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Canada

Canadian Association of Recycling Industries

R-NET

RECYCLING TECHNOLOGY NEWSLETTER

VOLUME 6, ISSUES 2 and 3, DECEMBER 2001

The Cambridge On-line Dictionary defines waste (unwanted material) by saying *"A waste product is a substance of no value or use which is made during a process in which something useful is produced."*

Talk to a recycler and you will hear a different definition of waste. *"One man's trash is another man's treasure."* All effluent streams - gas, liquid, and solid - constitute a resource to be recovered, i.e., a secondary raw material. This material can be used as a product either directly or after combination with another by-product.

After making sure that a pollution prevention policy is in place and that life cycle management correctly describes product development from cradle to grave, the next step that a company should consider is industrial symbiosis. Industrial symbiosis (exchange of resources) is a cooperation among several companies wherein waste products from one company are used as a resource in another. The industrial symbiosis in Kalundborg (Denmark) consists of a power station, a plasterboard manufacturer, a pharmaceutical and biotechnology company, a soil remediating company, and a refinery. In Alberta Weyerhaeuser, a pulp and paper company, replaced expensive commercially supplied sodium hydroxide with a waste by-product from a Husky Oil refinery in Saskatchewan.

The most important challenge that awaits all parties interested in recycling is to create an exchange of information, develop joint research activities, and adapt existing technologies and practices to accommodate cross-sector applications. A need for *Design for Recycling* was evident during the deliberations of parties attending the Technology Gaps Recycling Workshop, whose findings are summarized in this issue of R-Net.

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

TECHNOLOGY GAPS IN RECYCLING

Compiled by Elizabeth Giziewicz

The Materials Technology Laboratories (MTL) of Canada Centre for Mineral and Energy Technology (CANMET) at Natural Resources Canada (NRCan), in cooperation with Policy-NRCan, organised a Technology Gaps Recycling Workshop in partnership with Industry Canada, Environment Canada, the National Research Council (NRC), Process Research ORTECH Inc., and the Canadian Association of Recycling Industries (CARI). The objective of the workshop, held March 1-2, 2001 at Sheridan Park Conference Centre, Mississauga, was to discuss technology gaps and to identify technological innovations for the improvement of recycling in four sectors: automobile, construction, plating, and electronic scrap. A total of 53 leading specialists from industry (34), government (17), and academia (2) discussed concerns and issues related to technology gaps in recycling.

Workshop participants met in facilitated break-out sessions to identify what is and is not working well in recycling in their respective sectors. They subsequently addressed what solutions might counter the technology gaps, and what factors might help or hinder achieving these solutions. The plenary discussion indicated common recycling technology weaknesses across all sectors.

The issues identified below are presented "as it was said" during the deliberations throughout the workshop.

AUTOMOTIVE INDUSTRY

RECYCLING TECHNOLOGY GAPS

Dismantling

- Develop a reverse assembly line automation technology for dismantling of cars.
- Develop "mini-shredders" that could be easily moved to remote areas.
- Maximize the utilization of parts resulting from dismantling.
- Improve storage and transportation processes.

Separation

- Do media separation based on specific gravity of materials.
- Develop a brand new process to replace shredding or,
- Change the shredding process - break up the auto differently.
- Develop a better chemical and physical separation process.
- Do a better identification of materials (including phase analysis), develop analysers.
- Find a mechanism to get rid of PCBs and other hazardous material (mercury, lead, etc.,).
- Use air classification.
- Develop sensors for process automation (impurity/trace element detection, improve quality, reduce energy/cost).

Product Development

- Make products from co-mingled plastics (parking curbs etc.,) and develop markets.
- Use ASR for slag stabilization.
- Recycle the foam.
- Recycle tires into a high value product(s).
- Develop products and markets for glass.
- Look at reusing some of these materials instead of recycling to make a cheaper, yet safe, car.
- Find products for the organic stream.
- Find a process for converting ASR into fuel.

Refining / Upgrading

- A solid commercial scale demonstration of existing technology for recycling of EAF dust.
- Recover usable zinc from EAF dust.
- Facilitate transportation of EAF dust through revised regulations.
- Upgrade steel scrap by removing zinc, cadmium and lead.
- Improve detection of trace elements in liquid metal.
- Eliminate trace material from liquid metal (i.e., magnesium, aluminum, steel, beryllium).
- Develop new improved low-cost sensors for process automation (better input detection, reduced energy consumption, reduced production cost, and improved product quality).
- The technology is not adequate for the segregation of alloys.
- Find an easy way to recycle aluminum alloys, separate magnesium from aluminum.
- Recover iron.
- Efficient removal of liquids (oil, glycol, hydrofluorocarbons (HFCs)).

Design with Recycling in Mind

- Ensure that recyclability is part of the design, design a car for improved recycling.
- Package things differently to facilitate dismantling: easy access and easy removal.
- Increase the amount of recycled materials in new cars.
- Standardize all components.
- Make a modular car for easy dismantling.
- Eliminate the use of hazardous materials.
- Develop something like the toothpick in a club sandwich: magnetic fastening system or dissolvable fasteners.
- Use fewer polymers.
- Eliminate composite materials.
- Label materials going into cars.
- Use only reusable parts.
- Increase the repairability of parts.
- Develop an upgradable car with a longer overall life.
- Increase the overall durability of the car: produce a stainless steel car.
- Produce a biodegradable car.

Notes:

- Things such as electronic chips, switches containing mercury, air bags with intact detonators and sodium azide (toxic by inhalation, ingestion, or skin absorption) canisters,

Literature

Legislation Prods Foam Recycling
Reich M.
Chemical and Engineering News ***2001****, September 17, 22 (Eng)*
The Dow Chemical Company is exploring two processes for recycling the polyurethane foam used in car seats, in headrests, behind dashboard, and under carpets: a mechanical pulverization process developed by Mobius Technologies and a solvolysis process now in use by Regra Recycling in Pirmasens, Germany. The first process pulverizes scrap foam into a fine powder at room temperature. The solvolysis process dissolves the foam in dicarboxylic acid in an un-pressurized reaction vessel to produce an oligomeric dispersion. Either pulverization or solvolysis could provide recycled polymer to replace up to 7% of virgin ingredients by weight and still meet automobile manufacturer's specifications for car seat foam.

