



# Sulfur, Sodium, Ash ... Oh my!

AVS tackles the challenge  
that comes with lignite coal

*By Tracie Bettenhausen*



When coal leaves the live storage barn (bottom center) and heads to the boiler, it will be analyzed for a second time.

Some issues are hard to miss. Like when a Volkswagen falls down. “I mean, you physically have a piece of slag that’s the size of a Volkswagen. And if you’re dropping it 275 feet, it’s loud and can cause considerable damage,” says John Jacobs, plant manager at Antelope Valley Station.

Slag is ash: it builds up in the boiler when there’s too much sodium in the coal. The boiler is where the coal burns. At the top of the boiler and along the walls are tubes. The burning coal heats steam in the tubes, which travels to the turbine, turning the generator to make electricity.

At Antelope Valley, if the coal contains more than 5 percent sodium, slag sticks to and builds up on the boiler tubes, making the plant run less efficiently because slag insulates the tubes against the heat. Sometimes, so much slag can build up, it’s the size of a car.

The less slag, the better. But projections show that the coal coming to Antelope Valley will soon contain as much sodium as the plant can handle. It will also contain more sulfur and ash.

If sodium is a Volkswagen-size problem, higher levels of sulfur and ash look more like a Boeing 747.

So in 2005, a task force was formed to find solutions. “We looked at air jigging, we looked at bringing PRB (Powder River Basin) coal in, we looked at burning DGC (Dakota Gasification Company) gas as a replacement for the higher sulfur coal. . . . Anything and everything. We looked under every rock for anything that could possibly be done,” Jacobs says.

After three years of “cutting and slicing this about every which way we can,” the task force brought three projects to the board of directors.

# 1

**Problem:**  
higher sodium,  
sulfur and ash

**Solution:**  
coal  
analyzers

Until now, the Great Plains Synfuels Plant has done all coal analysis for Antelope Valley. Antelope Valley uses the plant's "fines" – gravel-like coal that, for the Synfuels Plant, is a waste product, but for Antelope Valley, is the primary fuel.

The Synfuels Plant takes a snapshot analysis of the coal every six hours. But with increasing sodium, sulfur and ash levels to contend with, Jacobs says "a six-hour best guess on the coal isn't going to be adequate."



**Tyler Mickelson**

New coal analyzers will take a second-by-second analysis. Tyler Mickelson, mechanical engineer II, says the analyzers will be placed over each belt and will use a low radioactive source to analyze the coal. The

radiation charges the coal, and each element gives off its own gamma ray. The analyzers can keep up with the belt, each of which carries up to 2,000 tons of coal per hour.

Two analyzers will be installed on the belts that bring coal over from the Synfuels Plant. "Based on what we see coming over from the Synfuels Plant, real-time, that will allow the operator who's bringing the coal in and looking at that analysis to do one of three things: either take the coal to our live storage barn; or if the coal is non-compliant coal and we can't blend with what we've got in the system, we can take the coal outside; or if the silos are empty, he can take that coal directly in for burn."

If the coal is put into storage, it will be analyzed again by two units installed on the belts that take coal into the plant. "Once you take coal outside, then you've lost control of what the quality is, because it goes on the pile. You don't know when you bring it back in what the coal analysis is," Jacobs says.

# 2

**Problem:**  
higher sulfur

**Solution:**  
more lime into  
the scrubbers

Antelope Valley uses dry scrubbers to remove sulfur dioxide from the flue gas. It works like this: pebble lime is fed into a ball mill and mixed with water in a process called "slaking." The mixture forms a slurry, which is sprayed into the scrubber. All flue gas passes through dry scrubbers before moving on to the baghouse. The lime reacts with sulfur dioxide, "scrubbing" it out of the flue gas.

The scrubber keeps the plant running in environmental compliance. When the coal contains greater than 0.85 percent sulfur, every piece of equipment has to be running at maximum capacity to keep up. Jacobs says that's like running a car at top speed all day, every day of the year – things eventually break down.



**Dawn Moore**

"There's no redundancy right now. If the current slaking system goes down, there's nothing to back it up," says Dawn Moore, senior mechanical engineer I.

"The new slaking system will take over as the primary system, with the original slaking system as backup."

The slaking system's capacity will be doubled. If a higher-sulfur coal is being used, more lime slurry can be sprayed into the scrubber to keep up.

# 3

**Problem:**  
higher ash

**Solution:**  
newer bags,  
sonic horns

Think of the baghouse as a very big vacuum cleaner. There are 56 compartments in the baghouse, each one holding 288 bags. Each bag is about a foot in diameter and 36-feet long.

