

# Research on Electronic Waste Recycling—Liupanshui City as an example

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**Abstract.** According to the present situation and trend of industrialization of electronic waste at home and abroad, combining the reality of Liupanshui region of electronic waste recycling. This paper studies on the technology and process of electronic waste recycling being basic on the precious metals which recover from the electronic circuit board. Using water elutriation to Prepare blister copper process is simple and the key technology is the waste water solid-liquid separation technology which combines with the research on the hydrometallurgy of chemical method and physical method research. In order to realize the real recycling, zero pollution, zero emission and to receive precious metals which matches with the national standards. As well as to lay a solid foundation for creating Liupanshui circular economy demonstration city and national environmental protection model city.

## 1 Foreword

Electronic waste is electronic products that it is lost its useable value or its useable value cannot meet needs. With the more and more use of electronic products in manufacture and daily life , the production of it is keeping increasing and the electronic waste has been increasing at an alarming speed including family, office, commercial manufacture medical treatment , business and so on, and a majority of it have no recycling reasonable and effectively. According to the date of National Bureau of Statistics, the quantity of television in China is nearly 370million high at present, the quantity of refrigerator and washing machine is about 150million and 190million. Most of them was into China family in 1980s. It is according to time life in 10 to 15 years in calculation, there was at least 5million television,4 million refrigerator and 6 million washing machine scraped since 2003 and it was to keep growing at an average annual rate of 20%. It was excepted that the scraping of them would be to 1.6million in the end of the 12th Five-Year Plan[1].

What's more, the quantity of sale of computer and cell phone is increasing at a high speed of them updatation in several years. There are at least 30,000,000 computer and 27,000,000 cell phones. However, the speed of update in them is quicker than household appliances, every year there are about 5million computers and thousands of cell phones get into the elimination period and it will be the peak time for the electronic waste increasing in ten years to twenty years later. The Chemical constituents of electronic waste mainly contain metal, plastics, resin, rubber, semiconductor and composite. The statistical date of the United Nations environment program report showed that there are about 272 kilograms plastics, 130 kilograms copper, 0.45 kilograms gold, 41 kilograms iron, 30 kilograms plumbum,20 kilograms stannum, 10 kilograms antimony and so on in one ton electric Leiterplatte. At present there are more than 40,000,000 ton electronic waste is put into production every year, it cover metal resources and nonmetal resources it to 100 billion yuan[2,3].

Therefore, electronic waste is also known as 'City Mine', there is pretty high economic efficiency on it,

because the degree of recycling on it is very high and the costing of exploiting it is lower the costing of the exploiting primary ore. On the other hand, in the condition that resources is poor in per capita distribution because there is a such huge people living in China, it has very big realistic significance to recycle electronic waste no matter speak from waste treatment and reducing environmental pollution, or speak from recycling valuable metal and slowing down contradiction in supply-demand relationship of resources.

## 2 Industrialization present situation and the trend of electronic wastes at home and abroad

The traditional extensive economic growth mode of high-involvement, high consumption and high emitting with ways has come to an end all over the world, such as being not to change the pattern of economic growth, developing conservation-oriented society, being hard to continue using resources and being hard to bear in environment. To realize dynamic equilibrium of People and Nature, Resources and Environment and Economy and Society, to prompt coordinated development of ecological environment system and Economic System[4], we should strictly follow circulation process that is defined as the principle with 'minimization , recycling and reclamation', forming the circulation process 'resources –production- renewable energy'. After knowing about the significance on circular economy, there are some laws enacted to comprehensively treat the problem of economic waste at home and aboard in recent years[5,6]. At the same time, the kinds of ingredients which the electric products needed showed the trend of growing tensions. With the influence of the described above, the recycling and reusing of electronic waste are becoming a hot directions of research and industry.