2001 Conference on Selective Catalytic Reduction (SRC) and Selective Non-Catalytic Reduction (SNCR) for NO_x Control
May 16-18, **2001**
National Energy Technology Laboratory, United States Department of Energy
http://www.netl.doe.gov/publications/proceedings/01/scr/scr01.html
contains the following articles, published in English:

Ammonia Removal from Coal Fly Ash by Carbon Burn-Out
Giampa V.M.
http://www.netl.doe.gov/publications/proceedings/01/scr/giampa.pdf
Fly ash containing between 300 and 750 ppm of ammonia was successfully treated by the Carbon Burn-Out (CBO)

process. Between 94% and 98% of the liberated ammonia underwent thermal decomposition to nitrogen and water. The author states that the CBO pilot demonstrations prove that fly ash ammonia contamination can be eliminated without any process changes.

Ammonia Removal from Fly Ash Using an Acoustically Enhanced Fluidized Bed
Levy E.K., Huang DeShau, Lawton K.B.
http://www.netl.doe.gov/publications/proceedings/01/scr/levy.pdf
A 6" diameter laboratory-scale heated fluidized (with air) bed was used to decompose the ammonium compounds. The acoustic excitation of the bed promoted active bubbling and improved the fluidization characteristics of the ash. The authors tested three different ashes with initial ammonia concentrations between 500 and 1100 ppm. 80% of ammonia was removed between 650° and 700°F, and 90% ammonia removal was achieved between 700° and 750°F. The authors are building a laboratory-scale inclined fluidized bed for continuous processing of the ammonised fly ash.

Removing Ammonia from Fly Ash
Gasiorowski S., Bittner J., Hrach F.
http://www.netl.doe.gov/publications/proceedings/01/scr/sgas1.pdf
Separation Technologies Incorporated (STI) patented a process that liberates ammonia from fly ash at ambient temperature. The ammonium salt contained in fly ash reacts with an alkaline reagent (i.e., CaO) and is removed as gas. Fly ashes with naturally high alkalinity need no additional reagents. In pilot plant trials conducted by STI, the continuous process has reduced the ammonia content of contaminated ash containing up to 1000 mg NH_3 per kilogram to less than 20 mg NH_3 per kilogram at a rate of approximately 1400 kilograms per hour.

and polyvinyl chloride (PVC) left in cars destined for shredding can result in hazardous situations and contamination of automotive shredder residue.
- Design changes that occur today will surface in the recycling of cars in 10 - 15 years.
- The auto is changing rapidly and the recycling industry is not always changing at the same pace.
- Consumer acceptance vis-à-vis recycled cars or car parts: perceived as dirty and old.

CONSTRUCTION AND DEMOLITION

General Concerns
- A very diverse, disconnected playing field, e.g., 80% of the industry consists of companies with less than 10 employees.
- There is a lack of awareness of issues.
- There is a lack of dissemination of options.
- There is a fear of liability for innovation.
- There is a lack of regulatory flexibility, i.e., specification rather than performance driven.
- The specification bid culture discourages enhancing performance (end of life, environmental concerns, and lead-containing materials (LCM)).
- Construction has the lowest research and development investment of all major industries.

Due to lack of time the discussion participants concentrated on the construction industry as a consumer of other industries' by-products and on the manufacturing of construction materials that contain or could contain materials such as mine tailings, recycled paint, slag, incinerator ash, pulp mill black liquor, gypsum, cement kiln dust, crumb rubber, tires, and paper.

CONSTRUCTION RECYCLING TECHNOLOGY GAPS

- Cost effective separation technology.
- Designing for obsolescence (i.e., design for recycling).
- We need technologies that will enhance the end of life re-use and recycling of multi-material products.
- Reduction of NH_3 content in fly ash at an acceptable cost.
- Economic technology that enhances early strength - development of fly ash concrete.
- Actual lab and field validation of specific examples where concrete performance can be dramatically improved. Collaboration between research and development resources and industry to identify potential improvements. A cost effective sorting or separation of multi-material products.
- Life cycle analysis and management knowledge.

Notes:
The following is working well:
- The sector is a good consumer of other industries' by-products.
- Recycling of steel and metal products as well as rubble and asphalt.
- Traditional application of fly ash and ground slag in concrete-cement industry.
- Lumber into landscape material.
- Paper going into laminates.

- Sustainable forestry in Canada.
- Wall-boarding industry if you are close to a recycler.
- Acoustic tiles and some of the carpet industry are doing some recycling.
- Recycled and recyclable roofing products.

METAL FINISHING INDUSTRY - PLATING

RECYCLING TECHNOLOGY GAPS

- There is a fear of new technology and new by-products.
- There is no means of recycling large amounts of zinc sludge.
- There is no system for segregating small amounts of contaminants.
- Lack of exchange of information between manufacturing companies who are competitors, therefore a lack of reliable benchmarking.
- Lack of selective separating technology for more metals and substances.
- Regeneration of hydrochloric acid-containing contaminants other than iron (e.g., zinc).
- There is no black box which will separate out everything in a recyclable form.
- There are no economically viable separation and recovery technologies for small platers.
- Selective separating technology / black box magic solution:
  - Simple boxes (e.g., filter cartridge) on a stream so that groups of metals are filtered out: it could be a scavenger unit for physical separation or ion exchange separation.
  - Develop a technology to treat small concentrations in large volumes, to fight dilution as a solution, e.g., filter placed in the line which is sent away to a recycler at regular intervals.
  - Clearly define the anticipated output of the black box(es): draw up an agreement among the players.
- Develop plasma systems which are ion specific.
- Long term incentives for the use of the technology: monetary subsidization, or legislated requirement.
- Waiver of certain regulations (or at least greater flexibility in respecting them).

