MethodsX 1 (2014) 181–186

Contents lists available at ScienceDirect

MethodsX

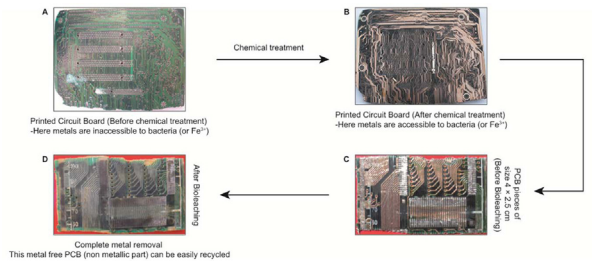
journal homepage: www.elsevier.com/locate/mex

Use of large pieces of printed circuit boards for bioleaching to avoid 'precipitate contamination problem' and to simplify overall metal recovery

N.N. Adhapure [a,*], P.K. Dhakephalkar [b], A.P. Dhakephalkar [b], V.R. Tembhurkar [c], A.V. Rajgure [d], A.M. Deshmukh [a]

[a] Department of Microbiology, Dr. B.A.M. University, Sub-campus, Osmanabad 413501, M.S., India
[b] Microbial Sciences Division, Agharkar Research Institute, Pune, M.S., India
[c] N.K.S.P.T's Arts, Science and Commerce College, Badnapur, Dist. Jalna 431202, M.S., India
[d] School of Physical Science, Solapur University, Solapur 413001, M.S., India

GRAPHICAL ABSTRACT



ABSTRACT

Very recently bioleaching has been used for removing metals from electronic waste. Most of the research has been targeted to using pulverized PCBs for bioleaching where precipitate formed during bioleaching contaminates the pulverized PCB sample and making the overall metal recovery process more complicated. In addition to that, such mixing of pulverized sample with precipitate also creates problems for the final separation of non metallic fraction of PCB sample. In the present investigation we attempted the use of large pieces of printed circuit boards instead of pulverized sample for removal of metals. Use of large pieces of PCBs for bioleaching was restricted due to the chemical coating present on PCBs, the problem has been solved by chemical treatment of PCBs prior to bioleaching. In short,

* Corresponding author at: Department of Microbiology, Dr. Babasaheb Ambedkar Marathwada University, Sub-campus, Osmanabad, M.S., India. Tel.: +91 9028581550; fax: +91 02472 251800.
E-mail address: adhapurenn@gmail.com (N.N. Adhapure).

http://dx.doi.org/10.1016/j.mex.2014.08.011

- Large pieces of PCB can be used for bioleaching instead of pulverized PCB sample.
- Metallic portion on PCBs can be made accessible to bacteria with prior chemical treatment of PCBs.
- Complete metal removal obtained on PCB pieces of size 4 cm × 2.5 cm with the exception of solder traces. The final metal free PCBs (non metallic) can be easily recycled and in this way the overall recycling process (metallic and non metallic part) of PCBs becomes simple.

ARTICLE INFO
Method name: Large pieces of PCBs for bioleaching of metals
Keywords: Microbial consortium, Large pieces of printed circuit boards, Bioleaching
Article history: Received 31 May 2014; Accepted 19 August 2014; Available online 30 August 2014

Method details

There were some attempts of using bioleaching for removal of metals from electronic waste [1–5,7,8]. Most of the research workers have used powdered sample/pulverized sample of waste printed circuit board for removal of metals [1,3,5,7,8].

'Precipitate contamination' problem

Normally precipitate formation is common in any bioleaching process. The precipitate is generally composed of ferric hydroxides. In the experiments of bioleaching of metals from pulverized PCBs, the precipitate formed during the process is composed of Sn, Cu, Pb and Fe [4,5]. Occurrence of such precipitate makes it difficult to distinguish between the precipitate and residual PCB powder [1]. It means the formed precipitate is contaminating the PCBs (pulverized) sample and making the overall metal recovery process more complicated. In addition to that, such mixing of pulverized sample with precipitate also creates problems for the final separation of non metallic fraction of PCB sample.

However, if large pieces of printed circuit boards were used for metal removal and complete metal removal is achieved, then the remaining board (non metallic part) could be easily recycled; which is otherwise difficult while using pulverized PCBs. Hence large pieces of PCBs should be preferred over pulverized PCBs so as to simplify the overall recycling (metallic as well as non metallic fraction) process and also to avoid the problem of 'precipitate contamination'. The main problem of using large pieces of PCBs for bioleaching is the chemical coating present on the PCBs which does not allow the bacteria (or Fe^{3+}) to penetrate through it and thus the bacteria (or Fe^{3+}) fail to reach the metal. Removal of chemical coating prior to bioleaching can solve the problem.

In the present investigation we attempted the use of large pieces of printed circuit boards instead of pulverized sample for removal of metals.

The method includes following steps:

1. Collection of PCBA, physical removal of plastic parts viz. RAM, PCI slot, chip slots from PCBA.
2. Chemical treatment of PCB.
3. PCBs were cut in different sizes (either 12 cm × 6 cm or 4 cm × 2.5 cm).
4. Bioleaching process.
5. Analysis of metals in leachate by AAS, analysis of Fe^{2+} and pH of leachate.

Collection of PCBA

Printed circuit board assemblies (PCBA) were collected from scrap market. Attached plastic parts viz. RAM, PCI slot, chip slots were removed from printed circuit board (PCB). These PCBs were used for chemical treatment as mentioned below.