Natural Resources Canada — Ressources naturelles Canada
Minerals and Metals Sector — Secteur des minéraux et des métaux

Canada

Canadian Association of Recycling Industries

R-NET

RECYCLING TECHNOLOGY NEWSLETTER

VOLUME 6, ISSUE #1, MARCH 2001

It is almost impossible to talk about scrap metal these days without touching on the subject of scrap electronic equipment. Electronic equipment contains various metals such as steel, aluminum, copper, lead, zinc, silver, cadmium, antimony, chromium, mercury, gold, palladium and platinum. Other materials found in large quantities in electronic scrap are glass and a variety of plastics and plastic composites. On average, plastics make up 20 percent of the weight of modern electronic equipment. They are used for their durability, light weight, corrosion resistance, and insulating properties.

The American Plastics Council, in its *Plastics from Residential Electronics Recycling: Report 2000*, states that in 1995 approximately sixteen plastic resins were used by the electrical and electronics sector. Six of them accounted for 77 percent of total resin consumption: Polystyrene (PS), Acrylonitrile Butadiene Styrene (ABS), Polypropylene (PP), Polyurethane (PU), Polycarbonate (PC), and Phenol Formaldehyde (PF).

Information Technology (IT) and Telecommunication (Telecom) Waste in Canada, a report commissioned by Environment Canada, estimates that in 1999, 33,972 tonnes of IT equipment scrap (including PC monitors, laptops, and peripherals, but excluding mainframes and other large equipment) and 2,961 tonnes of Telecom scrap (including telephones, fax machines, and mobile phones) were discarded in Canada. It estimates that in 2005 approximately 67,324 tonnes of IT and 4,328 tonnes of Telecom equipment will be scrapped. The PCs and monitors discarded in 1999 contained 1,356 tonnes of lead, 2 tonnes of cadmium and 0.5 tonnes of mercury. The report estimates that in 2005 the weight of lead, cadmium, and mercury in this waste stream will increase to 3,012 tonnes, 4.5 tonnes, and 1.1 tonnes respectively.

The recycling of electronic and electrical scrap will become a challenge in the coming years due to co-mingling of metals with various plastics and their composites. These materials will have to either be disassembled or used "as is" by the smelting industry which can extract metals using the plastic content as a reducing agent and as a source of energy for the smelting process.

Elizabeth Giziewicz
Editor-in-Chief
CANMET-Mineral Technology Branch

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The R-Net team has received numerous requests for copies of the papers we abstracted. We cannot, however, supply copies of the full articles since their reproduction is strictly prohibited through copyright. If you cannot access these articles through your library, please contact the Canadian Institute for Scientific and Technical Information (CISTI) at the National Research Council Canada. More information about CISTI services can be found on the Internet at **http://www.nrc.ca/cisti/**

Please keep writing to us with your ideas and suggestions. Share your success stories with us, do not forget to tell us about meetings and conferences that you are organizing, and be sure to let us know if you mention us in any of your publications.

Également disponible en français sous le titre R-NET... Bulletin d'information sur la technologie du recyclage.

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ISSN 1205-5549

PRINTED IN CANADA
IMPRIMÉ AU CANADA

Metal Scrap Recycling

RESIDUALS IN CARBON STEEL

By Elhachmi Es-Sadiqi

The Materials Technology Laboratory (MTL) of Natural Resources Canada is partnering with the United States Department of Energy and the American Iron and Steel Institute (AISI), with support from eight AISI-member North American steel companies, to study the effect of residuals in steels and to improve the efficiency of steel production and recycling.

Use of recycled scrap in electrical arc furnaces (EAF) steelmaking, and to a lesser extent in basic oxygen furnace (BOF) steelmaking, has been increasing, as a result of economic forces prompting an improvement in processing and production efficiency as well as legislative forces related to sustainable development and environmental concerns. As levels of residual elements such as Cu, Sn, Mo, Ni, P, and Cr entering the steelmaking process with steel scrap feed are increasing with more widespread recycling, the ability to control their detrimental effects is of major concern. There is a need to define tolerable residual levels relative to product quality and performance in modern steel.

During the early 70's, a new approach to steelmaking based on electrical arc furnaces (EAF) capable of producing steel from any charge, including 100 percent scrap, gained prominence. This resulted in a significant increase in scrap consumption and steel production. Small plants, called minimills, were erected to produce long products (billets, blooms, rods and bars) by melting ferrous scrap in modern electric furnaces and casting the raw steel in continuous casters. Currently, they are slowly penetrating the manufacturing of flat products (slabs, plates, sheets, and strips).

