

The background of the entire page is a high-resolution, close-up photograph of a pile of electronic waste. It shows various types of printed circuit boards (PCBs) in different colors (green, tan, brown) and sizes, densely packed with electronic components like capacitors, resistors, and integrated circuits. Some components are labeled with text like "145V", "560V", and "PRIMA".

# PCB Pyrolysis – Recycling of Printed Circuit Boards

WE KNOW HOW





## RECYCLING TASK

Recovery of precious metals from the recycling of electrical and electronic waste becomes more and more important worldwide, especially as a result of decreasing primary volumes of precious metals and continuously rising costs of initial extraction. Significant concentrations of copper and precious

metals can be found in particular in printed circuit boards (PCBs). These also contain exploitable and marketable ferrous and aluminum in quantities that should not be underestimated. Global recycling of printed circuit boards is estimated at 500 000 tons per year.





## PLANT OPERATOR

GEM Co. Ltd., Shenzhen, the Chinese recycling company which is operating this PCB treatment plant, was founded by Professor Kaihua Xu in 2001. Around 2500 employees are now recycling electrical

and electronic scrap at six facilities covering an area of around 4 million square meters. The company was transformed into a stock corporation back in 2010.

## PROJECT

A pyrolysis plant for printed circuit boards has been installed at Jingmen in the Hubei province of China. Assembly and start-up were successfully concluded in 2015 and, since then, the complete plant has reached its nominal capacity

of approximately 20 000 tons per year. The first section of this PCB treatment was realised in 2012. The first step is shredding of printed circuit boards with subsequent separation of ferrous metals (approx. 20% by weight) and aluminum (ap-

prox. 10% by weight). This is followed by three step sampling and feeding of the shredded printed circuit boards into big bags. This sampling involves analyzing for copper and precious metal contents.

Both the pyrolysis plant and the plant for mechanical pre-treatment have been engineered, designed and constructed by the German manufacturer URT Umwelt- und Re-

cyclingtechnik GmbH. As basis for this, URT used its experience from installing a pilot plant in France in 2011. In addition to this pyrolysis plant, URT has also delivered four

refrigerator recycling plants to Chinese company GEM (Green Environment-friendly Manufacture) for its facilities in Jingmen, Xiangxi and Wuhan.

## PLANT MANUFACTURER





20%

**Ferrous metals**



10%

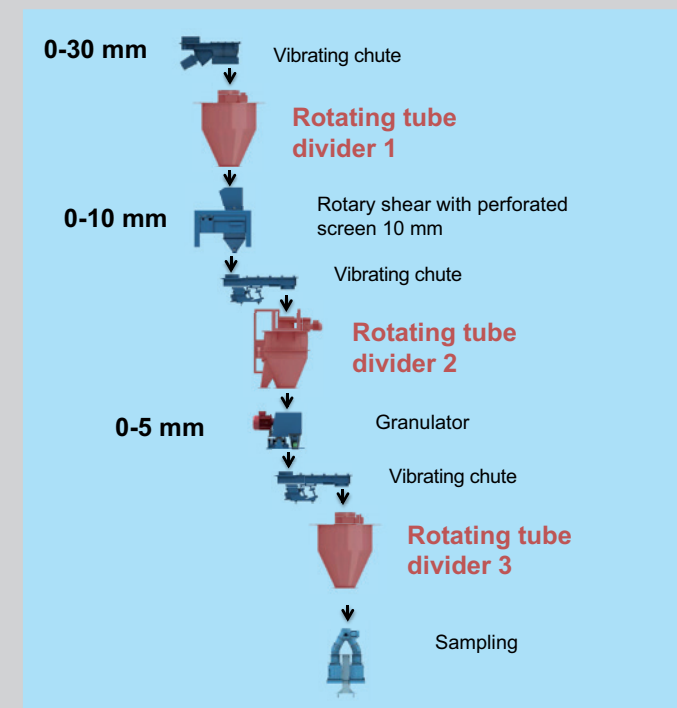
**Aluminum**



70%

**Printed circuit boards**

Mechanical pre-treatment of low-grade PCBs for the separation of ferrous metals and aluminum



Schematic diagram of sampling by means of triplicate sample divider



Metal concentrate after pyrolysis

## RECYCLING OF PRINTED CIRCUIT BOARDS

### Pyrolysis process

During the pyrolysis process, the pre-shredded printed circuit board material – in this case, pre-dominantly low-grade printed circuit boards – are heated to approximately 400 degrees Celsius to create metal concentrates. During pyrolytic decomposition, the organic fractions are converted into gases and transferred to thermal post-combustion. The emissions from the pyrolysis plant are

compliant with European requirements. The metal concentrates, which are free from bromine and do not cause pollution in downstream processes, are bought by copper smelters at a lower price than for other copper concentrates. For most copper smelters, treatment of metal concentrates is easier than for untreated printed circuit boards.

### Analysis

Determining precious metals and copper contents is important with all treatment concepts. By this determination, the suppliers of printed circuit boards can be found as well as the sales value of the metal concentrates. The plant's manufacturer URT specializes in this area by means of a sample divider. Intermediate shredding takes place before each sample divider procedure.

### Economic efficiency

A gross profit of approximately US\$ 500 per ton of PCB material will be achieved when applying the pyrolysis process. This gross profit is not subject to any significant fluctuations because the same metal unit values are used in the formula for procurement as well as for selling. This evaluation will include gold, silver, palladium and copper. Basically, you can achieve an EBITA of approximate-

ly US\$ 10 million/year with this plant.

### Research & development

For the engineering of pyrolytic decomposition, comprehensive knowledge of thermal metallurgy is required. The associated calculations and engineering of this process were undertaken by French company Terra Nova Développement (TND), in which

URT is a shareholder. There are further interesting research & development projects in the fields of precious metals recovery and the recovery of rare metals from electrical and electronic scrap.





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