Notes:
- Licensing or royalties after development of a technology.
- If the material is non-hazardous there is less pressure to recycle.
- Use of technology and removal are too costly for small companies: the paperwork is too cumbersome and it is easier to pay someone to take the material away.
- Unwillingness of regulatory agencies to allow innovative use of technology: governments don't understand or encourage recycling (political or policy gap).
- Unwillingness of large producing companies to thoroughly invest in recycling technology; economics don't allow for small volume input and for the contamination risk.
- Some companies do not believe in research and development; they are not working closely with their suppliers on research and development (economic constraint).
- Send mixed waste solutions to a larger "brother," who is capable of treating these solutions, concentrate the problem in fewer spots.
- Need to develop recycling facilities in Canada to deal with zinc recycling so that we can understand the volume and the constraints, and develop options.

A New Conti-Process for the Fluxless Recycling of High Purity Magnesium
Galovsky U., Kühlein M.
Magnesium Technology ***2001****, 49-53 (Eng) (Proceedings of the 2nd Annual Symposium, held during the 2001 TMS Annual Meeting and Exposition, New Orleans, Louisiana, February 11-15, 2001. Edited by Hryn J., Warrendale, Pa)*
An average medium-sized die cast plant produces approximately 1,500 tonnes of in-house magnesium scrap per year. This scrap could be recycled in-house instead of being shipped for recycling to the primary magnesium producer. The authors claim that the initial capital outlay for a modern in-house recycling unit could be recovered in one year. The article reviews a magnesium recycling unit produced by Rauch Fertigungstechnik Ltd., Austria, installed at the Lightmetal Competence Centre (LKR) in Ranshofen, Austria, used for remelting and casting magnesium scrap. It is a fluxless continuous process that uses protective gas based on the addition of SO_2 remelting up to 500 kg of class I scrap per hour. Two different types of scrap (fine AM60 and coarse AZ91) were remelted in the fluxless process under different gas atmospheres. To compare the quality of products, the recycling was also carried out in a flux-protected industrial-scale magnesium recycling unit. The authors discuss the influence of the recycling conditions on mechanical properties of the fluxlessly recycled magnesium.

Innovative Vacuum Distillation for Magnesium Recycling
Zhu T., Li N., Mei X., Yu A., Shang S.
Magnesium Technology ***2001****, 55-60 (Eng) (Proceedings of the 2nd Annual Symposium, held during the 2001 TMS Annual Meeting and Exposition, New Orleans, Louisiana, February 11-15, 2001. Edited by Hryn J., Warrendale, Pa)*

The authors described a newly developed and validated magnesium recycling process. It is particularly useful when dealing with highly impure magnesium scrap such as machining chips, oily magnesium, smelting sludge, dross, or a mixture of the above. Magnesium is recovered in a vacuum distillation, similar to a Pidgeon reduction process. Magnesium is gasified and then solidified into a crystal magnesium crown. Impurities remain behind as they have a higher boiling point. This process does not require any protective gas. The scrap's aluminum content should not exceed 40%. The work presented is a part of the "Magnesium Manufacturing & Product Development Group" projects in Manufacturing Systems Department, Ford Research Laboratory, Ford Motor Company. The experiments were conducted at the Nanjing Welbow Metals Company in China.

Recycling of Hazardous Solid Waste Materials Using High-Temperature Solar Process Heat 1. Thermodynamic Analysis
Schaffner B., Hoffelner W., Sun H., Steinfeld A.
Environmental Science and Technology ***2000,*** *19, 4177-4184 (Eng)*
The authors studied the thermochemical conversion and recycling of electric arc furnace dust (EAFD) and automobile shredder residue (ASR). The currently used commercial recycling techniques involving blast, induction, arc, and plasma furnaces consume large amounts of electricity which, when derived from fossil fuels, contributes to greenhouse gas emissions. Concentrated solar radiation provides "clean" thermal energy, achieving temperatures of 1500°K and higher. The authors present a highly technical thermodynamic study for the recycling process of EAFD and ASR. Chemical equilibrium compositions are computed over a wide range of temperatures for the carbothermal and CH_4-thermal reduction process. The maximum solar

- Develop an education team separate from all companies to work with small companies to improve their processes and increase their understanding, this will allow new problems to be addressed.
- Have a government team to investigate inter-industry synergies.

ELECTRONIC SCRAP

RECYCLING - TECHNOLOGY GAPS

- Separation technologies - R & D necessary, plastics a particular problem.
- Cathode ray tube (CRT) recycling technologies exist but they are expensive.
- There are composite plastics in new products: right now they need to be separated into various grades.
- Need for flexibility in technology to address changes in equipment design and material components.
- Existing technologies are often not suitable for small scale application.
- Identification of materials.
- Technology to manage workplace hazards i.e., beryllium, CRTs.
- Some existing technologies are not cost effective.
- Regulation levels the playing field: we need to give a clear message.
- Better automated processes, because volume will increase and labour is too expensive.
- Determine who will pay for the separation technology, we may still need to do it manually, pull if reusable, or remove, if it is hazardous.
- We need to mark the type of plastics being used (there is a move in this direction).
- American Plastics Council and its European equivalents are active in separation technology. We need to take a new look at this and see if some incentives can be given to make the technology commercially viable.

Notes:
- The priority is to invest in a regulatory policy framework to encourage recycling with industry involvement.
- If barium gets into the PC it will be a serious problem: is there a Canadian role in regulating to ban substances?
- Collection is an issue because we are dealing with small items of little value.
- Transportation is a major issue for CRTs because there are few places that do it.
- There is a flow of electronic scrap from Canada to the United States where it is separated and then shipped back, this is inefficient.
- The product life cycle is very short, how to get more years out of the product, or get a second use?
- Encourage upgradability.
- Take a modular approach.
- Design for disassembly, recovery of reusable components and recycling.
- Improvements in scientific knowledge about environmental and health effects of materials used in electronic equipment.
- Poorly developed technology and knowledge transfer.