In the United States and Canada, 60 percent of liquid steel is produced in the basic oxygen furnace (BOF). The charge consists, on average, of approximately 26% scrap iron and scrap steel and 74% molten pig iron, which melts the scrap. There have been numerous efforts to improve BOF production capacity in recent years, driven by productivity improvements and by the demand for new steel grades. Steelmaking furnaces currently produce about 110 million tonnes of liquid steel, with a value of approximately $28 billion, for further processing. Methods to improve the consistency and efficient operation of steelmaking furnaces are unquestionably valuable to the steel industry. The consistent delivery of molten steel free of undesirable levels of residual elements is essential in the production and fabrication of steel for many critical applications.

The majority of the undesirable residual elements in liquid steel originate from the mix of metals contained in obsolete scrap. The levels of Cu, Sn, Ni, Mo, and P are increasing, and it is anticipated that other elements such as Pb, As, Sb, and Bi will become a challenge in the future. Careful selection of charge materials for the steelmaking furnace is necessary to control and reduce the amounts of these residual elements to acceptable levels. Unfortunately, one of the impediments to improved BOF and EAF steelmaking productivity is the lack of a simple, reliable method for scrap analysis.

As part of its R&D activities on recycling, MTL is investigating the effect of residuals on the quality and properties of given steel chemistries with various combinations of undesirable elements. This study is composed of two phases. The first, which has been completed, is a comprehensive literature survey on the effects of residuals in steels. The literature review identified their effect on surface quality during casting and hot rolling processes, and on the final product properties of carbon steels. The report encompassed the effects of the residuals on hot shortness and hot ductility, scale formation and adherence, embrittlement and mechanical properties, weldability, corrosion, and galvanizing properties. In the second phase, MTL is evaluating and characterising the effect of residuals in two selected grades of steel (low and medium carbon) on hot ductility and hot shortness, scale formation and adherence, and mechanical properties. MTL employed its vacuum-melting furnace, casting, and hot rolling facilities to produce the steels with accurate chemistry and residual content. A Gleeble thermal simulation and high temperature testing were used to investigate hot ductility. MTL's advanced characterisation equipment and expertise are being utilised to understand and quantify the effects of the residual elements on the properties of steel.

The results of this study will permit the identification of permissible residual content and possibly will allow the exceeding of existing limits by controlling processing parameters. This will result in energy savings and furthermore in the reduction of greenhouse gases by increasing the recycling of steels.

For additional information, please contact Elhachmi Es-Sadiqi, Materials Technology Laboratory, CANMET, by phone at (613) 992-2780, by fax at (613) 992-8735, or by E-mail: essadiqi@nrcan.gc.ca

Policy Issues

THE ROLE OF GOVERNMENT IN ENCOURAGING SUSTAINABLE DEVELOPMENT PRACTICES AND RECYCLING

By Michael Clapham

In 1995, legislation was enacted to help strengthen the Canadian Government's performance in protecting the environment and promoting sustainable development. Through amendments to the "Auditor General Act", Ministers in each Federal Department were

Literature

Characteristics of Electronic Wastes

Menad N., Björkman Bo

*EPD Congress **2000**, 231-243 (Eng). Edited by P.R. Taylor, The Minerals, Metals & Materials Society, ISBN Number 0-87339-459-3*

This work, financed by NUTEK, the Swedish National Board for Industrial and Technical Development, was performed as part of the recycling program at MiMeR (Minerals and Metals Recycling Research Centre) at Luleå University of Technology in Sweden. The authors describe how numerous analytical methods were employed to fully characterize the inorganic and organic content of a Personal Computer. The following investigative methods were used:

- Scanning Electron Microscopy (SEM) to examine morphology,
- X-Ray Diffraction Analysis (XRD) to identify different crystallized compounds such as metals and oxides,
- Infrared spectroscopy (IR) to identify organic fractions,
- Thermogravimetric (TGA) and differential thermal analyses coupled with mass spectrometer (DTA/QMS) to quantify the amount of plastics and to observe the behaviour of electronic wastes under different atmospheres such as air, oxygen, and nitrogen,
- Infrared Spectroscopy (IRS) and X-Ray Diffraction Analysis (XRD) to examine the reaction products,
- Atomic Absorption Spectroscopy (AAS) to determine the quantitative amounts of all chemical elements.

The methods and the findings are described in detail. The results are presented in twenty-two figures and in four tables. The authors claim that incomplete combustion produces harmful materials, such as hydrogen cyanide and carbon monoxide.

A Life Cycle Approach to the Environmental Assessment of Process Alternatives in the Recycling of Galvanized Steel

Viklund-White C.

