

## Case history

### Sizing up fly ash

Classifying a utility's fly ash creates a consistently sized product.

Once considered a power generating station's waste product from coal combustion, classified fly ash has now become a useful commodity to collect and sell. It's primarily used as an additive in high-quality concrete and portland cement. And demand is as high as ever.

Phoenix Cement, headquartered in Phoenix, markets Class F fly ash for use in concrete. Through a unique partnership with the Arizona Public Service utility, Phoenix Cement collects the raw fly ash at two of the utility's power generating stations: Cholla Power Plant, Joseph City, Ariz., and Four Corners Power Plant, Fruitland, N.M. Dale Diulus, manager of fly ash products for Phoenix Cement, said the company markets most of the collected fly ash after classification.

"We have an entire service company, which sets us apart [from other fly ash marketers]," Diulus said. "We also manufacture portland cement and

have a complete in-house laboratory to test fly ash and cement products."

For use in portland cement, the ash must meet a fineness standard set by the American Society for Testing and Materials (ASTM). The specification requires that no more than 34 percent of the fly ash be retained when wet-sieved on a 325 (44-micron) sieve.

#### Raw fly ash inconsistently meets ASTM specification

In 1974, the first of Phoenix Cement's fly ash collection facilities was built at the Cholla Power Plant. For years afterward, the company simply collected the precipitated raw ash left from coal burned at the plant.

"Well, basically we just attempted to take the raw fly ash produced [at the power plant] and market it, like most other companies do," Diulus said. "But when we constantly tested the fly ash to monitor its quality, we found



*Each centrifugal classifier at the Four Corners Power Plant processes fly ash at a 40-t/h capacity.*

that [the fly ash particle size] was just too inconsistent to reliably meet our customers' needs and standards."

Ron Helms, fly ash operations manager for Phoenix Cement, said many variables in power production can change the fly ash characteristics. As the power plant operates around the clock, demand for power varies. To adjust, power plant officials change the airflow for combustion and the fineness of the pulverized coal being burned, which produces inconsistent

fly ash. "It's coarse one hour and fine the next," Helms said. "Oversize fly ash was diverted to waste storage silos at the plant."

Often, the ash was too inconsistent to be marketed for use in concrete. Beginning in 1986 Phoenix Cement determined they needed to size the fly ash at the Cholla plant.

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**Once classified, the in-spec fly ash is conveyed to a 1,300-ton storage silo for unloading to trucks for bulk shipment.**

ity product that we wanted to put our name on, we would have to invest in some equipment to make a consistent fly ash,” Diulus said.

### Phoenix Cement searches for classifier

In 1986, Phoenix Cement began considering ways to ensure the fly ash was consistently sized for customer needs and met ASTM specification. Helms said plant operators examined the classification equipment on the market.

“We didn’t actually go and visit other facilities,” he said. “We just studied the information available. When we initially looked at classification equipment for Cholla, the sole purpose was to reduce the fineness of the raw fly ash we collected from the power plant. We wanted the ash to not only exceed ASTM standards but provide high strength in cement products.”

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They narrowed the search to a centrifugal classifier, which operated similarly to a cyclone and had no moving parts. “The other alternative of course was a dynamic classifier, but it consumes much power to separate the material,” Helms said. “And we felt at the time that the centrifugal unit — with no power usage and minimal maintenance — was our best bet.”

So Phoenix Cement installed two Marsulex centrifugal classifiers at the

Cholla plant in 1986. By doing so, they were able to consistently deliver fly ash sized for use in concrete. As demand for the high-quality fly ash rose, Phoenix Cement began developing the ash collection-beneficiation facility at the Four Corners plant. As expected, the raw fly ash particle size was inconsistent.

“At Four Corners, depending on which line we were monitoring, you would see ash size measurements that would sometimes be under that [ASTM] limit, sometimes over,” Diulus said, “the same as it had been at Cholla [before we installed classifiers].”

With the classifiers working well at Cholla, Phoenix Cement knew they wanted the same equipment installed at the new facility. Helms said the company’s relationship with the classifier manufacturer and their willingness to work together was a selling point when it came time to buy classifiers for the Four Corners plant.

“And their equipment — they have quality equipment,” Helms said. “Over the past 12 years, we’ve had very small maintenance costs on these classifiers [at Cholla]. The price was right. They helped put together a package that worked for us.”

### Centrifugal classifiers installed at Four Corners

In May 1997, two centrifugal classifiers were installed at the Four Corners Power Plant. Except for their larger capacity, the classifiers were identical to those installed at Cholla 12 years earlier. The two Cholla classifiers each process fly ash at 25 t/h, while the two at Four Corners can each process 40 t/h. Helms characterized the installation at Four Corners as “very smooth.”

