

3.1.1. High temperature treatment technology including incineration, direct melting and cracking.

#### 3.1.1.1. Incineration

The WEEE was firstly mechanically crushed and then given to the incinerator for incineration. The temperature of the first incinerator was set at about 600-800°C to separate organic gas from solid material. The solid material contained various metals, which would be treated for recovery. The organic gas was sent to the second incinerator further combustion, the temperature was set at about 1000-1200°C. The gas derived from combustion contained bromine gas, dust and so on, which would be discharged into air after quench tower, alkali treatment, dust removing and filtration. The cost of incineration is high, and its product, bromine compounds and bromine gas, still polluted environment.

#### 3.1.1.2. Direct melting

Direct melting technology is widely used in WEEE treatment in USA. The main problems of this technology can be summarized as follow: the non-metallic material can not be reclaimed by incineration; some metals and non-metals can form poisonous gas, which is difficult to do innocuous treatment; large investment and energy are demanded.

#### 3.1.1.3. Cracking

The cracking technology is defined as follow: under high temperature and low pressure, high temperature and high pressure or normal pressure, the organic matter is placed in closed vessel to transform into oil gas. The problem about bromine is still exist by this technology disposing discarded printed circuit, and metals of recovery need to further treatment. More important, the pollution still exists with this technology.

### 3.1.2. Chemical treatment technology

#### 3.1.2.1. Pickling

The strong acid and strong oxidant were used to dispose the discarded print circuit, which containing noble metals. The peel precipitation of noble metals and discarded acid solution (containing copper and other low value metals) were firstly obtained. Then, the peel precipitation of noble metals was treated to restore gold, silver, palladium and so on noble metals. At last, the acid solution, containing high concentration of copper, was used to reclaim bluestone or electrolysis copper. The acid

solution after separation of noble metal usually induced second pollutoin.

#### 3.1.2.2. Corrosion

For example, the copper chloride was used to reclaim the discarded printed circuit board containing copper. The discarded printed circuit board was firstly placed into the copper chloride solution, and then the copper dissolve and noble metal remained unchange under the control of reduction potential. Thus, the recovery of noble metal was done and the mother solution can be reused by chlorine oxidation.

#### 3.1.3. Mechanical and physical treatment technology

The metal was separated from non-metal after using physical method to crush the print circuit boards. However, it is difficult to crush the print circuit boards because of tight integration of metal and non-metal. The high temperature made the non-metal to decompose and form poisonous gas during the process of crush. At the same time, the serious dust pollution was formed. For these reasons, Germanic researchers developed low temperature crushing technology and equipment to perfectly solve the question of waste gas, but the question of dust pollution was not solved. The investment of this technology was very large.

By adding water method, Tsinghua University combined the Chinese practical situation to explore a suit of new technology for recovery of printed circuit boards. This new technology was characteristic of economy and green, and achieved initial success in recovery of metal and non-metal.

#### 3.1.4. Supercritical water technology

The metal and non-metal were separated in low temperature and high pressure. This technology is currently in experimental state, and not matures (Shanableh, 1996). Furthermore, researchers have devoted large efforts in the relevant fundamental research (Zhang and Kuo, 1996).

In recent years, China has done some efforts in WEEE recovery, such as the recovery and treatment of discarded battery, the selected crushing and metal recovery of discarded printed circuit. However, the majorities are still in experimental state. Jiangsu Chunxing metal company is a successful example to do WEEE recovery. This company mainly produces the regenerative lead, and the raw material is not metal ore but lead-acid battery. The production capacity can reach 100000 ton/year. The