*EPD Congress **2000**, 219-230 (Eng), Edited by P.R. Taylor, The Minerals, Metals & Materials Society, ISBN Number 0-87339-459-3*

Around 50% of world zinc consumption is used to galvanise steel. A Life Cycle Assessment study is presented to evaluate different options of dealing with zinc obtained from galvanized steel scrap. The author compares the following options: landfilling the electric arc furnace (EAF) dust, zinc extraction by dezincing of scrap, zinc extraction from dust by four different processes, and primary zinc production. The author assumes that the dezincing plant and the dust treatment processes are located adjacent to a steel plant. The dezincing operation is assumed to be located in Denmark where the electricity is derived 95% from fossil fuel. The results indicate that the recycling of zinc used for galvanizing steel does not necessarily decrease the potential impact on the global warming and acidification. The author shows how LCA analysis may be used, in conjunction with technical and economical analysis, in the decision-making process.

Recovery of Iron and Copper from Spent HCl Used to Clean Up Dirty Car Radiators

Rabah M.A.

*Hydrometallurgy **2000**, 56, 75-92 (Eng)*

required to have sustainable development strategies. As part of these strategies Natural Resources Canada (NRCan) along with other government departments (OGDs) are promoting recycling as a key component of sustainable development both within the Federal Government and with private sector clients.

Factors that can accelerate or impede the speed at which industry and society adopt sustainable development concepts include government regulations, taxation policy and incentive programs. Also government is a large contributor in setting the business and societal environment in which we all operate. Policy and regulations can have a positive and sometimes negative impact on the ease in which a product can be recycled. For example, the Rechargeable Battery Recycling Corporation (RBRC) program, outlined on page 7, on the recycling of Ni-Cd batteries required changes to regulations at the federal and state/provincial levels to make the program work. This took a great deal of time, as it was not initially obvious what the problems in collection, storage and transportation were. In order to make the program work it took time and dedication by government regulators and industry to implement a modified structure to ensure that the spent Ni-Cd batteries could be collected and returned to the recycling plants. It also required companies to pay a license fee to participate in the recycling program creating an economic driver.

The Mineral and Metal Policy Branch of NRCan works with OGDs, Provincial Governments and industry, to promote greater recycling of metals and minerals through information gathering and the identification of R&D opportunities. Information gathering is necessary to obtain a better understanding of the industry in order to better assess policy directions leading to increased recycling of materials.

NRCan has established a framework and a database for Canada's metals recycling industry. This database is currently available to the public on our website (**http://mmsd1.mms.nrcan.gc.ca/recycle/**). NRCan along with Statistics Canada and OGDs have formed a working group, which is discussing the possibilities of developing an annual "supply side" statistical survey on the domestic generation of recyclable materials within Canada.

A key policy issue under discussion, which will potentially have major implications for increased recycling, is the distinction between hazardous wastes destined for final disposal and hazardous recyclables destined for recovery operations. On the domestic front this will involve the new Canadian Environmental Protection Act (CEPA) and Canadian Council of Ministers of the Environment (CCME) definitions which differentiate between hazardous materials for final disposal and secondary resources destined for recycling. At the international level participation will continue in the Basel Convention Working Group and the Organisation for Economic Co-Operation and Development (OECD) Waste Management Policy Group. The ongoing work program of the Basel Convention Technical Review Committee includes a crucial activity of establishing environmentally sound management of recyclable materials, as well as the continued process of listing recyclables as either hazardous or non-hazardous. Continued participation in the OECD's Working

Group on Waste Management Policy, to amend the Council Acts related to the movement of recyclables, will also assist in advancing recycling globally.

NRCan has developed a business case which seeks to encourage recycling and the diversion of materials from the waste stream. This recycling plan addresses policy, statistical measures and R&D. Through our laboratories (CANMET), we will be looking for partners in the private sector and OGDs to develop and optimise technologies facilitating increased recycling of materials and end-of-life products.

As a key organisation for mining, metallurgy and petroleum industries the Canadian Institute of Mining and Metallurgy (CIM) continues to be a forum for NRCan's researchers and policy specialists to be active along with industry in the progress through R&D. NRCan staff participates in the Materials Science and Engineering as well as the Environmental committees of the Metallurgical Society (MetSoc) of the CIM, promoting recycling strategies and technical solutions. One project that is underway within the Environment committee is to develop an awareness of the role of biotechnology in waste management and recycling. The goal of this initiative is to help develop policy direction through the use of biotechnology solutions to waste management and recycling concerns.

