A "wheel" good grinding tool at Palo Verde

A supply of 10 000 grinding wheels used to be kept in stock at Palo Verde—now only 1185 of a new type of wheel are needed for the same maintenance tasks.

A NEW TYPE OF abrasive grinding wheel used by the maintenance department at the Palo Verde nuclear power plant is outlasting previously used wheels by a ratio of about 10 to 1. Michael D'Amato, technical advisor in the plant's maintenance department, said the new wheel saves time and dose during jobs. Tests done at the plant also show the wheel is more cost-effective than the older type product.

Grinding wheels fit on the ends of portable hand-held power tools that are much like electric drills. The tools, called grinders, are used by workers to cut away metal during jobs such as erosion/corrosion piping replacement. Depending on the type of grinder used, grinding speeds can vary from 1500 to 20 000 rpm.

Palo Verde, in Wintersburg, Ariz., is operated by Arizona Public Service Company. The site has three Combustion Engineering pressurized water reactors; Units 1 and 2 are rated at 1243 MWe (net) each and Unit 3 at 1247 MWe (net).

"With this new product, we achieved benefits," said D'Amato. "In the past if we wanted to cut a piece of pipe, for example, it might take a total of four wheels to do the job. That means using one wheel at a time until it is worn away, and then replacing it with a new one. That changeout takes time, about 15 minutes for each one, for a total of 45 minutes in changeouts alone. In contrast, now we can go in with one wheel, do the job, get in and get out, and it saves us time. Now when work is performed in the radiation controlled area [RCA], we save dose. When work is outside of the RCA we're not getting dose, but we're just saving time."

Grinding wheels in general are made from a number of materials, including compositions of abrasive grains and bonding substances that are combined to create wheels with specific characteristics. The bonding agent holds the grains together with selective degrees of strength, allowing the abrasive to do the work. As abrasive grains fracture and wear away, the bond must also wear to keep the tool sharp. This worn bonding and abrasive material

Maintenance worker Jeff Youngblood tests a grinding wheel on a piping segment at the Palo Verde nuclear power plant. (Source: Michael D'Amato/Palo Verde)

becomes dust and debris.

Grinding wheels come in different sizes. Palo Verde has about 20 different types, the standard sizes being the 6-in. and 4-in. wheels. They also come in different thicknesses, such as 1/4 in., 1/8 in., and 1/16 in., depending on the metal that needs to be cut.

Many types of abrasive wheels, such as the older ones used at Palo Verde, are composed of aluminum oxide or alumina zirconia oxide grains or a combination thereof. The new ones used at the plant—in this case Ripcore™ grinding wheels manufactured by Diversified Diamond Products, Inc., of Phoenix, Ariz.—are made from a chemical process. During the process, a substance made from alumina is formed into a gel, dried, and then crushed into particles. These particles then undergo sintering to form abrasive grains, which are often blended with other abrasives to make wheels with characteristics geared toward specific applications.

D'Amato said that testing done at Palo Verde compared the old wheel with the new one. The tests showed that the old type, which started at a diameter of 4.014 in., failed at a size of 2.815 in. after two cuts of material. The amount of wear per cut was calculated by measuring the beginning diameter, subtracting the ending diameter, and dividing the result by the number of cuts made. In this case, the existing wheel showed 0.600 in. of wear per cut.

Meanwhile, the new wheel had a beginning diameter of 4.132 in. and a finished diameter of 3.976 in. after two cuts. In this case, the new wheel resulted in 0.078 in. of wear per cut.

The bottom line, according to the tests, was that if 10 000 of the old-type wheels were needed for jobs at Palo Verde, only 1185 of the new wheels would be needed for the same tasks. The new wheels (about $6.50 each) are more expensive than the old ones (about $3.50 each), but they are more economical because they wear less, according to D'Amato. If 10 000 wheels are consumed at a cost of $3.50 per wheel, then the cost of wheel consumption is $35 000. When wheel consumption is reduced to 1185 wheels at $6.50 per wheel, the cost of wheel consumption is only $7702.50, a savings of $27 297.50, even though the premium wheels cost more per unit.

D'Amato remarked that a sometimes overlooked savings can be realized in the time spent changing wheels. If 10 000 old-type wheels were used, those wheels must be changed that many times. At 15 minutes per wheel change, workers could spend 2500 hours just changing wheels. When wheel consumption is reduced to 1185 wheels, the time spent changing wheels is reduced to 296.25 hours.

Other benefits, according to D'Amato, include the minimization of grinding debris, which falls in line with the plant's ALARA (as low as reasonably achievable) goals. "When we cut into a radioactive pipe, naturally we have radioactive waste," he said. "Now, however, we don't have to dispose of those three extra wheels. We also don't have the additional grinding dust, which is contaminated and messy."

In that regard, he added, if a wheel wears down 71 percent less than the existing wheel, it is a safe assumption to conclude that 71 percent fewer abrasive particles will be airborne.

In addition, should the operators use what D'Amato called the "load up the wheels prior and bring in extra grinders" method, their supply of grinders needed will be reduced by 88 percent, minimizing the number of tools that need to be brought into the RCA and possibly getting contaminated.

"Our people found out that anytime you don't have to stop work to change a wheel out, they really liked it," D'Amato said.—*Rick Michal* NN