



Secondary resources and recycling in developing economies



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ARTICLE INFO

Article history:

Received 19 July 2012

Received in revised form 11 May 2013

Accepted 14 May 2013

Available online 12 June 2013

Guest Editors: Christian Ludwig,
Xaver Edelmann, Martin Lehmann

Keywords:

Recycling

Developing economies

Sustainable model

Secondary resources

Green economy

ABSTRACT

Recycling of metals extends the efficient use of minerals and metals, reduces pressure on environment and results in major energy savings in comparison to primary production. In developing economies recycling had been an integral part of industrial activity and has become a major concern due to the handling of potentially hazardous material without any regard to the occupational health and safety (OH&S) needs. With rising awareness and interest from policy makers, the recycling scenario is changing and the large scale enterprises are entering the recycling sector. There is widespread expectation that these enterprises would use the Best Available Technologies (BAT) leading to better environment management and enhanced resource recovery. The major challenge is to enhance and integrate the activities of other stakeholders in the value chain to make recycling an economically viable and profitable enterprise. This paper is an attempt to propose a sustainable model for recycling in the developing economies through integration of the informal and formal sectors. The main objective is to augment the existing practices using a scientific approach and providing better technology without causing an economic imbalance to the present practices. In this paper studies on lead acid batteries and e-waste recycling in India are presented to evolve a model for “green economy”.

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1. Introduction

Mining and metallurgy is known from time immemorial. The un-sustained mining practices have led to the over exploitation of natural resources causing extensive environmental degradation. It is well known that the primary metal production requires virgin material sources, involves lengthy processes that are energy intensive. The recycling and secondary metal production on the other hand, conserves the natural resources, the process is shorter, requires less energy and there is substantial reduction in the waste destined for disposal. It is also proven that the percentage recovery of metals from the secondary sources is higher than the primary production (Schlupe et al., 2009).

Metals have the unique quality for being reused and recycled without much alteration to the natural form, which has been fully exploited, but the process by which such metals are recycled or reprocessed is becoming a major environmental concern. At this juncture there is a need to encourage Environmentally Sound Technologies (EST) for recycling of metals especially the non-ferrous metals to facilitate the recycling process and taking adequate measures to ensure that there is no adverse effect on the environment and human health. Recycling, though, has become an integral part of the system but there is a need to evolve appropriate technologies

for recycling by optimizing the process to achieve best results. Metal recycling and secondary processing is invariably associated with the economics of recycling. In most of the developing countries recycling activities are carried out in the unorganized sector using highly polluting technologies leading to extensive damage to the environment. These also pose health hazards due to handling of hazardous substances and poor work place environment (MAIT-GTZ study, 2007).

2. Recycling and secondary resource

Recycling has assumed global importance in view of the need to conserve natural resources. Considering the need to recover metals from the wastes and secondary sources there has been intense advocacy for recycling especially the ferrous and non-ferrous metals. In this process a number of countries have set up recycling facilities and are able to recycle not only indigenously generated wastes but they also import wastes from other countries for recycling. Globally recycling of aluminium, brass, copper, lead, nickel, tin etc. has gained importance over the last two decades. The scenario was different two decades ago where in the developing nations including India were being made as dumping ground for the waste generated by the developed nations. However, in this process there was an awakening in these poor nations of the possibility recovery of material from the waste and making it a profitable venture (Gaule et al., 2005; Hagelueken and Meskers, 2008). Today scenario has changed as scrap and wastes containing copper, lead, zinc etc., have become important secondary resources the world over. Some of the developed nations have set up “State of the Art” facilities using environmentally

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sound technologies with higher production capacities for recycling like Umicore, Belgium; Boliden, Sweden; Xstrata, Australia; Xstrata, Canada etc. Thereby they are sourcing secondary materials from the developing countries like India who do not have such facilities for extraction of metals from waste.

As regards the metal recycling both ferrous and non-ferrous, there are two major advantages, one conservation of resources by recovering the mineral resources from waste and conservation of energy as recovery of minerals by reprocessing of waste from secondary sources require much less energy than processing the ores and primary resources. It is also well known that the metals from the secondary raw material have a higher percentage of the metals for recovery than the primary ore sources (Waeger et al., 2011). The steps required for reprocessing secondary material is shorter and generates less waste as a result the wastes destined for final disposal is reduced.

The Basel Convention on the Control of Transboundary Movement of Hazardous Wastes regulates the movement of hazardous and other wastes from one country to another, wherein prior consent in writing is required from the destination country ensuring environmentally sound management of the waste in question, which was mostly destined for treatment and disposal. The need for recycling and recovery of material was realized towards the end of last century, thereafter transboundary movement of hazardous and other wastes were liberalized when such wastes were destined for recycling and recovery. The Institute of Scrap Recycling Inc., (ISRI) has been compiling and updating periodically the lists of recyclables and providing specific codes to each waste category. The major lists include the metal scrap and other wastes which can be recycled. The main objective of these global activities is to promote recycling of scrap and waste materials thereby waste of one became resource for another. While addressing the COP 10 of the Basel Convention Achim Steiner UN Under-Secretary-General and UNEP Executive Director stated that 'Prevention, minimization and recovery of wastes' by efficient extraction of valuable secondary raw material from wastes can create green business opportunities with economic and social outcomes in developing world to help eradicating poverty.