For more information contact Michael Clapham, International and Domestic Market Policy Division, Mineral and Metal Policy Branch, Natural Resources Canada, by phone at (613) 992-4404, by fax at (613) 943-8450, or by E-mail at mclapham@nrcan.gc.ca
Also visit http://mmsd1.mms.nrcan.gc.ca/recycle/

Mining and Metal Processing By-Products

Electrochemical Approaches to Environmental Problems in the Process Industry
Jüttner K., Galla U., Schmieder H.
*Electrochimica Acta **2000**, 45, 2575-2594 (Eng)*
The removal and destruction of pollutants in industrial effluents, waste waters, and flue gases can be carried out directly or indirectly by electrochemical oxidation or reduction processes in an electrochemical cell. Metals are removed by cathodic deposition. Organic materials are oxidised to carbon dioxide directly at the anode, or indirectly using anodically formed oxidants such as Cl_2, hypochlorite, peroxide, or ozone. This article is a well-researched compendium on cathodic processes (extraction of metals), anodic processes (aqueous effluents and organic waste), electrochemical gas purification, and the recycling of process water. The authors claim that the electrochemical recycling of the rinsing water used in electroplating processes is easier than a final treatment of the effluent. The arti-

A sample weighing 100 kilograms was prepared by mixing and homogenizing spent hydrochloric acid, used for cleaning and scale removal of dirty car radiators, from different maintenance workshops. The paper contains a process flow sheet for the recovery of iron, copper, and hydrochloric acid. Atmospheric air is blown into the hot, spent acid, oxidizing ferrous ions to insoluble hydrated iron oxide FeO(OH) (goethite) which precipitates out of solution. Copper is removed by solvent extraction from the resulting solution. 98% of the iron and 94% of the copper are recovered. The remaining HCl is of acceptable purity for industrial and commercial use.

Determination of Metal Additives and Bromine in Recycled Thermoplasts from Electronic Waste by TXRF Analysis
Fink H., Panne U., Theisen M., Niessner R., Probst T., Lin X.
*Fresenius Journal of Analytical Chemistry **2000**, 368, 235-239 (Eng)*
The authors developed a new method for analysing metal additives in thermoplasts, from consumer electronics, destined for recycling. The samples were dissolved in organic solvent and the resulting solutions or suspensions were analysed by total-reflection X-ray fluorescence spectroscopy (TXRF). From the TXRF spectra, the elements were quantified by integration of one or several characteristic peaks and normalization to the internal standard. The authors used one hundred different randomly selected samples from shredded electronic waste. These were scrutinized for Ti, Zn, Br, Cd, Sn, Sb, and Pb. The obtained results were validated independently by instrumental neutron activation analysis (INAA) rendering the method reliable.

cle explains how electrochemistry can be successfully used to replace traditional chemistry. The article reviews various cell designs along with various electrodes designs (such as three dimensional electrodes) and gives operational data for different types of waste water electrolysis cells. The article contains 129 literature references.

Construction and Demolition

Cold In-Situ Recycling of Structural Pavement Layers
Earland M.
*Waste Materials in Construction, pages 1037-1043 (Eng). Edited by G.R. Woolley, J.J.J.M. Goumans and P.J. Wainwright, **2000** Elsevier Science Ltd., ISBN Number: 0-08-043790-7*
The Transport Research Laboratory in Berkshire, United Kingdom, performed a three-year study on using an existing highway as a “linear quarry” where the highway itself was the source of road stone aggregates. The structural maintenance of highway pavements was done by “cold in-situ recycling.” The existing road materials were stabilized in-place, at ambient temperature, using foamed bitumen and Portland cement (as hydraulic binder), sometimes used in conjunction with lime or pulverised fuel ash (PFA) derived from furnaces of coal burning power generation. The author states that this method proved successful for maintaining roads with design traffic loading up to 20 msa (millions of standard axles) over the life of the pavement.

Bitumens Modified with Recycled Polymers
Murphy M., O’Mahony M., Lycett C., Jamieson I.
*Materials and Structures **2000**, 33, 438-444 (Eng)*
Polymer-modified binders are currently being used to improve the performance of bitumen used on roads. The ability of some polymers to recover elastically gives asphalt additional strength, durability, and increased resistance to rutting and fatigue cracking. The authors investigated bitumen modified with scrap polymers to find blends that have properties similar or better than those of binders currently used in road construction. The following scrap polymers were investigated: polyethylene (low density and high density), polypropylene (homopolymer and copolymer), ethylene vinyl acetate, styrene butadiene styrene, polyetherpolyurethane, truck tire rubber, and ground rubber from elastic in diapers and swimwear. The authors provide a description of results from viscosity, softening point, and penetration tests. The authors found that three bituminous blends (with low density polyethylene, ethylene vinyl acetate, and polyetherpolyurethane) should be subjected to further, more advanced testing.

Et cetera...