- Impose a tax on landfills: if manufacturers are responsible for the end of life, it drives the front end. (We will get some benefits from European legislation because most components are imported, although it is not clear which materials will be banned.)
- Scalability of facilities needs investigation - development of technologies which are appropriate for smaller scale, smaller market/community applications.
- Get everyone who has a stake in the life cycle analysis and management voluntarily at the table.

COMMON RECYCLING TECHNOLOGY GAPS AND ISSUES ACROSS ALL FOUR SECTORS

- Separation technology.
- Scaling down technology for smaller companies to make recycling economically viable.
- Initial design for ultimate recycling.
- Refining technology (e.g., removing impurities) - cleaning it up.
- Automation (automated processing).
- Instrumentation: on-line sensors to identify materials (also hazardous materials).
- Constant change in materials used (materials become obsolete in short time).
- There is a lack of a green procurement policy on the part of our governments.
- There are no technologies to improve the efficiency of existing technologies.
- How to create products out of the composite materials generated by recycling activities?
- Low-cost, on-line, monitoring, control, and separation technologies.
- Application of technologies used in one sector to another sector.
- Creating products out of recycled materials and creating a market for these products.
- A clear understanding of life cycle analysis in each sector.

COMMON RECYCLING TECHNOLOGY THEMES

- Regulation issues/changes.
- Lack of information exchange within each given sector and between companies.
- Intellectual property (can stifle research).
- Cost and value.
- Low risk acceptance.
- Education / raising awareness.
- Recognition: positive spin, whole new conceptual approach to recycling.
- Governance: co-ordinating a positive approach, promoting eco-communities.
- Infrastructure (e.g., transportation).
- R & D funding (basic research for the future).
- Risk management and partnerships.
- Collaboration, (i.e., on research).
- Green credits and incentives.
- Life Cycle Analysis.
- Lack of technology transfer between stakeholders.
- Intellectual property, who owns the technology?
- Lack of technical resources.
- Technologies are changing too rapidly; it is difficult to keep up with how to take the machines apart and then to sort them.

energy conversion efficiency is determined. The major sources of irreversibility are identified. This information determines the constrains to be imposed on the design and operation of a solar chemical reactor. The authors state that especially for highly contaminated waste materials containing high concentrations of heavy metals, the solar thermal process might become cost competitive with conventional fossil-fuel-based processes, at current fossil fuel prices, even before the application of government subsidies and/or credits for pollution avoidance.

The following documents related to the aforementioned publication, coming from the same research facility, are available for downloading from ***http://www.pre.ethz.ch/cgi-bin/main.pl?publications***

Fuels from Sunlight and Water (Eng)
Steinfeld A., Palumbo R.

Brennstoffe aus Sonnenlicht für das 21. Jahrhundert (Ger)
Hirsch D., Kraeupl S., Schaffner B., v.Zedtwitz P.

Concentrated Solar Power in 2001 (Eng)
C. Tyner et al.

Light Years Ahead (Eng)
Steinfeld A., Epstein M.

Analysis of Recycled Thermoplasts from Consumer Electronics by Laser-Induced Plasma Spectroscopy
Fink H., Panne U., Niessner R.
*Analytica Chimica Acta **2001**, 440, 17-25 (Eng)*
The article describes a detailed study on employing laser-induced plasma spectroscopy (LIPS) for online elemental analysis of thermoplasts from consumer electronics which are destined for future use in an industrial environment. The authors determined the opti-

mum wavelength for plasma ignition and the best parameters for time-resolved detection, such as delay of the integration relative to the plasma ignition, gate width, and irradiance. The article describes in detail two experimental setups used in the study: a vertical detection geometry containing a pierced mirror, and an angled detection geometry. The authors analysed a sample consisting of 96 plastic pieces from shredded electronic waste. Reference analysis was performed by total reflection X-ray fluorescence (TXRF) analysis and by instrumental neutron activation analysis (INAA). Linear calibration plots were obtained by normalization to carbon as an internal standard with limits of detection that are sufficient for the envisioned online application. The article contains 43 references.

Recovering Zinc and Lead from Electric Arc Furnace Dust: A Technology Status Report
Zunkel A.D.
*Recycling of Metals and Engineered Materials, 227-236 (Eng) (Proceedings of the 4th International Symposium, organised by the Recycling Committee of the Extraction & Processing Division and the Light Metal Division of TMS, October 22-25, **2000**. Edited by Stewart D.L., Daley J.C., Stephens R.L., Warrendale, Pa)*
The author summarizes the processing options for low-carbon steel electric arc furnace dust (EAFD). After discussing the present EAFD management status by listing different types of EAFD treatment processes, the following challenges are discussed:

- Major issues facing EAFD producers, processors, and process developers.
- Commercially operating EAFD treatment processes.
- EAFD treatment plants under con struction or commissioning.
- EAFD treatment processes under development or evaluation.
- Dormant EAFD treatment processes.

RECOMMENDED NEXT STEPS

- Create a "Department of Recovery" at the federal government level.
- Identify government and industry champions for recycling.
- Develop an integrated communication strategy which takes into account such things as rapid response, association engagement, early warning, involvement in regulatory or legislative change.
  - Use government as the hub or the glue: get them to act as the facilitator.
  - Each sector should set up an information exchange system.
- Articulate the rationale or drivers for improving recycling technologies & activities and define the ultimate goal: do we mean closed loop recycling? or the creation of new products from recycled materials? or just don't put it in the landfill?
- Get all industry associations to monitor the development of regulations and ensure industry input into any changes and to develop an integrated communication strategy.
- Promote the establishment of a "Life Cycle Analysis and Management Centre of Excellence" as an independent research facility.
- Gather data on what needs to be recycled in Canada and why: What we can afford to dispose of and why? What are the volumes and what are their impacts on the environment? What are the economic benefits?
- Get copies of R-NET and access NRCan's website (http://www.recycle.nrcan.gc.ca/) for recycling information.
- Create a virtual centre of excellence on recycling (e.g., look into separation technologies).
- Unrepresented industry should get involved in the Canadian Standards Association (CSA) and the American Society for Testing and Materials (ASTM) processes to develop standards where none exist (e.g., the use of fly ash).
- Develop an R & D strategy to find solutions for efficient recycling.
- Find out what environmental impact the country is most interested in addressing.
- Create a "Design for Recycling" consortium.
- Acceptance and management of risk, risk sharing between the various stakeholders, between industry and government.
- Ban the use of the word **WASTE**.
- Improve procurement policies.
- Set up a recycling information exchange between various technology and sectors.
- Public education - show the benefits of recycling.
- Appropriately label recycled/recyclable materials.
- Address the intellectual property issue in order to facilitate information sharing.
- Improve partnership between research and development institutions and industry, implement a non competitive research model.
- By-product synergy concept.
- Change legislation to reflect the need for re-use.
- Reallocate resources at the federal level to address recycling process management.
- Have greater incentives for research and development, e.g., direct funding from governments encouraging solutions for recycling.
- Regulatory and policy framework to encourage and enhance recovery - linkages to environmentally sound management initiative.
- Increase focus of design for environment at all levels including the academic level.

