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Green lead—oxymoron or sustainable development for the lead–acid battery industry?

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Abstract

Because of the toxic characteristics of lead, the lead industry is potentially faced with a significant constriction of its future markets if it fails to satisfy regulators and communities that its products will be dealt with in ways that offer the highest level of safety. Legislation banning various lead products in different countries continues to expand, particularly within Europe. Denmark has banned the use of lead compounds. The lead industry is currently coordinating (through the London-based Lead Development Association International) the voluntary lead risk assessment in Europe. This assessment is providing valuable research data associated with the ecotoxicity of lead. Building on this, and addressing the issue of changing and improving practices associated with lead, the green lead project is being created as a product stewardship initiative of the lead industry.

Keywords: Battery; Environmental protection; Green lead; Life-cycle assessment; Product stewardship; Sustainable development

1. Introduction

Green lead is the vision of mining, processing, transporting, treating, manufacturing, storing, using and recycling lead with zero harm from lead exposure to both people and the environment [1]. This is a cutting edge approach to product stewardship, to eco-labelling, and to branding.

Green lead is significant for several reasons. First, it has been developed in the face of growing concern over the toxic effects of lead products on human health and the environment. Denmark, for example has banned the use of lead except in car batteries and X-ray shields. The European Union (and other jurisdictions) is tightening controls on lead handling and manufacture. Second, it is an industry initiated, commercially driven, voluntary third-party certification scheme, which combines process certification (under ISO) with strict performance standards for compliance. Third, the focus of the certification is not a single enterprise and its products, but a number of enterprises all involved in separate parts of a global lead cycle. This, in particular, makes the study interesting and may provide lessons for other sectors of industry when the need to certify all aspects of a product from the way it is derived, transported, manufactured, used, and re-used is given. The green lead approach could equally be applied to other non-ferrous substances.

The basic process concept of green lead is the identification of impacts associated with lead, the establishment of standards and mechanisms to minimize these impacts, and the certification of organizations that achieve these standards. It is the world's most ambitious product stewardship exercise. The initial focus will be on lead used in batteries, which accounts for 75% of global lead use. BHP Billiton's Cannington mine is the world's largest single-mine producer of lead and has been the leader in developing this initiative, both to secure its markets and to demonstrate its social and environmental credentials.

To achieve the vision of green lead will require collaboration and cooperation between different stakeholders, companies, and industry leaders throughout the product chain (Fig. 1). Success will also depend on input from these parties in the form of ideas, policy-making, framework development, and commitment to the vision of green lead.

Green lead builds on the work of the voluntary risk assessment on lead currently underway in Europe. This activity involves the collection of data on occupational exposure, environmental emissions, and levels of lead in the local environment for facilities that produce and use lead in the European Union. There will be an investigation of the risks to

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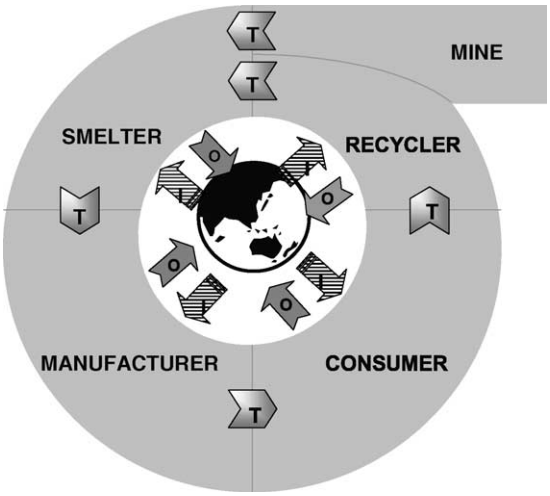

Fig. 1. Green lead 'σ-cycle'.

occupationally-exposed workers, as well as to the local population and environment. Calculation will be made of the contribution of industrial emissions to total lead exposure for the general population and for the wider environment. Both environment and consumer non-government organizations (NGOs) are being consulted and are contributing to the development of the project. It is also recognized that one or a few companies cannot meet all of their environmental objectives, or produce a truly 'green' product, without the cooperation and input of the other companies with whom they interact.