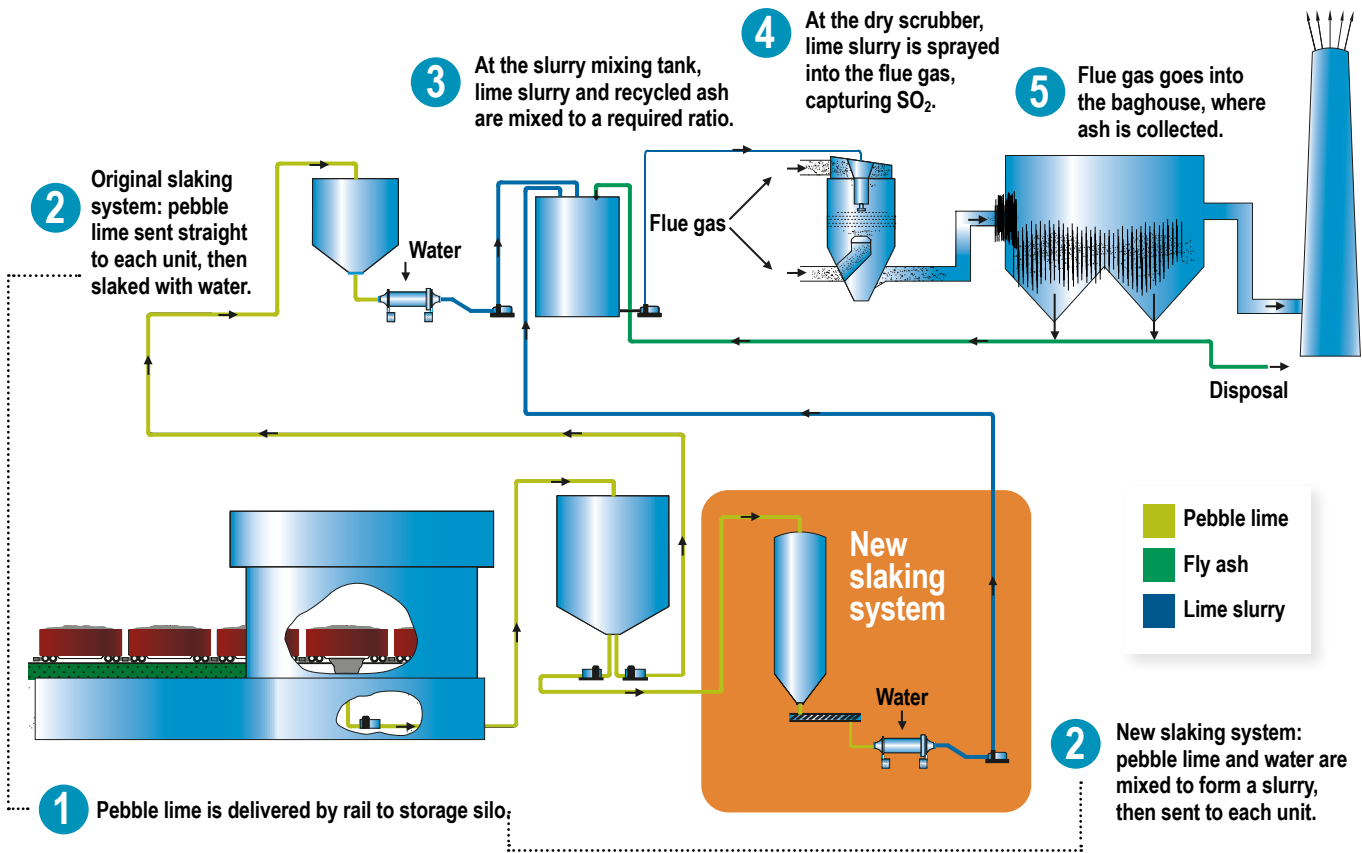
The bags clean the flue gas of ash before it goes up the chimney. As flue gas passes through the baghouse, it inflates the bags. When the bags collapse, the collected ash falls to a hopper at the bottom of the bag. As the coal's ash content rises, the bags get plugged up more frequently. Currently, Antelope Valley collects 450,000 tons of flyash each year.

Up to this point, the bags have been replaced every four to six years. But since they'll be handling more ash, the bags will now be changed out every three years.

Also, a tool that's been tested in one compartment for several years will be placed in all compartments: sonic horns. Duane Miller, scrubber and fuel supervisor at Antelope Valley, says tests show improved air flow through the compartment that has sonic horns. "We're really looking for something that will give us a little breathing room. The baghouse has been operating at the upper limits of what it can do. It's kind of like holding your feet to the fire – you can only stay there so long," Miller says.

Miller says the sonic horn would "bust your eardrums" if you were inside the compartment, and safety procedures must be followed. But from the outside, it sounds

# Scrubbing SO<sub>2</sub> simplified



like a “low whoosh... whoosh... whoosh. . . Just like the waves in the ocean lapping up against the beach. There’s a frequency that happens every so many seconds. With the low frequency, you get this wall of energy that hits the bag. It doesn’t really do any damage to the bag, but it’s enough to fracture the ash on the inside and shake it loose,” Miller says. The horns blast a sound wave that breaks the ash off the sides of the bags, and the ash falls down to a hopper and is then transferred to disposal.

These three projects are planned for completion in 2009-2010. The cost will be \$23 million, to engineer, purchase and install the new technologies. The price tag is less than a quarter of the cost of some of the first projects that came to the drawing board.



Duane Miller inspects the baghouse during a plant outage in 2005.