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THE CANMET-CARI-EUROPEAN COMMISSION (TRAWMAR) INTERNATIONAL JOINT WORKSHOP ON RECYCLING AND SUSTAINABLE DEVELOPMENT

MONTREAL, QUEBEC, APRIL 23-26, 2001

The International Joint Workshop was a part of a continuing series of exchanges between Canada and the European Union that began in the early 1980's. It was organised by the Canada Centre for Mineral and Energy Technology (CANMET), the Canadian Association of Recycling Industries (CARI) and the European Commission (EC), through the Thematic Network TRAWMAR (Targeted Research Action on Waste Minimisation and Recycling), which is funded under the Industrial and Materials Technologies Research Technology Development programme of the European Commission's Directorate-General for Research.

The Montreal Workshop attracted about 60 invited participants from Canada, Europe, Japan and the United States. It featured 32 technical and overview presentations on recycling, sustainable metallurgical processing, effluent treatment with emphasis on plating solutions, and waste treatment and management. In addition, there were several presentations related to international collaboration especially within the framework of the Intelligent Manufacturing System (IMS) program, which Canada supports.

The first session, **INTERNATIONAL RESEARCH DIMENSIONS** featured:

Recycling: Key Component of a Sustainable Development Strategy was discussed by Michael Clapham, Natural Resources Canada, Ottawa. Recycling is a fundamental element of the life cycle management of products and their constituent materials.

Competitive and Sustainable Growth - New European Research Programmes (Projects and Actions Concerning Waste Processing and Recovery) was presented by Alain Adjemian, European Commission, Brussels, Belgium. Every five years brings a new multi-annual Framework Programme (FP), established and executed by the European Union, with defined objectives, basic scientific contents, administrative conditions and financial resources (http://www.cordis.lu/). Dr. Adjemian gave an overview of one presently running (FP5). One of the Target Research Actions (TRA) of this program is to develop technologies for modern and clean processes with zero waste production through waste prevention and recovery. Dr. Adjemian also discussed the successes of an earlier Programme (FP4). He ended his presentation with the introduction of the next Framework Programme which is being proposed by the European Commission for the years 2002-2006 and is designed to create a European Research Area. Also, a related initiative was presented: a call for proposals to create an European Virtual Institute on Recycling to improve synergies between projects, the dissemination of best available technologies, the development of standards, the creation of awareness on legislation,

- Abandoned EAFD treatment processes.
- EAFD stabilization and vitrification.
- Other EAFD management options, such as sale to exempt markets, hazardous waste landfills, minimization to upgrade zinc and lead values in EAFD, and dezincing and deleading prior to scrap melting.
- Significant trends and developments in EAFD processing and management.
- Products from EAFD treatment.
- EAFD processing economics.

The author concludes by saying that the EAFD treatment is becoming an economically driven resource recovery opportunity rather than an environmentally driven hazardous waste disposal problem, although EAFD treatment processes are generally not profitable in the absence of a tipping fee of at least US$90-100/tonne of EAFD.

Processing Steel Wastes Pyrometallurgically at INMETCO
Money K.L., Hanewald R.H., Bleakney R.R.
*Recycling of Metals and Engineered Materials, 397-408 (Eng) (Proceedings of the 4th International Symposium, organised by the Recycling Committee of the Extraction & Processing Division and the Light Metal Division of TMS, October 22-25, **2000**. Edited by Stewart D.L., Daley J.C., Stephens R.L., Warrendale, Pa)*
The INMETCO process is described and illustrated with a detailed flow diagram and pictures of relevant equipment. The following metals are reclaimed: Ni, Mo, Co, Cr, Fe, and Mn, and Zn, Pb, and Cd. The authors describe how the INMETCO process is used for the processing of electric arc furnace (EAF) baghouse dusts, rolling mill scales, and belt grinding swarfs from steel producers. The modified INMETCO process allows for the removal of metals from many other waste materials such as pickling solu-

tions from the specialty steel industry, plating waste liquids and filter cakes, spent nickel and chromium plating baths, super alloy wastes, spent catalysts used in chemical petroleum refining and food processing industries, and nickel-cadmium batteries. The authors emphasise that in 1990, the EPA stated in a new ruling that high temperature metal recovery was the best demonstrated available technology (BDAT) for the treatment of nickel-cadmium batteries. INMETCO is the only North American operator of such process. INMETCO does not landfill any residues from its process. The non-hazardous slag co-product passes the EPA TCLP leaching test, and is sold to local aggregate consumers. Some of this material is used as a base for parking lots and driveways.

The Importance of Using the Appropriate Allocation Procedure for Metals
Dubreuil A., Smith B.
Environment Conscious Materials-Ecomaterials, 81-91 (Eng) (Proceedings of the International Symposium organised by the Materials Science and Engineering Section of the Metallurgical Society CIM, August 20-23, ***2000****. Edited by Mostaghaci M.)*
Life cycle analysis (LCA) examines the environmental impact of products by studying the associated material and energy flows. Every time a LCA is performed an allocation procedure must be established to appropriately assign proportional shares of material and energy flows to the products and co-products of an industrial process. The allocation procedures are defined by ISO Standard 14041 and illustrated by ISO Standard 14049. Two allocation procedures are applicable for recycling (based on the inherent properties of the recycled material): closed loop - if the properties are maintained, and open loop - if the properties are changed. To highlight the importance of the allocation procedure to recycling, the authors used a case study of copper pipe used

the organization of conferences and workshops, and business initiatives on waste prevention and recovery.