TOOLS, METHODS AND CONCEPTS

By Michael Clapham

Life Cycle Assessment (LCA)

There are a number of tools that are being used internationally that are evolving into accepted techniques for evaluating the potential environmental impacts associated with the production, use, recycling and disposal of a particular product. Life Cycle Assessments (LCA) and Life Cycle Management (LCM) are tools that are used to understand the impacts and management of materials and products from source to end of useful life. A frequent misuse of LCA has been to compare one material to another for particular applications. It is very easy to bias the outcome to justify the use of a substitute material. Policy decisions related to product use and recycling can be highly influenced by these biased LCA’s which often ignore sound science, economic and social implications. This misuse of LCA has led to certain recyclable materials being excluded from use by product designers based upon perceived negative environmental impacts arising from natural source production (mining, forestry) as well as from their perceived environmental impacts related to inherent hazardous elemental characteristics. These use exclusions are occurring regardless of the fact, that these materials are being managed in an environmentally sound manner.

Automotive Recycling

Optimization of Scrap Automotive Tyres Recycling into Valuable Liquid Fuels
Mastral A.M., Murillo R., Callen M.S., Garcia T.
*Resources, Conservation and Recycling **2000**, 29, 263-272 (Eng)*
The authors report on a laboratory study in which rubber from old tires was converted into liquid fuel by batch hydrogenation in a mini reactor (60 cm^3 capacity) equipped with a pressure manometer. The influence of the following variables on the hydrogenation reaction was studied: temperature, reaction time and initial hydrogen pressure. The resulting oils were analysed by thin-layer chromatography–flame ionization detection (TLC-FID). The authors state that the conversion of rubber from old tires into liquids is a feasible process, which produces oils, gases, and carbon black.

Post-Consumer Products

CHARGE UP TO RECYCLE!!!!

Communities, businesses, and public agencies throughout Canada recycle their used Nickel-Cadmium (Ni-Cd) rechargeable batteries through the Rechargeable Battery Recycling Corporation (RBRC) of Canada *Charge Up to Recycle!* program.

The Rechargeable Battery Recycling Corporation (RBRC) program was started in the United States in 1995 and Canada in 1998. In both the United States and Canada, regulatory changes were required in order to promote the recycling of Ni-Cd batteries. Between the years of 1995 and 1999 approximately 7300 metric tonnes of Ni-Cd batteries, collected in the United States and Canada, were recycled.

The RBRC is a non-profit, public service organisation that:
- Implements, manages, and consults on rechargeable battery recycling programs.
- Provides an easy recycling solution for manufacturers, marketers, and collectors of Ni-Cd batteries.
- Ensures the environmentally-sound collection, transportation, and recycling of rechargeable batteries.
- Educates rechargeable power users about the benefits of Ni-Cd battery recycling through highly effective marketing and public relations programs.

Hazard Characterization and Risk Assessments

Using an LCA approach along with laboratory testing an analyst can determine, at critical parts of the life cycle, if there is a process, product or material that exhibits hazard characteristics that could pose a danger to human health and/or the environment. However, hazard characterization alone cannot determine if this process, product or material could be used in business or society in a safe manner. It is through a risk assessment that this determination can be made. Risk assessments can determine if a substance is dispersable to such an extent that risk cannot be managed in an environmentally sound manner. There are three main points that arise from a risk assessment supported by sound science. Firstly, just because a hazard has been identified it does not mean that the hazard cannot be managed safely within the environment. Secondly, there will rarely be a case where there is zero risk. Finally, it is in the effectiveness of the management of the risks that will determine if a product or process can be used with a high degree of confidence that it will not cause harm to human health or the environment.

Extended Producer and Extended Product Responsibilities

Although it may appear that these two concepts are similar they in fact do differ substantially in the allocation of responsibility. Both can be equally effective given the right circumstances. Although there may be a voluntary component to extended producer responsibility there is often a significant regulatory backstop. In the case of the extended product responsibility there tends to be a greater emphasis on economic and marketplace drivers.

Extended producer responsibility is more common in Europe and parts of Asia. The governments mandate, directly or indirectly, that product producers and importers take the responsibility for the take-back or paying for the management of end-of-life products. The intent is to shift the cost of product end-of-life management from the taxpayer to the manufacturer. In turn it is hoped that this will create an incentive to producers to pay more attention to that part of the life cycle. For example having product designers design for easier recycling of a specific product at the end of its useful life.

