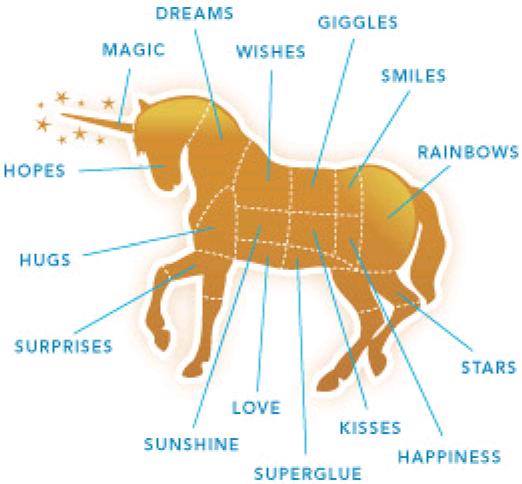

The Zero Waste Institute Newsletter

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Above: from the recent spoof selling canned unicorn meat (http://www.thinkgeek.com/stuff/41/unicorn-meat.shtml)

Reuse Recommendations for Tantalum Capacitors

There is a worldwide explosion going on in the demand for electronic goods. The most visible manifestation is the proliferation of cell phones, though other computing devices, game boxes and controls are also booming. These devices all use one very problematical component, namely electrolytic capacitors. You might have guessed microchips at first, which are also the subject of intense manufacturing rivalries, but those are primarily based on silicon rather than on exotic metals. With electrolytic capacitors (EC), the story is very different.

EC's require an intense focus on details of fabrication. You must end up with two conductors inside a package, separated by a non-conductor called a dielectric, with each conductor connected to one external wire,. The closer together the two conductors can be brought, the better the device works, but if they get too close, they can short together and the device will burn up. So the dielectric needs to keep them apart enough so that current cannot flow directly from one conductor to another, while still being as thin as possible. There are many ways to do this but the best one that has been found is made with an exotic metal, tantalum and another unusual metal, manganese and the contacts are made with silver. (reference 1).

Of these three metals, the one causing the most trouble out in the world is tantalum. There is not a lot of tantalum being mined and some of the traditional sources have been exhausted. Today, a very large source is found in the Democratic Republic of Congo (Congo). But this part of Africa is subject to immense social upheavals involving genocide, shifting dictators and governments, uncontrollable armies, rape, child soldiers, enslavement, starvation, killing and forced labor. The armies have learned that foreigners will pay fortunes for their tantalum-containing mineral called *coltan*. Torrents of stories in newspapers and popular magazines have described the mayhem endured by populations as armies occupy their territories and press them into service as destitute miners of coltan (2). Most of the writers wring their hands over the social upheaval and go no further. But here I want to ask what happens to the precious tantalum after a first use and how can it be recaptured and reused, to ease the demand for coltan.

Most of the tantalum in an EC is found in a central wire made of that metal, surrounded by a sintered powder of the same metal which is pressed around the wire and clamped in place by high pressure forming. Then the manganese compounds are put around this center and silver compounds used to create the contacts to the outside world. There is a lot of processing with oxygen, heat and hydrofluoric acid as the package is assembled (see reference 1). But the point to take note of for our purposes is that the tantalum itself is present as a central “lollypop” of a tantalum wire surrounded by tantalum powder. In most cases, electronic devices fail for reasons having nothing to do with the EC so the lollypop is intact after the computer, cellphone etc. stops working. What can be recovered?

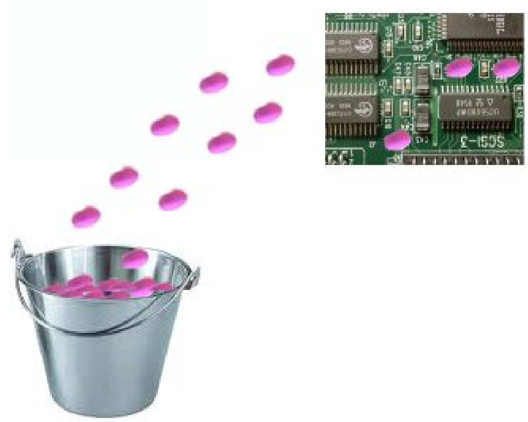
One fact to be noted is that tantalum has an extraordinarily high melting point of 3000 degrees Centigrade. This is made use of in some of its other applications but not here. But everything else will melt away before tantalum does. Even gold melts much lower, at about 1000 deg. C. and iron about 1500 deg. C.

The description of the last step in the EC assembly process is short and sweet:

“The slug and lead frame assembly is moulded into an epoxy resin case which is laser marked with the manufacturer’s identification, value, polarity and date code.”

Note how devoid of critical detail this last step is. It is not a technical step so there is a lot of flexibility in how to do it. Zero Waste approaches always look for unused system or manufacturing parameters that can be tweaked for special uses. Here we have found exactly that.

Let us imagine that we take over this last epoxy potting step and insist that all cases for all EC’s, no matter where they are made, must be irridescent purple. Let’s make sure that there is one color which identifies all of the EC’s used in any electronic circuit board anywhere. That opens the door for automatic processing to remove EC components using an automated plucking machine that looks over a circuit board, finds all the purple components, pulls on them with pincers hard enough to pull them out of the board and places them in a bin. The tantalum is still largely in the form of metal so that a high heat would burn off the case, melt the silver and manganese and leave the tantalum. Other processing could then use smelting techniques to capture the remaining tantalum and other metals. Perhaps the organic epoxy case could even be formulated to chemically reduce the metal oxides in the EC back to metals as it burns, making the metals easier to reclaim.



As always, my goal in making these suggestions is not to arrive at an ultimate solution but merely to identify some promising pathways for thinking about reuse, making use of available parameters that may have been overlooked. Unfortunately our wasteful society has been known to simply snort contemptuously at the thought of lifting a finger for reuse, preferring to throw any and every excess into a dump.

Obviously my hope in proffering this reuse pathway is to reduce the demand for newly mined coltan, thus eliminating the funding for the pillaging armies of the Congo. Miners tend to oppose metals recapture on the basis that early discard leads to high demand which is good for business, no matter what the social cost, but we need to look beyond corporate greed.

Let us not miss a few other notes on these suggestions.

- First, this is not actually a Zero Waste recommendation since we are not reusing a perfectly fine EC for its original use. This is closer to destructive recycling, though that works better for metals than for most other materials.
- We still need to upgrade the thinking by finding ways to pluck out unharmed, the still functional EC and reuse it, but that is part of a larger project for reusing all of the components on circuit boards. That puzzle is harder to solve. Should circuit board connections be redesigned from scratch?
- Removing even a single component from circuit boards for recycling should have a significant effect on the egregiously misnamed “e-waste recycling” which is not actually a waste and not actually recycling. Anything which provides an alternative, no matter how small, to sending circuit boards to third world villages for burning, is desirable.

Obviously there is much more thought needed on the redesign of circuit boards and their components. Hopefully this will open a door that leads to deeper solutions.

Paul Palmer
Zero Waste Institute

References:

1. : http://www.esa.int/esapub/eurocomp/eurocomp8.pdf
2. http://www.seeingisbelieving.ca/cell/kinshasa/

Do you know of anyone who should be receiving this newsletter?. Please send me an email with their email address.

Paul Palmer
zwi@sonic.net
http://www.zerowasteinstitute.org