

## Steam "on-demand"

**B**lack Rock Milling in Le Grand, CA, operates twin 100-hp steam generators of the "mono-tube coil" design featuring counter-flow heat exchangers and options especially selected for short-run, on-and-off feed production. Chip Maguire with Clayton Industries, based in El Monte, CA, says these units are the "super economizer" model—SEG-100—designed for high-efficiency steam generation.

The basic mono-tube coil design incorporates a single heat exchange tube, coiled vertically above the fire box. High-efficiency units—like those installed at Black Rock—include an additional coil section, which Maguire says gets residual heat energy out of the stack gas.

"This is all accomplished within the same generator body, although the 'SE' section can be removed from the main generating coil if necessary. Also, this type of generator uses the 'counterflow' technique in which feed water is pumped downward from the top of the unit. This pre-heats the feed water before it enters the main steam generating section."

Maguire notes that conventional steam boilers have a

horizontal heat exchanger design, which typically features a water level controller to pump in more feed water as water is converted to steam. Heating is by natural convection. By contrast, he says, the counterflow design forces water down against the natural convection current, which increases the heat exchange coefficient.

"This counterflow heating occurs across the entire length of the coil," Maguire says, "which is what gives this type of steam generator the advantages of fast start-up, excellent fuel economy and a very small footprint inside the plant."

For Black Rock Milling, Maguire says, the installation includes a water softener for the well water source. Downstream from the softener, there is an ion exchange unit to remove calcium and magnesium compounds from the feed water. Then the feed water enters the "hot well" where water temperature rises to 180-

200°F, controlled by a thermostatic control valve.

"Retention time in the hot well helps to eliminate corrosive oxygen and carbon dioxide from the feed water," Maguire says. "Also, sodium sulfide is injected into

the feed water at this point to further diminish residual oxygen before the water reaches the steam generation zone. Proper treatment with sodium sulfide requires 7-8 minutes for a complete reaction.

"In feed pelleting and flaking applications," Maguire adds, "ideally almost all of the steam goes into the feed product, so you don't get much condensate returning to the hot well. But, if there's a heating application—like a fat tank or something that has a coil type heating element where the steam will condense—then the hot well serves to recycle condensate and heat."

Maguire notes that the Black Rock installation features a fairly short run from the steam generator room to the point of use, which also reduces condensate and heat loss. Moreover, although the pelleting and flaking operations are exposed to ambient temperatures, all the steam lines are well-insulated, so the system does not have much condensation along the steam header, even in colder weather. □

**"High-efficiency steam generators—like those installed at Black Rock—include an additional coil section to retrieve residual heat from the stack gas."**

*—Chip Maguire, Clayton Industries*



Black Rock Milling's Scott Kamper, left, and Chip Maguire of steam generator supplier Clayton Industries at the control panel of one of the Le Grand, CA., feed plant's twin 100-hp, high-efficiency, mono-tube coil steam generators, used to supply steam for pelleting and flaking operations.