On abroad, there are Fuji, Panasonic, Toshiba and NEC have themselves electronic waste recycling reproduction companies in Japan ; there are Kamet Recycling GmbH and Daimler-Benz UlmResearch Centre electronic waste recycling centres in Germany; there is

Noranda Minerals Inc company in Quebec province in Canada. The representative of the USA is Foulmer Group; There is Weicheng Environmental Protection and Technology limited company in Singapore and so on. They have formed mature profit model.

At China, to alleviate the harm of electronic waste on the environment and reinforce the recycling of resources, a series of laws ,regulations and policy have been constantly issued by our country, such as Measures for Administration of the Pollution Control of Electronic Information Products, Waste Household Appliances and Electronic Products Pollution Control Technology Policy, Waste Electrical Electronic Products Processing Fund Collection Management Method Used, Regulations on Recovery Processing of Waste Electrical and Electronic Products and so on. The regulation of waste electric and electronic products recycling has to be stipulated clearly as follows:(I) The State encourages and supports the scientific research and technology development of the waste electronic products processing; (II) According to national provisions that they will get tax preferences if only enterprises deal with electronic waste.:(III) Local people's government should take the infrastructure construction on the recycling of electronic waste into the urban and rural planning. Waste electrical electronic products processing fund collection management method used stipulate:(I) The State established Waste Electrical Electronic Products Processing Funds to take the allowance for waste electric products recycle posts; (II) The producer of television, refrigerator, washing machine, room air conditioners and microcomputer will be collection of old funds.(7yuan to 13yuan in standard, Qingdao and Haier are to about 300 million at first every year. ) (III) The company of the recycling of the high-class electronic waste will get funds that each television is 85yuan, each refrigerator is 80yuan, each washing machine is 35yuan, each room air conditioner is 35yuan and each microcomputer is 85yuan. Nowadays, NDRC (National Development and Reform Commission) also appoint Zhejiang province and Qingdao as the National electronic waste treatment pilot provinces and other experiments in selected places and demonstration projects are also on working. Twelfth Five-Year Plan for economic and social development provided that holding on building a conservation-minded and environmentally-friendly society to quickening focus of the change of the economic development mode, saving sources, developing circular economy, promoting the development of economic society to be good with population Source environment and going on the road of sustainable development. Liupanshui city also is called to create a national civilized city, create national health city, create National environment protection city and create a national circular economy demonstration city, this promote us to need to attach great importance to the beneficial recycling and treatment of electronic waste. Facing so much abundant “gold ore” and the policies of national uses, the standard electronic waste at home is few at present.

According to the department of statistics in Liupanshui, there are at least 4.05 million electrical products including television, refrigerator, washing

machine, room air conditioners and microcomputer in 2010. If it figure up in terms of scrappage in 10%, there are about 405 thousands electric appliance needed to be disposed every year. However, there isn't the Professional disposal center of electronic waste to dispose them in Liupanshui city, caused a huge potential hazards for our ecology environment. There have been paid a heavy price in other areas. Thanks to the potential high interest in electronic waste, some underground department stores or “workshops” where have no green credential in Guangdong and Shenzhen which develop fast, formed a whole production chain underground and get billions of yuan. At the same time, when having been incinerated and heat, dismantled and smelted expensive metal ,electronic waste components produced a lot of volatile organic compound and PM(particulate matter), bring heavy pollution to local air, water and soil ,because there is no efficient protection and environmental protection measures. Therefore, Liupanshui should learn from past mistakes so as to avoid falling into the same old trap again. Nowadays, there are only two companies that the Guizhou Province Environmental Protection Bureau empower the qualification to be engaged in the electronic waste dismantling all over Guizhou province, Guiyang material recycling company (Enterprise Qualification Certificate Number E5201021) and Zunyi green ring recycling and disposal of waste electric and electronic products company (Enterprise Qualification Certificate Number E5203021). And they are just working on disassembling processing of electronic waste, still far from according ecological regulate to make full use of the natural resources and environmental capacity , taking green manufacturing and the recycling of electronic waste together, making them be the pattern of “recycling economy”. So the science of electronic waste has enormous developing space in Liupanshui city in Guizhou province. The recycling of electronic waste and reusing are good for keeping sustainable utilization of sources, quicken the processing industrialization of renewable resources in Liupanshui city. Because of the environmental protection and public welfare ,it also can remit the problems in shortage of resources, and lay the foundation for the establishing of circular economy demonstration city and national environmental protection model city in Liupanshui.