It is proposed that the lead industry should:

- support world-wide governments with environmental protection efforts by taking the initiative in setting lead industry standards;
- unite in taking responsibility for the total environmental impacts of lead, throughout its entire life-cycle, in a cooperative, accountable, proactive and benchmark-setting way.

Sustainable development recognizes the need for equity between this generation and those of the future. It has been argued that extraction-based industries can never be truly sustainable because of increasing concentrations of substances extracted from the earth's crust and produced by society. In the context of lead, however, the emphasis is shifting towards reducing to zero the deleterious effects of this metal upon both people and the environment.

2. Product stewardship

Green lead is an elaborate exercise of product stewardship, which is a principle that directs all sectors in the life-cycle of a product to minimize the impacts of that product on the environment. This emphasis on the entire product system in achieving sustainable development is a unique approach. Under product stewardship, all participants in the product life-cycle (designers, suppliers, manufacturers, distributors, retailers, consumers, recyclers, and disposers) share responsibility for the environmental effects of products [2].

Traditional environmental management focuses upon minimizing environmental impacts within a particular company or at a particular site. Product stewardship seeks to extend the responsibility for a product throughout the product chain. For example, a producer may assume responsibility for the facilitation of product take-back and recycling in cooperation with a recycler, or a miner may change reagents used in the flotation process to reduce emissions from the smelter downstream.

The cooperative nature of product stewardship allows opportunities for the identification and reduction of environmental impacts that are not possible with traditional environmental management. Each player is accountable to other members of the product chain for their environmental performance, and is obligated to benchmark and demonstrate best environmental practice, as far as their capabilities allow. Members may impose supplier and contractor obligations, which may restrict business with those who do not meet set standards of environmental and social performance.

3. Life-cycle assessment

A firm understanding of the environmental aspects of the entire product chain is required. One tool that may be used is life-cycle assessment (LCA). This is the compilation and evaluation of the inputs, outputs and the potential environmental impacts of a product system throughout its life-cycle. The product life-cycle for lead can be represented graphically as the green lead 'σ-cycle', as shown in Fig. 1. To achieve the green lead vision of 'zero harm to people and the environment from exposure to lead', the following development process is proposed.

3.1. Step 1: impact identification

The first step towards ensuring 'zero harm' is to identify and quantify the environmental, safety/health and social impacts associated with the lead life-cycle. To fulfill this step, an 'Aspects and Impacts Register and Risk Assessment' will be developed. Each sector will conduct a full LCA for its operation. Subsequently, each of these sector-specific LCAs will be combined to develop a LCA for the entire lead life-cycle.

3.2. Step 2: develop standards/criteria for green lead

The next step is the development of performance standards/criteria based on the results of LCA and other tools utilized for impact identification. These standards/criteria will define the test for 'green lead'. There will not be an absolute guarantee that no lead enters the bodies of humans or

the air, the water and the soil, but rather will establish maximum allowable levels below which no identifiable harm will occur. The standards will employ surrogate measures of lead in blood, air, soil and water, to demonstrate compliance with the 'no harm' claim. This will draw heavily on the voluntary risk assessment in lead, as well as on the work of groups such as the Society for Environmental Toxicology and Chemistry.

Communication between sectors will be required to determine criteria that can apply across sectors. Sector-specific performance standards may also need to be identified and defined. The standards/criteria will cover areas of environmental protection, workplace health and safety, and community issues. Green lead is an international undertaking. As such, companies volunteering to join green lead will come from a variety of countries, with different legislation and standards of practice. Accordingly, performance standards will need to go beyond legislative compliance and reflect international best practice. A staged approach is proposed in which criteria will be developed and reviewed on a regular basis (at least annually) to allow impacts to be addressed in order of priority, and to achieve a continuous improvement in standards.

