After the **goldrush**

Small-scale gold miners in the developing world risk their health every day. **Antony Benham** discusses a major project in Ghana that will improve the lives of these workers.

Worldwide the small-scale mining industry employs around 13 million people, mostly in the developing world. A further 80-100 million people depend on small-scale mines for all or part of their livelihood. Many are children. Gold is the most attractive commodity for these workers, who tunnel and dig using primitive tools, usually without permits. They pay a high price for this precious metal. They often damage the environment and their own health, by using mercury to extract gold from the sludge at the bottom of a goldpan.

We went to Ghana on the west coast of Africa to develop new methods of extracting gold without resorting to mercury and found an ideal alternative in cheap furnaces.

Small-scale and artisanal gold mining in Ghana employs thousands of workers in both formally registered concessions and informal, usually illegal operations known as 'galamsey'. Miners extract gold from ore cheaply and simply, but they operate in difficult and dangerous conditions with minimal safety equipment. Daily hazards include noise, dust, occasional collapsing tunnels and toxic fumes from blasting and mercury.

Mercury accumulates in the body causing serious health problems.

Artisanal miners use mercury because it is easy to obtain and has the unusual property of attracting gold to form an alloy. Miners stir this toxic metal, usually by hand, into their pan of finely crushed minerals. They recover the gold from this mixture by heating the alloy over an open fire. This process releases mercury vapour to the atmosphere. When inhaled, mercury accumulates in the body causing serious health problems such as brain damage, central nervous system failure and reproductive defects as well as damage to some major organs. In the environment, microbes quickly convert mercury into methyl mercury. Fish and other animals absorb it and so it enters the food chain.

Completely eliminating mercury from artisanal mining is difficult. The metal absorbs gold excellently, it is relatively cheap, easily available, and people may not notice its toxic effects for many years. Any alternative process needs to be at least as effective as mercury, cheap, quick and easy to set up.

Previous attempts to eliminate mercury focused on glass retorts, similar to those used in chemistry labs for distillation, to recover mercury vapour released during heating. Miners can buy these at a subsidised rate, but rarely do because the process takes much longer than directly heating the mixture over a fire and the equipment must cool before they can extract the gold.

We worked with the Department of Mines at the University of Tarkwa in Ghana to develop an alternative. Our solution involved a furnace to directly smelt the gold-bearing concentrate. Miners can cheaply construct the furnace using readily available sheet metal or even from discarded wheels. They place the gold-bearing sludge in clay crucibles, together with a few cleaning agents to remove impurities, and heat for about 40 minutes. High temperatures are needed because gold melts at 1064°C. An electric fan blows air through the charcoal fires to drive temperatures upwards. When the mixture has melted, the miner removes the crucibles and pours out the molten liquid into another metal crucible. The gold settles to the bottom of the slag and once cooled and tipped out, the miner can grab a small hammer to prise the metal ball from the tip of the slag.

We have demonstrated this method to miners in the Tarkwa area and have proved that it is possible to recover one hundred percent of the gold. In addition, we have shown that oil palm kernels, which are widely available in Ghana, are a possible alternative fuel to charcoal. The next task is convincing the miners to adopt this method and ditch the mercury. ❖

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