An example of the extended producer responsibility is the recycling of end-of-life-vehicles (ELV's) in the Netherlands. Auto Recycling Netherlands (ARN) was created in 1993 and is owned by the car manufacturers and combines importers, car dismantling companies, garages, car repair shops and shredders. Around 250,000 ELV's are scrapped annually in the Netherlands but, prior to 1995, only metals were recycled. These metals constituted about 75% of the weight of the ELV . Through measures proposed by industry via ARN an increase of 11% of the recycled weight (primarily non-metallic) of the ELV was achieved by 1998. ARN has not only served to reduce the volume of ELV waste but has also improved the safety and environmental friendliness of car dismantling. In order to augment recycling of ELV's the Dutch government imposes taxes on dumping of waste and has introduced a mandatory waste disposal fee on new

RBRC is funded by the licensing of the Environmental Protection Agency (EPA) certified RBRC Battery Recycling Seal to manufacturers and marketers of Ni-Cd batteries and battery-powered products. These RBRC Licensees pay a fee to place the RBRC Battery Recycling Seal on their Ni-Cd battery packs as well as product packaging and instructions. The seal features an 1-800 telephone number to help the consumer find the nearest drop-off battery collection location.

Over 300 manufacturers, resellers, or marketers of Ni-Cd rechargeable batteries and products in which they are used participate as Licensees in the RBRC Program. This represents over 90 percent of the Ni-Cd portable-powered product industry in the United States and Canada. Approximately 29,000 retail and community locations across Canada and the United States take part in the program.

National Canadian retail stores participating in the program include: Astral Photo Images, Authorized Motorola Dealers, Battery Plus, Black's Photography, Canadian Tire, Future Shop, Home Hardware, London Drugs, Makita Factory Service Centers, Personal Edge/Centre du Rasoir, Radio Shack, and Zellers.

The participation of consumers is vital to the success of this program and is the reason for which RBRC uses a large proportion of its resources for marketing and promotional activities. The RBRC web site generates up to 2,000 hits per month, and the consumer help line averages 3,400 calls each month.

The *Charge Up to Recycle*! program in Canada consists of four recycling routes encompassing:

- Retail Recycling Plan: consumers return used Ni-Cd batteries to participating retailers.
- Community Recycling Plan: consumers bring used batteries to collection sites, usually operated by a municipality
- Mail-Back: consumers mail their used batteries directly to the RBRC consolidation facility.
- Business and Public Agency Recycling Plan: Businesses, institutions, and government agencies (e.g., police and fire departments, hospitals, etc.) forward their used rechargeable batteries to a designated consolidation facility.

In each case the used Ni-Cd batteries end up in the RBRC consolidation facility. From there, batteries are shipped for recycling to the International Metals Reclamation Company (INMETCO) in Ellwood City, Pennsylvania. The Ni-Cd battery contains cadmium and nickel oxide electrodes. A solution of potassium hydroxide serves as the electrolyte. After the recycling process is completed, the reclaimed cadmium is returned to Ni-Cd battery manufacturers, and the nickel and iron become part of the remelt alloy that is used to make stainless steel. The battery electrolyte is used as a reagent in the facility's wastewater treatment plant. INMETCO is a subsidiary of Canadian-owned INCO.

Starting in January 2001, RBRC expanded the Ni-Cd battery recycling program to include Nickel Metal Hydride (Ni-MH), Lithium Ion (Li-Ion), and small sealed Lead (Pb) rechargeable batteries.

For more information, please contact Susan Antler, Rechargeable Battery Recycling Corporation Canadian Program Co-ordinator by phone at (416) 535-6710. For more information about RBRC's public education campaign and rechargeable battery recycling program in the United States and Canada call the toll free consumer help line 1-800-8-BATTERY, or visit the web site at http://www.rbrc.org

COMPOSTING COUNCIL CONGRATULATES EDMONTON AND NOVA SCOTIA

More than 400 delegates and exhibitors attended the 10th annual composting conference in Edmonton, Alberta from September 27 to 30th, 2000. Sponsored by the Composting Council of Canada, the City of Edmonton and Olds College, the conference made its Western Canada debut. "Edmonton has become a world leader in large-scale composting and is an example to other cities," said Susan Antler, executive director of the Council, in her welcome address. "It's why the Composting Council chose to hold its conference in the city."

Forty technical presentations were complemented with exhibits and fields trips, including a tour of the newly opened Edmonton Composting Facility. Delegates marvelled at the colossal facility that transforms Edmonton's 180,000 annual tonnes of residential waste into compost through mixing, screening and aeration processes.

During September, the City began delivering all its residential waste to the $100 million Composting Facility, built and operated by TransAlta Energy. Together with recycling, 70 percent of Edmonton's household garbage is now being diverted from landfill.