### 3 The recycling of the electronic waste combining with physics and chemistry

The recycling of electronic waste is a burgeoning system engineering what is complex process referring to the tearing down, breakdown, classifying and innocent treatment of electronic products with some risk and including bad treatment process design, not complying with technical norms and being easy for secondary pollution to the environment. Such as, what noise source of electronic waste disposal is from cutting equipment, scrap metal crushing and plastic and the operation of glass grinder will cause secondary pollution

to the environment; poisonous and harmful material components in electronic waste and the process of the broken parts and sorting will produce gas and dust to be bad for secondary pollution in environment. We need to make technological innovation below:

(1) Be careful for preparation and design in process: the project center divides into circuit board processing laboratory, scrap metal processing laboratory and waste plastics processing laboratory. Adopted by the laboratory techniques will advancement and applicability and optimize to the process, making it to be osculating, applicative and fluent organic Integrity.

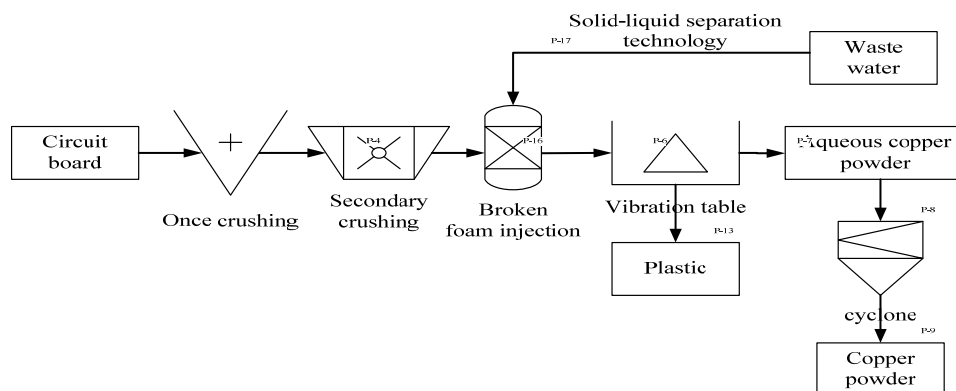
(2) As a support by advanced technology: the project center will dismantle and disposal by adopting the advanced technology for household electronic appliances

at home and abroad and process into a variety of renewable utilization of materials. Reduce running noise by setting up basis of crushing equipment suspension and choosing low noise model. For emission on standard, electronic waste components and the broken parts are both conduct in a closed facilities with cleansing gas and dust.

Ingredients seen Tab 1, circuit board consists of base board insulation and copper conductive layer, taking some other metal plating onto copper layer according to different requirements. It is composed of plastics(30%), indifferent oxide(30%) and metal(40%). Thanks to PCB( printed circuit board) contains a lot of metal and some compound non-metal. Such as, epikote, curing agent, curing catalyst and so on. So Circuit board

**Tab.1 Circuit boards have composition and weight per ton(Kg)**

composition	plastic	Cu	Fe	bromide	Pb	Sn	Ni	Sb	Ag	Au
weight	272	129.73	40.82	25.40	24.49	19.96	18.14	9.98	0.45	0.45
composition	Cd	Ta	Mo	Pd	Be	Co	Ce	Pt	La	Hg
weight	0.36	0.17	0.14	0.11	0.08	0.08	0.05	0.03	0.03	0.01



**Fig.1 The process flow of blister copper preparation by Water wash method**

hardness is taller and toughness is Strong. We should use equipment with shearing and cutting to break it. At the same time, it will produce lots of quantity of heat and poisonous gas when we constantly break, so it's important to pay attention to dust prevention and exhaust air. Nowadays, most of the basal plate of PCB are glass fiber reinforced epoxy resin copper clad what contains halogenated flame retardant what produce dangerous biphenyl barking dogs when burns. So it is usually recycled by physical method. The typical physical recovery of electronic waste has technology of metal blister copper containing Water wash method seen chart 1.