The Minerals, Metals & Materials Society (TMS) and Extraction & Processing Division (EPD): A Forum for Interaction Among Professionals was presented by John Hager and Brajendra Mishra from the Colorado School of Mines, Golden, Colorado, USA. It summarized recent TMS activities, especially at the international level.

Overview of the Intelligent Manufacturing Systems (IMS) Program was presented by Allan Martel, Canadian IMS Secretariat, Ottawa, and Alain Adjemian, European Commission, Brussels, Belgium. The IMS facilitates international partnerships and provides an international platform for combining complementary skills. Through co-operation in IMS, costs, burdens, and risks related to R&D can be reduced and shared. IMS research is industry-driven, because it unites the end users of manufacturing technologies with advanced technology producers and research institutions. It focuses on real-world issues, ensuring the market relevance of its technological improvements.

Eco-Efficient and High Performance Hard Chrome Process was discussed by Pascal Négré, Protection des Métaux, Montreuil, France. This IMS project, with its knowledge-sharing approach, incorporates cooperation between companies from Europe, Canada, USA, Japan and Korea. The project, which will take 3.5 years to complete, intends to prove that this kind of cooperation (with a complex intellectual property agreement) is not only attainable, but also fruitful. The scientific goal is to arrive at an electrolytic solution free of hexavalent chromium, Cr (VI), for use in stable hard-chromium plating.

Eco-Efficiency Through By-Product Synergy: North American Case Studies was reviewed by Roger Yates of Hatch Associates, Mississauga, Ontario. Once companies have reduced wastes and conserved energy, they can begin to look at the value-added prospects of their remaining wastes and unused energy streams. The idea is that one industry's wastes are another industry's base materials. To facilitate the exchange of by-products, businesses will work together to determine available discards and their potential users. By-products can then be exchanged, sold, or donated between industries, creating a by-product synergy.

A session on **LIFE CYCLE DEVELOPMENT (RECYCLING)** featured:

Recycling, a Canadian Update was presented by Len Shaw and V.I. Lakshmanan of the Canadian Association of Recycling Industries (CARI). With increasing awareness of greenhouse gas (GHG) emissions and the rising cost of energy, the recycling industry will find a major role in providing partnerships between producers and end users of materials. To realize the environmental and economic benefits of recycling, an aggressive co-operation between technology developers, industry end users, and facilitators, including government agencies, based on a level playing field and shared vision, will be essential.

TORBED Process Reactor Technology for Asphalt Paving Recycle was discussed by Robert Laughlin of Torftech (Canada) Inc., Mississauga, Ontario. The reactor effectively destroyed the coal tar from old asphalt and cleaned the aggregate, such that it could be reused. The energy generated from the destruction of the coal tar was reused in the creation of new bitumen-containing asphalt paving. The concentration of carcinogenic polyaromatic hydrocarbons (PAHs) was below the regulatory limit.

Recycling and Valorisation of Stainless Steel Slags was a topic reviewed by Johan Van Dessel, Belgian Building Research Institute, Brussels, Belgium. The slag purified by direct current arc plasma technology could be used in road applications as stabilized sand and in concrete applications. The first step of the research activities concentrated on improving the quality of the slag by modifying the stainless steel process. Different additives were tested to minimise fluorine additions and to replace the fluorine flux. The result was a 20% reduction in used fluorine and an increased awareness of the quality and the composition of stainless steel slag at the processing plant.

Synergistic Effects of Chemical Admixtures in Concretes Containing Supplementary Cementing Materials was related by Noel Mailvaganam, National Research Council of Canada, Ottawa. The addition of admixtures, such as superplasticizers, exhibited significant improvements in the rheological, structural, and durability characteristics of the concrete-containing fly ash or silica fume.

Design for Recycling was presented by Vince Catalli of ***by dEsign Consultants***, Ottawa. An architect-turned-recycler presented the basic rules that should be followed in the construction of easily deconstructable buildings, such as easily definable layers of different construction materials, avoidance of cross-contamination, avoidance of adhered/fixed and concealed connections, application of materials with an inherent finish, and use of modular material. He also discussed designing construction and renovation projects in such a way as to facilitate future renovation and demolition, potentially encouraging the reuse and recycling of individual materials and entire assemblies in new projects and products.

Life Cycle Perspective of Plastic Recycling was discussed by Reinhard Ballhorn of TRAWMAR. Unlike the recycling of metal scrap which is market-driven, the recycling of plastics is primarily driven by legislative measures. A sensible mix of physical and chemical recycling techniques (such as the chemical recovery of polymer molecules, gasification, and depolymerisation) in combination with energy recovery will provide the most promising way to cope with the economical and ecological challenges facing plastics recycling today and in the future.

Car Plastic Fuel Tanks: Closed Loop Recycling Process Design and Life Cycle Assessment was presented by Jean-Marie Yernaux, Solvay S.A., France. A "repair additive" used to restabilise recycled high density polyethylene (HDPE) actually improves the mechanical and rheological behaviour of the resin during extrusion. In 2001, Renault, Inergy, and Solvay will conclude a validation test, which likely will lead to Renault using HPDE recycled material in new fuel tanks.

Automobile Shredder Residue: Some Recycling, Resource Recovery, and Disposal Options was reviewed by Michael Day, National Research Council of Canada, Ottawa. Approximately three hundred kilograms of automotive shredder residue (ASR) is produced for each tonne of steel recovered from scrapped automobiles. Several

to carry water. The authors conclude that, when compared with an open-loop recycling allocation procedure, the closed-loop allocation more closely resembles the actual situation that occurs with various metal products. The authors also notice that primary and secondary metals belong to the same “capital.” Metals are not consumed, but are used in a given application for a period of time to take advantage of their unique properties. In this way the use of a metal in a product constitutes a “loan.” Any loss of metal arising from failure to recycle or unrecoverable disbursement to the environment must be “reimbursed” by an equivalent quantity supplied by primary production.

