I-INTRODUCTION

Printed circuit board constitutes the constructive component of electronic equipments of the modern devices. Printed circuit boards are typically manufactured by laminating dry film on clean copper foil that is supported on a fiberglass plate matrix. The film is exposed with a film negative of the circuit board design. An etcher is then used to remove unmasked copper foil from the base plate. A soldering metal such as tin/lead is then applied over the un-etched copper layer on the board.

(Table 1) shows the common materials used in the manufacture of the printed circuit boards.

Table 1 The components of a typical PCB

Metal	%
Copper	15-25
Lead	2-3
Tin	2-3
gold	0.5 - 1.5
• Others (base material)	• 60 – 69

- Pre-Preg (Fiberglass, in sheets or rolls) { in case of multilayer boards}.
- Copper Laminate Boards (any size or thickness)
- Copper Laminate Trim (thin strips of copper laminate, 35% Cu - 60% Cu)
- Scrap Circuit Boards (all grades containing gold fingers and other precious metals).
- Other types of scrap resulting from cutting of the laminate or final routing process.

Some of the printed circuit boards failed to meet the specifications are discarded as waste materials and may be processed using any of the available disposal options. In general these options are expensive as they require significant amount of efforts and handling by the manufacturer. Furthermore, since some of these disposal options did not include destruction of the waste circuit boards, the generator also retains much of the liability associated with improper handling or disposal.

As an alternative to off-site disposal, printed circuit boards can be handled and processed to recover the value of the raw materials that are used to produce the boards.

Disposal of failed boards is now prohibited on bases of environmental pollution control. However, it seems reasonable to makes use of these failed boards via recovering the metal(s) available such as gold, copper, tin, etc.

This target also benefits the following targets:

1. Saving the material economy or metal(s) sources.
2. Controlling the pollution hazards and comply with the environmental constrictions given by the law 4 at 1994.
3. Updating the public awareness to bolster the recycling technology.

Depending upon the volume and characteristics of the printed circuit boards processed through a particular vendor, the raw materials can be recovered and the salvage value potentially returned to the generator.

The economics of printed circuit board recycling will be determined by one or more of the following factors:

1. Volume of boards being recycled
2. Characteristics of the boards
3. Market value of the reclaimed components/raw materials.

And conditions of the hazardous waste/solid waste market. Boards containing valuable metals, such as gold, that can be readily reclaimed would be the most economically beneficial to recycle. Boards containing inherently toxic or hazardous materials may require more sophisticated waste management methods to score the above goals.

II- IDENTIFICATION OF THE PROBLEM

Metals present in the spent printed board scarp are copper, tin and lead and may contain gold, silver. The local board manufacturing industry, produced some boards that failed meeting the technical specifications and are usually wasted as scrap. Also the older boards in PC are frequently wasted as a result of frequent degradation or to the rapid developing of the printed boards. Some of the old boards equipment is often placed into surplus, or is reclaimed/reused. The old equipment may be disassembled and the printed circuit boards may also be scrapped and processed for metal values. Typically, wasted circuit boards contain 16% copper, 4% solder and 100 - 400g of gold each ton. The highest valued component is gold and pure copper that are readily saleable. The scrap of printed circuit boards remains unused. The estimated quantity of the printed circuit board scrap may be as high as 20 tons a year. A considerable quantity of spent PCBs is annually recurring and exerts polluting potential to the environment and loss of the national economy. It would be reasonable to make use of this scrap by recovering the valuable materials from those mineral resources.

Based on this concept, it becomes necessary to carry out this study to provide whom it may concern with a simple method to recycle the contents of the PCBs and help furnishing recycling facilities and to help decision making to manage the pollution hazards and control the environment. Unfortunately, the local manufacturer of PCBs has no facilities to recycle this scrap. This work has its aim to examine a method suitable to recycle scrapped boards and to recover valuable metals or some of their valuable salts having a marketing value.

III -AIM OF THE WORK

The objectives of this work are to recover the valuable metals, some alloys and some valuable salts from the scrapped printed circuit boards.

The program of this study includes:

1. Updating the literature review pertaining to the problem under investigation.
2. Selecting the proper method(s) to recover the metals of concern from the waste hardware. This would help to put general conceptual flow sheet of the successive steps to achieve the aim.
3. Designing and erecting of the experimental testing to carry out the experiments.
4. Optimizing of the conditions to attain maximum efficiency in terms of yield and quality.
5. Recovering of metals from the scrap using applying the designed flow sheet.
6. Separation and refining of the prepared products (gold, copper, tin and lead).

Parameters affecting the extent of recovery yield, and total efficiency of the method used were investigated. These include stoichiometric ratio, temperature, time, fluxing agents, acidic and alkaline leachants and solid liquid ratio. An economic study of the cost of recovery is also put forward.