



European BEST Engineering Competition

Case Study

How to reduce e-waste

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1. Introduction

With the rapid advancement of technology, the overconsumption and the short lifespan of consumer electronics there was an increase in the amount of electronic products being discarded irresponsibly, which has devastating effects on the environment and human life due to the amount of toxic and non-degradable material in these devices.

As such, correctly handling e-waste has become of utmost importance and to that end this work intends to outline the entire process of recycling a microwave oven, from collection to final material.

2. Reduce E-Waste by consumers

One of the many reasons why e-waste is so prominent is that many people don't know that appliances such as microwaves can be recycled, or don't know how to dispose of them safely, in order to combat this a small campaign could be started to help raise awareness and teach consumers about the topic.

Various electric appliance drop points could also be created where consumers would dispose of unwanted machines that would later be picked up by specialized companies.

3. Components

Copper and aluminum are part of the constitution of most components covered below. They're two of the most common materials used in the construction of electrical wiring.

Aluminum alone is used in a huge variety of products including cans, foils, kitchen utensils, window frames, beer kegs and airplane parts and copper is used in electrical equipment such as wiring and motors.

3.1. Magnetron

Magnetron is a vacuum tube in which the flow of electrons is controlled by an applied magnetic field to generate power at microwave frequencies. Magnetrons are capable of generating extremely high frequencies and also short bursts of very high power. They are an important source of power in radar systems and in microwave ovens.

This component can contain beryllium oxide in its ceramic insulators, which can be fatal if inhaled, so extra care is required when handling it. If it's in good

condition it can be reused in other microwaves but otherwise the valuable metals should be carefully extracted while the rest is safely disposed of.

3.2. High Voltage Transformer

These transformers are relatively expensive so reusing them is the best option when possible.

If reuse isn't feasible, the transformers can be scrapped for the copper, aluminum and laminated iron core.

3.3. Circuit Boards

Circuit Boards can be dismantled. First we shred them and crush them into small pieces. These small pieces are then sorted using air separators and electrostatic separators, after this process the metals and non-metals have close to no impurities and can be sold or reused.

3.4. Small electric motors

Electric motors can be dismantled with the use of a special machine that removes the cast iron casing and automatically collects the valuable metals inside, namely copper and aluminum.

3.5. Wires

We can reuse the wires since many of them are common among a diversity of electronic devices.

If the wire can't be reused, the electrical wire can be stripped down manually or with a machine that strips the wires and collects the contents in one motion, increasing the efficiency.

4. SWOT analysis

The solution we came up with is quite simple and most stages can be performed manually to reduce costs if needed, the resulting materials can also be sold generating profit or reused to reduce spending. However there are two potentially deadly risks when recycling microwave ovens: the toxic material inside the magnetron and the potential electric shock from capacitors if they are not discharged.

5. Conclusion

In order to fully recycle a microwave oven our solution separates its various components and handles them differently. A wide range of machines is required to automate this process with maximum efficiency and our estimate for the total setup is of around 35 000€, however this initial cost can be reduced by making use of manual labor.