Good Wood Gone Bad

Tom P-A.

*Waste Age **2001**, August, 36-51 (Eng)*

Extensive research on managing chromated copper arsenate (CCA)-treated wood waste is currently under way in Florida. The wood is just beginning to reach disposal, and will not peak for another 15 to 20 years. At the moment CCA-treated wood is exempt from the United States hazardous waste regulations and there is no established procedure for end-of-life management of CCA-treated wood. Most American states treat CCA-treated wood in the same way as they treat other discarded wood products. In Florida, discarded CCA-treated wood is primarily placed in unlined C&D waste landfills or at C&D recycling facilities, with smaller amounts managed as municipal solid waste (MSW) in lined landfills or waste-to-energy (WTE) facilities. And undetermined amount is also recycled into mulch. In rainwater leaching tests making use of the US EPA’s synthetic precipitation leaching procedure (SPLP), the concentration of arsenic leached from CCA-treated wood exceeds the US primary drinking water standard of 50 parts per billion. Samples collected from Florida C&D

waste recycling facilities in 1997 found an average of 6% CCA-treated wood content in chipped wood piles, and more recent numbers are between 9% and 30%. The presence of 4% to 6% CCA wood in wood fuel transforms the ash into hazardous waste. An even smaller amount of CCA-wood causes arsenic to leach from wood mulch at levels higher than allowable in landfills. Also, if the fraction of CCA-wood is greater than 1% by weight in mulch, it leaches arsenic in concentrations exceeding the 50 parts per billion limit. There are numerous questions that the C&D industry should be asking, such as how to separate the wood, how to dispose of it, where to dispose of it, and how to process the material if it is sent to a lined landfill or waste-to-energy (WTE) facility. The separation of CCA-treated wood is not easy. For example surface staining is time-consuming. Although detection systems - X-ray fluorescence (XRF) or laser-induced breakdown spectroscopy (LIBS) could be incorporated into a conveyer system at a processing facility, they are not commercially available.

The Internet web page ***http://www.ccaresearch.org/*** describes CCA-treated wood projects sponsored through the Florida Center for Solid and Hazardous Waste Management. The site contains full reports of the Florida research. One of the featured publications is: *"Management of Discarded Treated Wood Products: A Resource Guide for Generators"* (***http://www.ccaresearch.org/publications.htm***).

Continuous coverage on issues related to CCA-treated wood is available at: ***http://www.wasteage.com***

resource recovery and recycling options for ASR were presented including pyrolysis technologies and recycling into composite materials. Emphasis was put on the use of ASR as a landfill day cover, because of its capacity for absorption of heavy metals, compactibility, erosion resistance, good traction, and soil conservation.

The Development of Compounding Procedures for Recycled Polyamide for Use in Automotive Industry was discussed by Edorta Larrauri, Gaiker, Spain. A technology was developed, on a pre-industrial scale, for the manufacture of polyamide details for the automotive industry using recovered polyamides from diverse industrial sectors. The process is currently validated by the cost-effective manufacture of fan blades and shrouds for the automotive industry.

EFFLUENT TREATMENT - PLATING WASTES were the subjects of a third session that highlighted European efforts to treat chromium-bearing solutions or to find alternatives to chromium salts in surface treatment operations. The session included the following presentations:

The Recovery and Recycling of Cr(VI) from Waste Streams by Rodolfo Solozabal, INASMET, Spain,

Regenabath - Novel Regeneration Methods for Strongly Acidic Metal Treatment Baths by John Collins of Capenhurst Technology Ltd., England,

Towards Zero Liquid Waste in Plating Industry by Development and Validation of Closed Loop Eco-Efficient Processes by Jacques Halut of Protection des Métaux, France.

Metal Waste (Cu and Ni) Prevention by Supported Liquid Membranes and Modified Electrodialysis by R.F. De Ketelaere, University of Gent, Belgium.

All four presentations dealt with effluents from electroplating industries. These effluents contain heavy metals, such as hexavalent chromium Cr(VI) which is a known carcinogen. The presenters listed the challenges and possible outcomes of their research leading to the recovery of the heavy metals present in the electroplating effluents. The last presentation featured the results of an extensive study on the development of an integrated process for recycling copper and nickel salts from industrial electroplating baths and effluents. In contrast, the first three presentations discussed projects at a very early stage of implementation.

New Chromate-Free Passivation Treatments for Zinc, Zinc Alloy, and Zinc-Containing Coatings and Surfaces was presented by Chris Smith, Defence Evaluation and Research Agency, UK. The development of an alternative to chromate passivation was discussed. It will provide the same level of corrosion protection as chromate-based passivation treatments and will promote the adhesion of surface coatings and paint films. Assuming that the process can be scaled up, various SME partners are ready to adopt it. They have already agreed on the future exploitation of the treatment.

Plating Effluent Management in Canada was reviewed by Peter Paine, Environment Canada, Ottawa. Regulatory and non-regulatory initiatives in Canada were examined.

Current treatment technologies for metal rinse waters were reviewed. The presenter also analysed several case studies, such as the installation of polishing filters, the recovery of chromic acid, and an evaporative distillation system.

Novel Process to Recover By-Products from the Pickling Baths of Stainless Steel was discussed by Carlos Frias, Técnicas Reunidas, Spain. The regeneration of spent pickling baths as well as the recovery of rinse water were achieved. Metals were recovered, by electrowinning, in the form of metal alloy deposits. Rinse water treatment using reverse osmosis and nanofiltration is ready to be used in industrial applications. Additional work is being proposed to explore membrane selection for electrodialysis (acid recovery) and electrowinning (metal recovery).