The Composting Council recognized both the City of Edmonton, population 650,000 and the province of Nova Scotia, population 940,000, for reaching the 50 percent reduction target set by the Canadian Council of Ministers of the Environment in 1989. The City of Edmonton relies on the voluntary compliance of its residents. Its curbside recycling collection program has a voluntary participation rate of 82 percent. All other waste set out for collection is sorted at the Composting Facility.

"While the approaches are very different, the end result is the same," says Antler. "Both Edmonton and Nova Scotia have recognized garbage as the resource it is, not something to be buried." Through legislation passed in 1996, Nova Scotia banned resources that can be recycled and composted, from beverage containers and tires to antifreeze and food waste, from landfill sites. "The province has been incredibly aggressive and bold in reaching its target," says Antler.

cars (domestic and imported). This disposal fee is used to fund ARN.

Extended product responsibility (EPR), sometimes known as shared product responsibility, tends to be more popular in North America. EPR focuses on minimizing the environmental impact and maximizing resource use associated with a product throughout its life cycle through collaboration of all parties involved with that product. Critics argue that by not focusing on the end-of-life stage of the life cycle there may be a failure to allocate through regulatory backstops manufacturer responsibility for this stage of the product life cycle. However, the argument in favour of this approach is that it involves all groups involved in the product life cycle. It places the recycle burden on the best equipped party in the life cycle and it encourages economic efficiencies within the system.

An example of the extended product responsibility is the recycling of lead acid batteries. In this case it is the secondary and some primary smelters who have the technology and economic incentive that will recycle this product. The emphasis would not be on the battery manufacture or the automobile industry to recycle this product, as it would be if the producer had the responsibility. It would involve other parts of the supply chain, such as the automotive parts suppliers, the scrap dealers and the consumers who all have a role to play in getting this product to a recycle facility.

For more information contact Michael Clapham, Natural Resources Canada, by phone at (613) 992-4404 or by E-mail at mclapham@nrcan.gc.ca

Events

4th International Conference on Electronic Products Recovery/Recycling (EPR2) held jointly with the 2nd Annual Electronics Recycling Summit
International Association of Electronics Recyclers (IAER),
National Safety Council (NSC)
April 17-20, 2001
Arlington, Virginia
IAER: Tel: (888) 989-4237, or email at: lblongfield@electronicsrecycler.com
NSC: Tel: (202) 974-2490, or email at: hollandm@nsc.org
http://www.iaer.org
http://www.nsc.org/ehc/epr2.htm

The 2001 World ITRA Expo
International Tire and Rubber Association
April 19-21, 2001
Nashville, Tennessee
Tel: 1-800-426-8835
Tel: (502) 968-8900
Fax: (502) 964-7859
E-mail: itraef@itraef.com
http://www.itra.com

9th IEEE International Symposium on Electronics and the Environment
Institute of Electrical and Electronics Engineers (IEEE) Electronics & the Environment Committee
May 7-9, 2001
Denver, Colorado
Fax: (732) 465-6447
http://computer.org/tab/ehsc

Other topics discussed at the three-day conference included composting biosolids, marketing and end uses, agronomic uses of compost, and composting's role in livestock management. The Composting Council will soon prepare a position paper that it hopes will encourage composting manure to alleviate issues associated with large-scale intensive livestock operations.

For additional information, contact: Connie Boyce, City of Edmonton, Waste Management Branch, by phone at (780) 496-5407 or by E-mail at connie.boyce@gov.edmonton.ab.ca or Susan Antler, Composting Council of Canada by phone at (416) 535-0240 or by E-mail at ccc@compost.org

CARI's Corner

Canadian Association of Recycling Industries

THE GROWING MINE ABOVE THE GROUND

By Leonard Shaw

It is estimated that next year 31 million personal computers will be redundant in the United States alone. By 2007 this number will grow to 500 million. In 1998 only 2.3 million computers and 1.5 million monitors, almost all business equipment, were recycled. In the same year, only 19,000 television sets were properly decommissioned while 24 million were sold.

Computers, television sets, cordless telephones and other electronic conveniences contain toxic materials. They are not wanted in landfill sites. Massachusetts has become the first state to ban the disposal of computer screens, TV sets and other glass picture tubes in landfills and incinerators. Under the regulation, introduced in March 2000, Massachusetts has set up six collection centres accepting monitors from individuals and towns. The centres send these items for refurbishing or recycling. Georgia encourages the recycling of electronic products by educating the public about the benefits of recycling through a web site and a brochure. The European Commission's Environment Directorate is developing a directive on waste electronic and electrical equipment (WEEE). Its major thrust is producer responsibility. In Canada, the Recycling Council of Ontario, in partnership with Environment Canada, is working on a strategy for the management of electric and electronic equipment.