The classifiers’ components include a primary air and material inlet, two secondary air inlets, internal baffles, air and fines outlets on each side of the unit’s internal chamber, and a coarse material discharge.

In operation, the classifiers use centrifugal force to separate particles at cut points between 15 and 100 microns. Air and feed material enter the primary inlet. Baffles apply drag forces to the coarse particles while allowing air to pass through the material for fines separation. The heaviest particles drop to the bottom of the classifier and exit through the coarse material discharge. Adjustments made to the secondary inlet determine cut size. The airstream carrying in-spec material follows a spiral path to the outlets on each side of the internal chamber, carrying the material away for final recovery.

While the Cholla and Four Corners classifiers operate the same way, Helms said adjustments were made on the Four Corners units. Computer control panels were installed so operators can adjust the operation via a PC, which gives the classifiers greater operating flexibility. The control units were made by a separate manufacturer, Helms said, making them a bit cumbersome to install.

“Installing the computer control system was probably a hang-up for a few days,” Helms said. “But as far as the actual classifiers are concerned, we had no problems whatsoever with installation or making them work.”

Many of the Four Corners classifiers’ interior surfaces also came with factory-installed ceramic liners. The lining reduces wear caused by the abrasive fly ash.

“We had a track record at Cholla for almost 12 years with the classifiers,” Helms said. “We knew exactly where the wear spots would be; we tried to eliminate those when we installed our classifiers at Four Corners.”

### Classifiers create consistent in-spec fly ash

At Four Corners, the fly ash is collected in a baghouse. From there a pneumatic conveying system transports the ash through four 16-inch-diameter lines to the power plant’s disposal silos. Phoenix Cement not only monitors the fly ash for particle size, but they also monitor the ash’s

unburned carbon content through samplers connected to each line. ASTM specifications require fly ash to have an unburned carbon content of 6 percent or less.

“If [carbon content] starts changing because coal burning efficiency is decreasing,” Diulus said, “you will see a change in the fly ash. We monitor that in the power production process, because those changes affect our customers.”

When the carbon levels are within accepted parameters, the fly ash in a line can be diverted to one of Phoenix Cement’s two 1,000-ton feed silos for classification.

Fly ash with high carbon content is left to travel to the power plant’s disposal silos.

The power plant itself benefits from such monitoring. If the monitoring reveals high carbon content because the coal burners aren’t operating as efficiently as they should, plant operators can make adjustments.

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The Four Corners plant burns between 8 million and 9 million tons of coal each year, 20 percent of which becomes fly ash. The utility provides Phoenix Cement more than 300,000 tons of fly ash for classification. A large fan draws the fly ash through the classifier. The classified ash is drawn by vacuum into a cyclone, which helps settle the fines. From there, it’s pneumatically conveyed to a 1,300-

ton storage silo. The fly ash is then loaded into trucks for bulk shipments.

At Four Corners, the classifiers allow Phoenix Cement to monitor the fineness of the fly ash they sell. Since installing the classifiers, Phoenix Cement has classified the fly ash at between 12 and 15 percent retained on a 325 (44-micron) sieve, which is nearly three times finer than the ASTM specification of 34 percent.

“We wouldn’t have an operation if we didn’t have [the classifiers],” Diulus said. “We could still use a minor portion of the fly ash internally for our cement manufacturing, because we actually intergrind the ash into the cement. But without the classifying capability, I doubt we could market the fly ash as successfully as we do.”

Diulus said the classifiers have held up under heavy use.

“They’re dependable,” he said. “We’ve handled hundreds of thousands of tons of fly ash a year and so far there have been very few problems. We run them 24 hours a day, 365 days a year. There’s not a lot of equipment that can stand that kind of usage.”

By installing the fly ash collection-beneficiation facility at Four Corners, Phoenix Cement has nearly doubled the fly ash sold. The classifier has been an important part of the company’s success.

“What it’s done is allow us to ship out a consistent quality product, day in and day out, no matter what type of fly ash the power plant gives us for raw material,” Helms said. “And that consistency is what sells our product to our customers — to a point at times that we have sold all ash in supply at both of our facilities. There’s a lot of fly ash on the market, but we’re unique because we create such a high-quality product. We see a continuing demand for it.

“I’m very satisfied with the classifiers,” Helms said. “I don’t think there’s better equipment on the market for the price and for the maintenance costs.” **PBE**

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