Technology of metal blister copper by Water wash method is simple, the accuracy the equipment needed is not high and having a good economic benefit. The shortcomings is on account that waste water from Water wash method is very big for water pollution. So key technology of it is solid-liquid separation technology of waste water. The blister crude can becomes refined copper By Wet-chemical method. For example,

## 4 Conclusion

With the concept of sustainable development having been around and improvement of people life and environment protection, the recycling of electronic waste program will wide development prospect because contradiction of resource shortage arises little by little and government issued relevant laws and regulations about it to make it popular all over the world at present. In 2002, the annual output value of electronic waste recycling industry held 1.6% of the GDP all over the world in the US. And our country plan on reach the GDP with 4,000 billion dollars in 2020. In our country electronic waste recycling industry output value will reach 64 billion dollars at that moment if aim at level of electronic waste recycling in the US 20 years ago. However, after the engineering center founded, it will help Huadong Company to recycle 500,000 units what is mixture from plastics, metal, fiberglass, gum and so on. It contains copper 20~30wt%, gold 80g/t and metal and non-metal with palladium, platinum, silver and tin.

The engineering center aims at PCB with Substrate fine crushing and powder synchronous separation technology, reaching more than 60% in metal recovery rate what applies to territory of firecrackers production and powder metallurgy; the nonmetal gotten applies to the territory of changing pitch, anticorrosive paint, PP, PE, PVC plastic and so on. Expects annual sales income is 57 million yuan as said above to help enterprise realize 5million annual profit.

The recycling and reuse of the wastes in Liupanshui city is good for promoting the sustainable use of resources, speeding up the renewable resources processing industrialization in guizhou and relieving resources shortage problems in the current economic development. And remanufacturing of electronic waste will promote chemistry and chemical engineering, energy conservation and environment protection, ferrous metallurgy and so on to solve a lot of problem of employment. Acquired good social benefits.

Electronic waste contains a lot of heavy metal and Other poisonous and harmful ingredients, such as polychlorinated biphenyls, lead and mercury. They will cause serious pollution of groundwater if discarded or buried it and then a large number of harmful substances will seep into the ground; It is not only waste of resources but also producing carcinogenic dioxins and other duties and teratogen to incalculable damage to the ecology and environment and to bring drastic consequences to us if we burn them. According to survey, the recycling of electronic waste is not popularization in Liupanshui city at present. Nowadays, it also exist "household appliances recycling guerrillas" to change their appearance recycling of household appliances for rural market and second-hand electric appliance market. There is a high electromagnetic radiation and High pollution potential safety hazard in them. So government need to spend great efforts in improving the laws and regulations, promoting environmental, improving the system of electronic waste management and recycling system. The engineering center relies on professional scientific research platform and team advantage to avoid the occurrence of the consequences sufficiently with scientific disposal of electronic waste. Otherwise, resource recovery of electronic waste can reduce the original mines and environmental pollution in new product manufacturing process. Energy conservation and emissions reduce greatly. For example, scraped car in our country can be efficiently used, reduce air pollution levels in 85% at present.

According to analytical of ownership of electronic appliances and use fixed number of year and upgrading in Liupanshui city, the yield of electronic waste is more. The development of process is also utilization of resources and environmental protection industry , and got strongly support in policy and law. It also avoids the risk of technology above.

All in all, in consideration of Start-up goal in the recycling of electronic waste in Guizhou province and urgency in the electronic waste recycling in the country, we should carry out the engineering center construction funds to quicken the speed of engineering center

construction and make the related research and the industrialization into the right track as soon as possible.

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