systems as this may cause damage to the bearing assembly from insufficient lubrication at time of start.

REMco recommends that if possible, the electric power to the lube unit be left on during non-crushing periods so that if the oil temperature is below 60°F the heater will automatically turn on to warm the oil. With this condition, if the oil pump is operated during non-crushing periods, the automatic heater will maintain the crusher at a temperature which would allow it to start crushing promptly without a warm up period.

Extreme Cold Temperature Conditions: Below 32°F

REMco defines extreme cold temperature operation as any time the crusher is to operate with an ambient temperature lower than 32°F. Under these conditions, it is possible that the heating time to warm the oil tank may be greater than desired and it may interfere with the crusher's operating cycle. Because these conditions can vary greatly, additional measures may be required to assure smooth and continuous operation of the crusher. It is suggested that you contact REMco for guidance for your specific conditions.

Typical REMco Oil System

Users with an Automatic Grease Lubrication System

Special consideration is needed to pump grease during cooler weather when running with a REMco automatic grease system. It is typically recommended to allow the crusher run at no load for 15 minutes or so to bring up the bearing temperature before bringing the machine to full load. This allows the grease to warm up the bearings to be properly lubricated before the machine is put into operation.

Typical REMco Automatic Grease System

Cool Temperature Conditions: 50°F to 38°F

A small space heater mounted inside the cabinet of the grease reservoir is sufficient to make the grease pump through the grease lines into the crusher.

Cold Temperature Conditions : 37°F to 25°F

A larger space heater or a special insulated and heated wrap around the grease reservoir may be needed and grease may still have trouble flowing through the grease lines until the crusher is running and warm.

Extreme Cold Temperature Conditions: Below 24°F

It may be necessary to use a heated wrap on the grease reservoir and electric heater tape and insulation on the grease lines that deliver grease to the bearing cartridge to allow the grease to flow. Additionally the crusher will have to be running at operating temperature (above 60°F) to allow the grease to flow through the grease portals inside the steel walls of the cartridge to deliver grease to the bearings.

Users with a Manual Single Point System

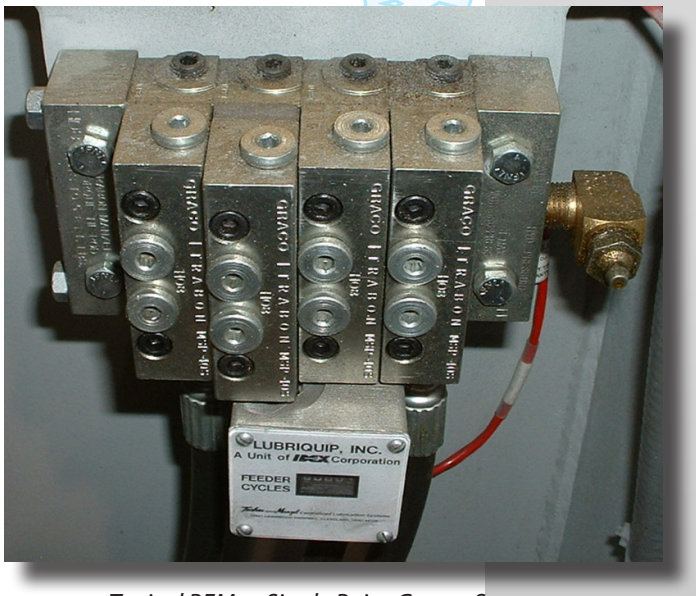
Users that operate a REMco unit with a single point system, it is recommended to grease when the crusher is warm and rotating. Grease is delivered to the bearings through the walls of the bearing cartridge which is warmed by the heat generation of the rotating shaft and bearings. By greasing the crusher when it is at operating temperature the grease flows easier making the grease gun easier to pump.

Cool Temperature Conditions: 50°F to 38°F

The crusher should be running and warm when greased.

Cold Temperature Conditions: 37°F to 25°F

The crusher should be running warm but the lines will be cold which may make pumping the grease difficult. REMco suggests storing the grease gun in a warm environment to aid the process as much as possible.



Typical REMco Single Point Grease System

Extreme Cold Temperature Conditions: Below 24°F

It is recommended that the grease lines be wrapped in heater tape and insulated to allow the grease to move through the lines freely.

Don't forget about yourself in cold weather, ice and snow can cause slip and fall injuries and no one wants that, dress warm, be safe, and we'll have more REMco Tech Tips for you in our next news letter.

Upcoming Events

It's that time of year again!

REMco will have its latest VSIs on display, these are no nonsense crushers built for the tough aggregate jobs that lesser machines just can't do without breaking the budget, true cubical product shape, increase product quality, strength and durability, manufacture all types of sands; concrete sand with the right F.M., asphalt sand with the right grading, durability and volume, blast sands, and much, much more. All these materials are produced with less power, lower wear cost and lower cost of ownership then our competitors.

On display will be our latest technology developments in:

- New and improved Rotors
- New and improved crushing chambers
- New and improved crushers
- SmartBox crusher monitoring system
- Ask us about Tech Speak

The REMco PROcone is a heavy-duty secondary cone that is available in three head sizes, 36-in., 45-in. and 51-in. The crushing chamber is designed to maintain its feed opening throughout the life of the wear liners, providing consistent feed acceptance even when liners are worn. The crusher's large feed opening is designed to receive angular, elongated material typically produced from a jaw crusher.

The REMco PROscreen with built-in feed box, discharge lips, heavy-duty coil springs and adjustable vibrator mechanism is available in widths from 4 ft. through 8 ft. in one-, two-, three- or four-deck designs.

This newsletter is produced for REMco users and its intent is to make your life easier! We want to hear what has been happening with the REMco crusher in *your plant*. Send us your questions, comments and job stories to the email below.

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