3.3. Step 3: green lead process certification

There are two types of certification, namely: (i) green lead process certification; (ii) green lead product certification.

Green lead process certification confirms that an operation is managing its environmental, workplace and community impacts in a way that meets established green lead criteria. It is proposed that ISO 14001, SA8000 and OHSAS 18001 will form the basis of that process certification. Identification of impacts, establishment of standards and maintenance of green lead certification will be an ongoing process. It is anticipated, however, that the methodology adopted will be similar to others used for environmental certification, such as the 'hazard analysis critical control point mechanism' for food assurance.

Green lead product certification confirms that a lead product throughout its life-cycle has only been processed and handled by certified green lead operations, and that those operations contain lead within a closed system by meeting the standards for lead in blood, air, soil, and water.

Setting the compliance standard for green lead is a complex matter. It poses significant questions such as what is the level below which no harm can be demonstrated in people and the environment? Over what time frame should that be considered? What allowance should be made for lead naturally present in the environment? Should different standards apply to different parts of the lead cycle, such as mines or smelters? As mentioned above, it is expected that the voluntary risk assessment of lead will provide some guidance. In addition, consultations will be held with some of the world's best scientists. It is already clear that, to be credible with both regulators and the community, the standards will need to be substantially higher than present regulations and be based on the best understanding of the toxicological effects of lead, which may change with time.

It is envisaged that green lead will become an environment label used to identify products that are certified as meeting the green lead criteria. To ensure the validity and integrity of the environment label, a 'chain of custody' process will be developed and implemented to ensure that lead produced by green lead process certified operations is not mixed with uncertified lead. This would involve protocols that cover the separation of certified and non-certified streams. Each green lead member will have a chain of custody certificate attached to its product at the gate, before transfer to the next member. Each receiving member will use this certificate to ensure that the product they are receiving is certified green lead, and then take responsibility for protecting its integrity while in their custody. The only member that would not be required to check for green lead certification is the recycler. It is envisaged that uncertified lead will, by being processed by a green lead certified recycling operation, be incorporated into the green lead cycle. This will maximize the proportion of lead that is recycled and will help bring uncertified lead into the green lead stream.

The integrity of the environment label will need to be enforced by the use of independent accredited bodies to assist in auditing the process for certification. Certification will be provided by an independent, not-for-profit third-party, who is external to the lead industry so as to provide a credible and transparent result. The details of the mechanism will be developed in parallel with the first steps of stage 1. Regular audits will form part of the improvement process, which will include the review and modification of certification criteria in the light of information concerning best science, increased industry standards for environmental performance, and feedback from stakeholders.

3.4. Step 4 and beyond: product stewardship and sustainable development

It is anticipated that the concept of product stewardship will be achieved through the process of participants in the lead life-cycle collectively examining their lead impacts, setting high standards, and achieving improvements in environmental safety and health performance. These efforts and the ultimate achievement of the green lead goal, will contribute to the pursuit of sustainable development for the lead industry.

It has been decided that green lead will initially only apply to lead used in batteries, as this constitutes 75% of lead consumption (at least in OECD countries), the batteries are perfectly recycleable, and there are significant structures in place to enable the process to be trialled throughout an entire life-cycle. Due to the virtual impossibility of recovering lead in some uses, such as leaded fuel, in glass and ceramics, it can be said that these products will never be 'green lead' certified. It is anticipated that ultimately green lead criteria

will include restrictions which require green lead organizations to sell lead only to other green lead organizations, and to utilize only green lead suppliers.

4. Marketing green lead

Central to the green lead concept is the acceptance of the need to market effectively the certification and the trademark. According to the International Social and Environmental Accreditation and Labelling Alliance successful eco-labelling programmes rely on:

- previous consumer awareness on the type of information contained within the label;
- third-party certification;
- market structure;
- consumer willingness to pay for a premium labelled product;
- inexpensive and clear labelled format;
- the relevance and significance of the environmental criteria;
- marketing of the eco-label to inform the consumer of the meaning of the label, and to assist them to realise the market benefits of the product label;
- re-examination of the criteria after a period of time to allow for changes to technology and new developments to be recognized and implemented in the production of the product.

