

Climate Magazine No. 6

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turn waste into gold



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For thousands of years, human beings have been searching for the fountain of youth and a secret recipe for turning iron into gold. And while alchemists and mystics continue their quest, the folks at the KEZO waste incineration plant in Hinwil have already – at least in part – found their holy grail.



KEZO CEO Daniel Böni: he and his team have developed thermo-recycling.

At the KEZO waste incineration plant in Hinwil, miracles are everyday occurrences. Thanks to its thermo-recycling plant, the company is able to separate 99% of valuable materials such as gold, copper and aluminium from waste and reintroduce them into the material cycle. This so-called «urban mining» makes good sense, both ecologically and economically. The process begins with an octopus-like grabber, whose six arms plunge into the mountain of waste found on the other side of the plant's shatter-proof panes of glass. Once it is full, the grabber then disappears to drop the waste into a funnel leading to the incinerator. It does this over and over again, without end: at the KEZO in Hinwil, waste is processed 24 hours a day, 365 years per year. Those

who simply think of waste as stinky, slimy, mouldy remains can learn a thing or two at the KEZO, where CEO Daniel Böni and his team are in the business of making one of mankind's most primitive dreams a reality – they turn the old into new. «It's almost like a fountain of youth,» jokes Böni. «Old people climb in, and fresh, young people climb out.»

60 kilograms of gold per year

KEZO in concrete terms: every year, from 100,000 tonnes of slag, the company generates 60 kilograms of gold, 1,500 kilograms of silver and 800,000 kilograms of copper and copper alloys. The lion's share of non-ferrous metals is made up of aluminium (70%) and iron (approx. 10,000



Separating tables are used to separate non-ferrous metals from

tonnes). Böni is thrilled with the results: «the copper content of our refined slag is equal to or higher than that found in the ore of a copper mine. We can extract just as much gold from one tonne of refined slag as from one tonne of ore from a good gold-mine in South Africa.» Except it is much better for the environment to recycle metal than to extract new copper or dig for gold.

And that is not all: separating and recycling the valuable materials also makes sense from an economic point of view. With the current price of copper at over 5 francs per kilogram, this amounts to more than 4 million francs obtained from the waste-extracted copper. And with gold now at 40,857 francs per kilogramme, KEZO's gold



precious metals on the basis of their density.

production brings in around 2.5 million francs per year, which is nothing to scoff at. Thanks to so-called «urban mining», raw materials have become an environmentally-friendly business for traditionally resource-poor Switzerland. This development is both remarkable and extremely satisfying, considering KEZO gold comes from electronic waste that is thrown away in the rubbish. The recycled metals are sold to smelting and production plants in both Switzerland and abroad.

The magic word is thermo-recycling. Contrary to conventional wet discharge systems, in which the slag is cooled down in water, the system developed by Daniel Böni and his team in Hinwil allows the slag to

stay dry. The major advantage of this system is that the precious metals clump together less with the minerals in the slag, «making it that much easier to extract them,» notes Böni. Furthermore, dry slag purified by heavy metals is much less harmful to landfill bottom liners than crudely-prepared wet slag. Until recently, iron was separated by magnets and the rest of the waste was dumped into a landfill. But that is now a thing of the past.

What was behind the gold rush fever in Hinwil? One catalyst was the Zurich Climate Prize, which was awarded to KEZO in 2010. KEZO also won the 2010 Special Prize for its refined slag sorting pilot plant, which has been in operation since 2008. This

«Yes» to metal recycling

Residents of the city of Zurich are already convinced by the idea of thermo-recycling. In 2015, 91.6% of the city's voters said «yes» to metal recycling, making a powerful case for the process. In addition, the Canton of Zurich has invested 38.9 million francs in Zurich's Hagenholz waste incineration plant to convert from wet to dry slag discharge. In doing so, it has taken on a pioneering role in Switzerland. Of the 30 waste incineration plants in Switzerland, 4 have already made the switch to thermo-recycling.



From the control room, plant staff manage and monitor all sieving, separating, breaking and transport operations – larger pieces such as bocce balls are removed by hand.

accolade would prove to be the beginning of a success story that has attracted widespread attention both at home and abroad. «Waste incineration produces energy and slag that contains several recyclable materials. Our goal was to extract these materials. Dry removal allowed us to loosen even the smallest bits of metal from the slag and reintroduce them into the material cycle,» explains Böni. He continues: «waste is no longer just waste – it has become an important resource.»

