

# SA company develops a non-toxic taphole clay

Refraline, a South African company, has developed a groundbreaking, non-toxic low-temperature binding system that replaces the use of tar and resin, which were used for decades in the smelting industry

**A**fter years of research, a high-tech binder system has been developed that fulfils all operational requirements. The newly developed non-toxic taphole clay (THC) not only delivers on all aspects of health and safety—by eliminating all toxins currently emitted when heating up a traditional taphole clay—but also ensures that the newly developed THC is more cost-effective for the end user.

For a long period, conventional taphole clays consisted of anhydrous tar that acted as a binder. Although effective, tar has two main problems concerning the environment and health.

The first is that it releases volatile organic compounds (VOCs) into the atmosphere. These VOCs play a significant role in the creation of tropospheric (ground level) ozone and fine particulates, which, in turn, contribute to photochemical smog. Ground-level ozone gas has been shown to create a significant amount of problems, including chest pain, coughing, throat irritation and congestion.

It can worsen bronchitis, emphysema and asthma. Ground-level ozone can also reduce lung functioning and inflame the linings of the lungs. Repeated exposure may permanently scar lung tissue. The same can be said for photochemical smog, which not only reduces visibility on days when atmospheric conditions are suitable, but can also irritate eyes and affect the respiratory system.

The other main problem with using tar in THC is that it contains benzo[a]pyrene, which is a polycyclic aromatic hydrocarbon. This binds to DNA, resulting in mutations and eventually cancer. It is therefore listed as a Group 1 carcinogen by the International Agency for Research on Cancer (IARC). Research has also shown that exposure to benzo[a]pyrene affects memory and learning in rats, and also has an effect on the number of white blood cells, inhibiting some of them from differentiating into macrophages, the body's first line of defence in fighting infections.

Recently, due to these problems, some THC used resin instead of tar to act as a binder, claiming it was a safer more environmentally friendly option. Most of the resin used, however,

contains formaldehyde as an ingredient. When formaldehyde is present at levels exceeding 0.1 ppm, some individuals may experience effects such as watery eyes, burning sensations in the eyes, nose and throat, coughing, wheezing, nausea and skin irritations. However, while some people are quite sensitive to formaldehyde, others show no reaction when exposed to the substance.

Not much is known about the effects of long-term exposure to formaldehyde, but a study in 1980 showed that exposure to the substance could cause nasal cancer in rats. In 2011, the National Toxicology Program in the United States named formaldehyde as a known human carcinogen.

Refraline's commitment to the environment and health and safety of the people who work day in and out around the furnaces of its customers caused it to intensify its research, eventually developing a non-toxic low-temperature binding system, which does not use tar or resin.

THC is required to close the taphole in a safe way after the taping of the furnace is complete, and then retain the metal that is building up



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until the furnace is ready to tap for metal again. This requires that the taphole clay be easily pressed into the taphole opening by using a mud gun. The heat in the furnace lining has to set off the bonding system to ensure sufficient strength in the THC to hold the metal trapped behind, like water behind a dam wall.

The vast temperature profile in the refractory lining requires a dual binding system to fulfil this task, ensuring the hardening of the THC at lower temperatures as well as at higher temperatures. The low-temperature binding system has to set the THC at around 300°C and has to be in place until the sintering of the material takes place at temperatures above 900°C.

Any variation for different metals can be accommodated using the same new binding system and only modifying the refractory aggregate to suit any furnace environment.

To the astonishment of Refraline's clients, industrial trials have now proven that its new THC eliminated all toxins emitted by a

traditional THC and fulfils all requirements to close a taphole safely under normal furnace operating conditions, at no extra cost.

With this competitive advantage, Refraline has since invested in a new production line at its factory in Meadowdale, South Africa, and is able to supply the smelting industry with this much sought-after THC.

Refraline has set a new industry standard with this engineered solution of a well-known industry problem. "We at Refraline believe that this development is fundamental to our business and we are proud that we have been able to reduce the health and safety risk for people working around furnaces on a daily basis," said a company spokesperson.

Smruti Rekha Dash, a Master of Technology student in ceramic engineering at the Rourkela National Institute of Technology, India, defines a taphole as an outlet for hot metal produced in a blast furnace. Taphole clays are used for plugging the taphole of a blast furnace. The

major objective of this material is not only to plug the taphole but also to be drilled for the subsequent cast.

The mud gun pushes the taphole clay into the taphole of the blast furnace where it hardens and checks the hot metal and slag from coming out of the blast furnace. The clays participate in the process as key elements to ensure reliability and safety in order to not disturb the blast furnace productivity. The particular arrangement of the taphole area and its management requires that the clays not only drive and resist the molten metal attack, but that they also have a positive influence on the hearth drainage and on the peripheral iron flow by the hole length.

The environmental aspects are assumed both as a politic in the improvement of human working conditions at the cast house level and as general environmental protection extending the blast furnace domain to the surrounding area. ▲

*Babington Maravanyika*