In addition, labelling scheme companies should be transparent about their organizational structure. This includes the source of their funding, the board of directors and certification standards, publication of information, and establishment of inquiry points. Transparency will assist in satisfying consumer interest and trust in the eco-labelling scheme.

It is proposed that an amount, at least equalling the certification license fee, will be levied on licensees to fund a substantial and ongoing marketing campaign to ensure that consumers understand the certification, as well as the logo and its meaning. Without this effort, the industry will be unable to convince communities, and hence regulators, that the product can be used safely and that a voluntary mechanism is adequate.

5. Proving the concept

In order to begin the process of proving up the issues arising from the green lead concept, a ‘pre-certification audit’ of operations has commenced at BHP Billiton’s Cannington silver, lead and zinc mine in Queensland, Australia. This includes the mining and processing operations on site in north western Queensland, trucking to the railhead at Yurbi, rail transport to Townsville, and ship loading in the port of Townsville. Following this initial proving-up exercise, is the establishment of a coalition of green lead partners from each other part of the full green lead cycle, which will include the transport chains that link the different sectors. This will encompass miners, road transporters, railways, shippers, smelters, manufacturers, consumers, and recyclers. In addition to this, active discussions are being held with a major car manufacturer with a view to enlistment into the green lead cycle, both because it is a user of green lead batteries and also to assist its battery-recovery process.

It is proposed that the coalition of green lead partners will be heavily involved in the design of the final green lead process and standard along with other stakeholders such as environmental and consumer NGOs. Governments and multilateral organizations will also be invited to contribute. The degree of success of the green lead project will be directly proportional to the level of inclusiveness that is achieved in the development and implementation stages of the project.

6. How can the battery industry contribute?

With the decline in other uses of lead in the last 30 years, the dependence on the production and marketing of lead–acid batteries has been paramount for the global lead industry. Over 75% of lead produced each year is used in the manufacture of such batteries. Recent data published by the International Lead Zinc Study Group [3] shows that the proportion of lead used in the USA goes to the production of lead–acid batteries has risen up from about 35% in 1960 to over 86% in 2000. The report states that:

> Lead−acid batteries are set to remain the technology of choice for the starter, lighting and ignition (SLI), 12 V automotive battery market. Its durability, simplicity of design for recycling, and low cost are unlikely to be challenged by substitute battery solutions. Buoyant growth in the Asian car and motorcycle industries over the coming decade should ensure annual world SLI battery market growth in excess of 3.5% a year over this period.

Whilst these are encouraging forecasts for the lead industry, any uncontrolled growth in the industry without regard for product stewardship is not sustainable in the eyes of the community at large. Hence, the suggested introduction and implementation of the green lead project.

The battery sector of the lead life-cycle can contribute to the green lead project by:

- individual battery manufacturers openly supporting and endorsing the green lead project;
- encouraging battery representative organizations to support openly and endorse the green lead project;
- suggesting improved assessment methodologies to ‘measure’ green lead practices;
- participating in the development of the green lead project in the battery sector;
- being creative in the promotion of green lead in the battery sector;

- contributing to the pilot assessment phase of green lead in the battery sector;
- helping to design systems that will facilitate the identification and recovery of green batteries.

The ongoing success of the green lead project is dependent on the support of all sectors in the life-cycle of lead to improve the practices within the lead life-cycle [4].

7. Conclusions

The ability for the lead life-cycle to take a major role in product stewardship is solely dependent on the ability to engage with all the sectors of the entire life-cycle of lead. The inclusive nature of the green lead project is one that seeks active input from all sectors of the lead life-cycle.

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