3. Informal sector and recycling in developing countries

It is well known fact that most of the recycling activities in the developing nations are carried out in the informal or unorganized sector. The poor and marginalized social groups are engaged in the recycling activity and resort to anything from waste collection or waste picking to recycling using acids and other hazardous chemicals for income generation. The informal sectors are often skilled in identifying wastes with potential value and also explore the methodology to recover the valuables. They also have excellent networking and communication to reach out for the resources.

In most of the developing countries the informal sectors are recycling wastes from various waste streams and there have been many studies on the recycling activities pertaining to copper, lead, zinc and precious metals in some of these countries. Some of the studies conducted in India, China, Indonesia, Vietnam, Cambodia, Argentina, Brazil, Costa Rica, etc., reveal that the informal sector plays a key role in recycling activities in these countries (Suchada et al., 2003; Streicher-Porte et al., 2005; Wilson et al., 2005; Chintan, 2005; Bondolfi et al., 2007; Medina, 2008). It was therefore found essential to involve them in the activities to make the system economically viable, rather than eliminating them. The informal sector provided cheap manual labour and also facilitate in providing employment for the urban poor.

At this juncture there is a need to focus on formalization of the activities of informal sector to be an important link in the recycling value chain and ensure "Environmentally Sound Management" (ESM) of the wastes, taking all practicable steps to manage the wastes in a manner which will protect human health and environment against any adverse

effects due to improper recycling or indiscriminate disposal of such wastes.

3.1. Lead acid battery recycling in India

Recycling of lead acid batteries is well known activity the world over. (Dr Ing. Hein Vest, 2002). It can be stated to a traditional activity that has been carried out in the informal sector in India. In view of the environmental and health concerns due to improper recycling of batteries to extract lead and indiscriminate disposal of the residue generated thereafter in the informal sector, the Government of India introduced a scheme for registration of the recyclers engaged in battery recycling to provide effective controls on the recycling of lead acid batteries scrap. To achieve environmentally sound management of the used lead acid batteries legal, institutional and technical conditions were provided through the regulatory framework and the supporting guidelines (Batteries Rules, 2001; Raveendra and Aradhya, 2006). The units processing lead acid batteries are registered under the Batteries (M&H) Rules, 2001 to ensure that they possess environmentally sound technology to process the waste and also have access to facility for environmentally sound disposal of the subsequent residue generated. Through this scheme of mandatory registration of the recyclers under the Batteries (M&H) Rules, 2001, the recyclers were encouraged to recycle and reuse wastes by adopting environmentally sound technologies. However, the inadequacy in managing the collection system for used lead acid batteries is still a challenge for the registered recyclers. The mandatory condition to return the old batteries while buying a new one and channelization of the such batteries only to registered recycling units provided some control on the lead recycling activities preventing the flow of the used batteries to the informal sectors. Still the sale of used lead batteries to the scrap dealers (kabadiwalas) prevails due to the fact that they give more money compared to the authorized dealers when the used batteries are returned. The registered units are also being closely monitored for processing wastes and for compliance with the conditions of registration. Despite the mandatory requirements there are many informal lead recycling units operating, as they are able to get enough battery waste for recycling.

The study on lead acid batteries management in India (BEST, 2007) revealed that there was lack of involvement of the Lead Acid Battery manufacturers, in other words the manufacturers were not brought under the purview of the rules and Extended Producer Responsibility (EPR) was not made mandatory. It was also observed that though the targets were prescribed in the rules but these were not adhered to and the study recommended Environmental Sustainability Targets (BEST) to be set for the manufacturer.

3.2. E-waste recycling in India

Most recycling activities in India are carried out in the informal or the unorganized sector and e-waste recycling is no exception to this. The recycling in the informal sector involves collection, dismantling and the extraction of metals including precious and other metals. Some of the studies carried out on the units in the informal sector reveal the use highly polluting technologies that pose extensive health hazard to all those engaged in processing of e-waste (MAIT-GTZ Study, 2007; ELCINA Study, 2009). However, the scenario is changing with the upcoming formal recycling units proposing to carry out an end-to-end recycling of e-waste to recover valuable resources in environmentally sound manner using the Best Available Technologies (BAT).

The informal sector has a historic role in waste management and recycling due to their active network and manual skills making waste recycling an economically viable activity (Streicher-Porte et al., 2005; Johannes et al., 2009) and e-waste recycling is in fact the most lucrative one. They have important contribution in reducing the waste destined for disposal. According to an estimate made (MAIT-GTZ study, 2007; Rochat et al., 2008), 95% of e-waste available for recycling in India is

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