

## The New White Powder

A new metakaolin source gives producers a cost-effective way to make high-performance concrete with a smaller carbon footprint.

By Rick Yelton

**W**hen Kevin Graham meets with clients, he offers a vial containing a white powder. It's an act that may seem a little out of character for a retired Royal Canadian Mounted Police officer who once headed up his nation's DARE effort to keep kids off drugs.

But it's not. Graham has embarked on another career, one in which the white powder he now offers will become an important tool in saving our environment and help create a more durable concrete.

**Whitemud Resources' processing operation and storage silo near Wood Mountain, Saskatchewan, will provide concrete producers a long-term, economical source of metakaolin.**

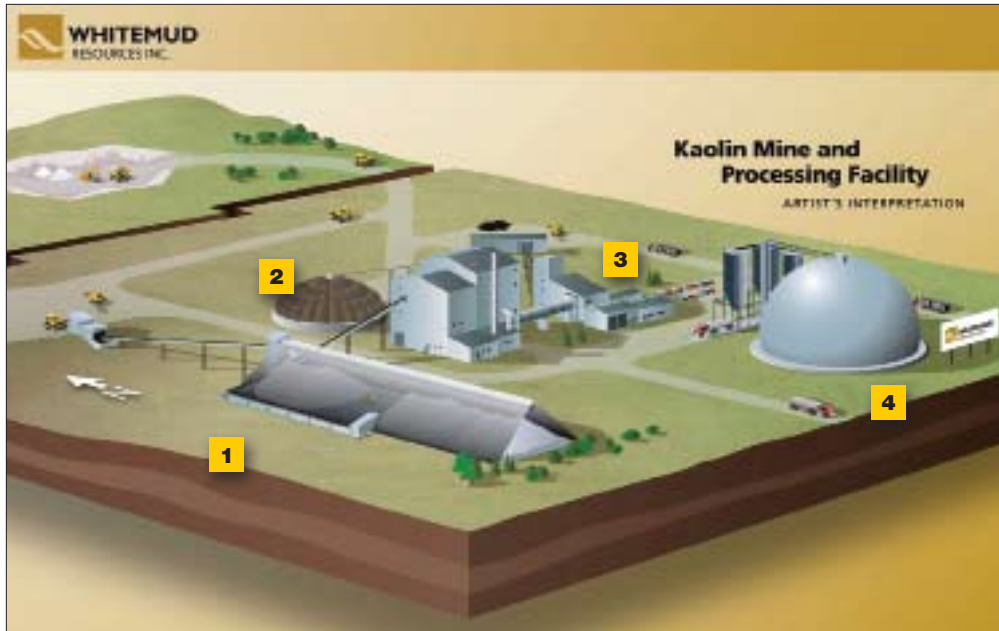
Graham and a group of very dedicated industry professionals including Burl Aycock, Kelly Babichuk, and Murray Yewchuk have been developing a new source of cement-grade metakaolin. Their company, Whitemud Resources Inc., has built a world-class mining and processing operation near Wood Mountain, Saskatchewan. With the plant going on stream in fall 2008, the mineral supplier has recently completed a series of quality tests with major North American producers. The results have been exciting.

**A plentiful supply of cement-grade metakaolin will change the way concrete producers approach sustainable, performance-based mix designs.**

While many portland cement operations are slowing down, the Whitemud team is charging full speed ahead. "We feel our plentiful supply of cement-grade metakaolin will change the way concrete producers approach sustainable, performance-based mix designs," says Aycock, Whitemud chairman and CEO.



RICK YELTON



WHITEMUD RESOURCES INC.

Whitemud's manufacturing process is similar to cement. Kaolin, a hardened clay, is extracted from an open pit mine. The ore is crushed, pulverized, and ground to a particle sized with a consistency of cement. The material is heated in a kiln. The powder is then cooled and stored in silos for shipment.

- 1** ore extraction and preparation
- 2** dry kaolin production
- 3** metakaolin production
- 4** storage and shipping

### Looking at the source in a new way

Aycock's team can't claim it discovered the more than 96-million-ton reserve of kaolin clay in the southwestern hills of Saskatchewan. The deposit has been identified by industrial geologists since the middle of the last century. But their exploration's focus was on a source of paper-grade quality calcined kaolin. The product must pass a very demanding whiteness test.

While Whitemud's metakaolin may not meet the paper industry's brightness criteria, it

can be used to manufacture high-performance concrete. "When we studied the ore deposit from the perspective of creating a cement-grade product, the numbers just fell into place," says Aycock.

The concrete industry has long recognized the benefits of metakaolin. In ACI 232.1, Use of Raw or Processed Natural Pozzolans in Concrete Mixtures, the committee reports that mix designs using an 8% to 12% metakaolin replacement at 0.4 to 0.3 water-cement ratio (w/cm) greatly improved the compressive strength at all ages. The document cites that researchers have also demonstrated that high-reactivity metakaolin enhanced resistance to chloride ingress in hardened concrete.

Yewchuk, Whitemud's marketing vice president, says all testing conducted with more than 20 interested customers and independent testing labs on both the chemical aspects of the finished product and its use in concrete has met or exceeded the qualities outlined by ACI. In addition to the lab work, the Wood Mountain plant's quality control parameters are as sophisticated as any cement operation, ensuring the product is consistently produced.

Yewchuk says that Whitemud is initially focused on two primary markets. The company is targeting the active oil producing area of western Canada where cement is used to seal boreholes. And it is very focused on the U.S. Midwest. "We have installed a rail siding and bulk tank loading facility so that reaching those markets will be economical and efficient," says Yewchuk.

**Greening the mix**  
According to Babichuk, Whitemud's president, the concrete-grade metakaolin will provide producers another tool they can tout concrete as a sustainable building material. In most applications, a producer can replace up to 20%

**Kaolin clay starts with a crystalline structure.**





100% Chance of Partly Cloudy

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of a portland cement with metakaolin. This replacement level provides 13% less of a carbon footprint in concrete.

The carbon reduction is derived two ways. First, the calcining process uses less energy because the kiln is operated at lower temperatures than those producing portland cement (800° C for metakaolin; 2000° C for portland cement.)

And perhaps more importantly, the chemical reaction that occurs as the clay becomes a cement does not create any CO<sub>2</sub> during heating. "We produce 55% less CO<sub>2</sub> than portland cement," says Babichuk.

But perhaps just as important, concrete made with metakaolin enhances the final structure's durability. "With the design community's forecast of service life exceeding 50 years, we feel engineers will incorporate metakaolin's qualities to concrete construction to provide longer service life in their life cycle equations," says Babichuk.

There also is a third benefit. "We are processing our product exclusively for the concrete industry," Babichuk says. Unlike other supplemental sources that are subject to question availability, Whitemud's president assures producers that a cost-effective source is available for the next generation. **TCP**

## The Change

The chemical formula of transferring kaolin to metakaolin through the dehydroxilation process is:



The heating or dehydroxilation drives the chemically bound water, transforming the powder into a reactive alumino silicat—amorphous pozzolan. In simple terms, the kaolin clay starts with crystalline structure, and when it is transformed into metakaolin, it becomes amorphous.

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