The special prize from Zurich was the impetus for engineer Böni and his team to continue with the development of their system and promote their vision of thermo-recycling. The team is supported by the Centre for Sustainable Management of Recyclable Waste and Resources (ZAR), an organisation funded by various different donors. The special award has also brought about increased acceptance of the project throughout the entire KEZO and ZAR networks, as well as an extraordinary amount of goodwill. ZAR considers itself a thinktank whose role is to both develop and advise.

Little by little, KEZO/ZAR have fine-tuned their sorting plants and procedures. A process control system with 22,000 specifications oversees all processes. Illustrated process data help the shift manager to make the right decisions. From inside the plant, you won't see or smell any waste whatsoever. In fact, you might just think you've ventured into the clinic-like cleanliness of Peter Sauber's high-tech Formula 1 race car construction site on the other side of Wildbachstrasse.

Up to 850°C

But unlike in the cool setting of a Formula 1 shop, the temperature at KEZO can really heat up. Waste has an extremely high heat value and burns with ease – the combustion chamber can get as hot as 850°C. Inside the chamber, the organic part of the waste is transformed into heat while the metals and minerals are exposed. A second treatment process separates the recyclable materials in the slag and electrofilter ash and reintroduces them into the material cycle. According to Böni, «this process is an important part of thermo-recycling.»

During the first step of the treatment process, magnets are used to remove the iron from the slag. The slag is then split into five different groups depending on its size.

«Waste is no longer just waste – it has become an important resource.»

Non-incinerated items such as rootstalks, telephone books and pieces which cannot be broken (such as chrome-plated steel pans) are manually removed from the slag pieces that are larger than 80 millimetres in size. Special breaking devices are also used to reduce slag pieces to the desired size. The next workstation: fully clad pipes, fans, sieving machines. Information panels explain that fine and broken waste incineration slag must be moved back and forth quickly and sieved. Super-sensitive sensors recognize a variety of different materials from their magnetic states. A high-performance computer immediately interprets



In the waste bunker: the crane operator, working behind shatter-proof glass, ensures that the incinerators are filled properly.

the signals and determines which stainless steel parts are to be separated from the slag. Those who can still remember the good old Ochsner dustbin and its knack for stinking up the kitchen are bound to think they are in some kind of science-fiction film.

The stainless steel pieces are blown out of the slag by compressed air released by jets controlled by the computer. Non-ferrous metals such as aluminium, copper, tin and precious metals are separated from the slag by an «eddy current separator». This is how it works: a rotating magnetic field in the pulley creates an eddy current in every electrically conductive metal particle, and the current in turn produces a magnetic field. As a result, the magnetic pieces are ejected from the drum and can be separated as non-ferrous metal.

Separating tables at the heart of the operation

«The plant is centred around its orange separating tables,» boasts Böni. These tables are used to separate non-ferrous met-

als on the basis of their density. The metals fall onto a fine, swinging sieve, where a fan blows them with ambient air. «This process allows for the lightweight aluminium to be lifted from the metal and strained through the sieve below,» explains the CEO. The heavy metals remain on the sieve and are transported upwards by the movements of the sieve. Böni opens a cavity and shines a torch inside; it resembles some sort of strange moonscape.

For Böni, there is no doubt: «the future lies in thermo-recycling.» And he is not the only one to think so: barely a week goes by without school classes, politicians or environmental experts from both Switzerland and abroad streaming through the doors of the KEZO in Hinwil. «There is a massive amount of interest,» beams Böni. «Our dry slag system has proven to be much more efficient – and ultimately more profitable – than its wet slag counterpart.»

Böni laughs. Dry slag is his favourite topic of conversation. Just as others might rave over Cristiano Ronaldo or Madonna, when it

comes to waste and wet and dry slag, Böni loves to talk shop. And he hopes to revolutionise his recycling system even further: «dry slag incineration plants will change the way people think of waste. In the future, thermo-recycling will make recycling more efficient and much easier for everyone.»

Daniel Böni understands that he is unable to control the amount of waste people produce. But he is confident: «the raw materials from waste are the resources of the future.» The KEZO is ready for urban mining on a large scale: its Hinwil plant has been operational since November 2016 and is capable of processing 100,000 tonnes of dry slag per year from waste incineration plants in Horgen, Zurich, Monthey and Solothurn. Böni proudly declares: «the plant is designed such that it can be expanded to double its current load.»

Further information
www.kezo.ch



More Information:

climateprize.zurich.ch
climateprize@zurich.ch



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Druck | ID 53047-1610-1002

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