In fact, in Canada we already have part of the solution: recycling the circuit boards in a copper smelter. Unfortunately, this recycling activity is actually discouraged by current government regulations. Shredded circuit boards are considered to be "hazardous waste" in Canada because they fail the leachate test. The result is that a recycler has to take on additional costs for a variety of administrative matters, and extraordinary expenses related to issues such as, for example, special transportation needs. These costs are a burden on the recycler and only slow down industries that could already be making an active contribution to improving the environment.

As an example take these two samples, which could be purchased by a copper smelter.

Chemical	Measure	Sample A	Sample B
Cu	%	16-21	27
SiO_2	%	26-28	8
Fe	%	0-9	28
S	%	-	30
As	%	0.02-0.03	0.1
Cd	%	<0.01	0.01
Ni	%	1	.05
Pb	%	0.7	1.5
Zn	%	1.5	5.0
Sn	%	0.7	0.1
Au	g/tonne	0.08-1.5	-
Ag	g/tonne	1.35-1.85	-

The smelter operator wants to maximize marketable products and minimize other elements and contaminants. Therefore, copper, gold and silver are desired; silica is used in the smelting process, sulphur is not wanted; and all other materials, even those that can be managed in the flue dust, should be minimized.

Given these preferences, Sample A is the preferred material. Sample B is a typical copper concentrate. Sample A represents a typical assay of an electronic circuit board. Both samples would leach heavy metals, but only Sample A would be subject to the leachate test and, therefore, the extra administration and costs. What kind of logic is this?

Canada will have the same growing problem with electronic wastes as the rest of the world. Clearly, we already have an environmentally sound recycling solution to solve at least part of the problem. But just as clearly, government policies need to be amended to maximize, rather than discourage, this recycling solution.

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By Elizabeth Giziewicz

End-of-life electronics form an emerging scrap stream that cannot be ignored. It includes virtually everything with an electric plug, from vacuum cleaners, typewriters, and telephones, to computers and automated teller machines.

The report mentioned on the front page, entitled "*Information Technology (IT) and Telecommunication (Telecom) Waste in Canada*" is accessible on the WWW page of the National Office of Pollution Prevention of Environment Canada. This is the first Canadian study estimating the amount of IT and Telecom equipment scrap that is currently being generated in Canada. It examines the reuse, recycling, and disposal of such equipment and predicts the amounts of obsolete electronics that will enter the waste stream in the next few years. The report is available in English at **http://www.ec.gc.ca/nopp/sustainable/itwaste/indexE.cfm** and in French at **http://www.ec.gc.ca/nopp/sustainable/itwaste/indexF.cfm** The site also features graphical presentations of some of the information contained in this report.

The Commission of the European Communities of the European Union is currently working on legislating electrical and electronic scrap. The Proposal for a Directive of the European Parliament and the Council ***on waste electrical and electronic equipment*** combined with a Proposal for a Directive ***on the restriction of the use of certain hazardous substances in electrical and electronic equipment*** can be accessed in English at **http://europa.eu.int/eur-lex/en/com/pdf/2000/en_500PC0347_02.pdf** and in French at **http://europa.eu.int/eur-lex/fr/com/pdf/2000/fr_500PC0347_02.pdf** In October, 2000 Karl-Heinz Florenz, Member of the European Parliament and the Directives rapporteur, chaired a public meeting in Brussels to hear the concerns of organizations likely to be affected by the legislation. Several of the presentations from this meeting may be viewed at **http://www.eutop.de/ewh** The amended version of the Proposal for the aforementioned Directive, delivered on December 27, 2000 can be accessed in English at **http://europa.eu.int/eur-lex/en/com/dat/2000/en_500PC0347_01.html** and in French at **http://europa.eu.int/eur-lex/fr/com/dat/2000/fr_500PC0347_01.html**

The Electronic Industries Alliance (EIA) webpage at **http://www.eia.org/** is packed with information on electronics recycling and related issues. The on-line library of the Environmental Issues Council of EIA (**http://www.eia.org/government/eic/index.cfm**) contains a number of articles and compilations such as *2000 End of Life Electronics Initiatives* (**http://www.eia.org//download/eic/21/PELM_10-2000.pdf**), *Assessing End-of-life Electronics: A Compendium* (**http://www.eia.org//download/eic/21/dfe-comp.html**) or *Common Sense Initiative (CSI) Council Recommendation on Cathode Ray Tube (CRT) Glass-to-Glass Recycling* (**http://www.eia.org//download/eic/21/Csi_rec.html**)

On February 1, 2001 EIA unveiled the *Consumer Education Initiative*, a comprehensive web-based information resource at **http://www.eiae.org** on recycling and reuse opportunities for used electronics.