Chromic Acid Recycling from Rinse Water in Galvanic Plants by Electro-Electrodialysis was presented by Gérald Pourcelly, the European Membrane Institute, France. The main objective is to develop and validate a new system for the recuperation of chromic acid from rinse baths in the electroplating industry. The system will use electro-electrodialysis (EED), with three compartments. The authors claim that the new system of chromic acid recovery will be modular, portable, and sufficiently inexpensive to be affordable for SMEs.

The next session emphasized **SUSTAINABLE METALLURGICAL PROCESSING**.

Sustainable Development at CEZinc was discussed by Sylvain Seyer, CEZinc, Valleyfield, Quebec. A virtual presentation of the operation was given. It was followed by a description of the electrolytic process for zinc production that emphasized the wastewater treatment plant and the Jarofix process for the stabilization of the iron-rich jarosite residues.

High Temperature Bacterial Leaching - HIOX Project was presented by Patrick d'Hugues of BRGM, France. A biohydrometallurgy alternative for the processing of sulphide minerals was presented. The process leaches chalcopyrite ($CuFeS_2$) and gold-bearing sulphide minerals by the use of thermophilic bacterial cultures at a temperature of 78°C. The HIOX (High temperature bacterial oxidation) is ready for implementation, and a patent application has been filed.

Integrated Cost Effective and Clean Treatment of EAF Dust was reviewed by Ibrahim Gaballah, INTL-Nancy, France. This project aims at the construction of on-site EAF dust treatment facilities with a daily capacity of 5 to 25 tonnes. The process uses H_2SO_4 to leach ZnO selectively while $ZnFe_2O_4$ is left in the residue to be recycled to the electric arc furnace. The goal is to produce pure zinc oxide using a fully closed loop circuit thus avoiding any liquid effluents. According to the project scope, no solid, liquid, or gaseous wastes will be produced. So far, the researchers have characterized and pelletized the EAF dust, explored its characteristics, solubilized its zinc content, electrodialized the feed-back solution, and decomposed the obtained zinc hydroxycarbonate.

The Goodfellow EFSOP™ Process for Energy Conservation in Metallurgical Industries was presented by Howard Goodfellow, Stantech Global Technology Ltd., Mississauga. The Expert Furnace System Optimization Process (EFSOP™) is a system for optimizing energy usage and the off-gas composition of electric arc furnaces. A

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patented, water cooled probe is used to sample the furnace exhaust gases. The analyser monitors the levels of CO, CO_2, H_2 and O_2 in the gas sample. The computer system logs these data and presents the information to the operator. The system also dynamically changes the process and fume system set-points in response to the off-gas chemistry. The components include gas sampling probes, hardware and software for data acquisition, process control, display, analysis and historical trending.

Electrolytic Methods for Recovery of Metals with Particular Emphasis on the Recovery of Zinc from Galvanized Steel was reviewed by William Morgan, Hydromet Environmental Recovery Ltd., Hamilton, Ontario. Dissolved metals are electrodeposited as a pure product and the solvent is regenerated, generally in one step in an electrowinning process. The emphasis was put on alkaline electrowinning in place of the acid process, which is currently practised. Refinement of the presented electrowinning technology could lead to an economically competitive processes for the recovery of zinc from clean and obsolete scrap, the recovery of zinc from EAF dusts, and the recovery of zinc from flue dusts.

The last session of the meeting focussed on **WASTE MANAGEMENT - WASTE TREATMENT.**

Waste Stabilization at Stablex Canada was presented by Roger Gibb, Stablex Canada Inc., Blainville, Quebec. The presentation examined the array of regulations under which the environmental industry operates, as well as ethical issues such as the social, economic, and environmental interests of the community in which the company operates. In the future, pollution prevention combined with an improved management of industrial waste streams will be of the utmost importance. However, there will still be a need to dispose of whatever is left over after the industrial processes in an environmentally responsible manner.

Solar Detoxification Technology for the Treatment of Non-Biodegradable Hazardous Water Contaminants was discussed by Julian Blanco, CIEMAT, Spain. In a three-year, recently completed project, solar energy was used to detoxify effluent solutions. The photo-catalytic oxidation process, on which solar detoxification is based, relies on the generation of hydroxyl radicals •OH when a semiconductor catalyst (TiO_2) is bombarded by near-ultraviolet light (wavelength below 380 nm) in the presence of oxygen. This technology could be used to remove contaminants from wastewater where biological waste treatment is not feasible. Potential applications include: methylated phenols such as phenol and cresol, chlorinated hydrocarbons, pharmaceutical compounds such as antibiotics, wood preserving waste such as pentachlorophenol, agrochemical wastes (pesticides), and groundwater decontamination. The technology has been validated by the construction of a full-size demonstration plant.

Canadian Construction Industry was reviewed by Michael Rich, National Research Council of Canada, Ottawa. The commercial, institutional, and industrial sectors of the construction industry have begun to identify opportunities in the fields of sustainability, performance and recycling. The use of by-product materials in concrete has been ongoing in the cement industry. The author gave several examples of scrap materials successfully incorporated into construction projects, such as the utilization of 25% fly ash in the concrete floor of a recently constructed large industrial plant. In the same plant, the steel support structure and roof joints were salvaged from a previously uncompleted project. The new objective-based National Building Code will be a timely encouragement to the efforts to find, develop and identify new and innovative solutions to the major challenges of increasing the overall sustainability and recycling in key sectors of the Canadian construction industry.

Recycling of Ferrous Sulfate by the Synthesis of a New Super Oxidant Material was discussed by Ndue Kanari, University Henri Poincare, France. The presenter summarised a three-year fundamental research project on the synthesis of potassium ferrate (Fe (VI)) from ferrous sulphate heptahydrate ($FeSO_4 \cdot 7\ H_2O$). Ferrates have strong oxidizing properties and could be used as a bactericide in treating drinking water and wastewater, in effluent decontamination and in soil remediation. The ferrous sulphate heptahydrate is a by-product of the production of titanium dioxide via the sulphate route; one tonne of TiO_2 results in 6 tonnes of $FeSO_4 \cdot 7\ H_2O$. The synthesis of potassium ferrate using KOH, $FeSO_4 \cdot x\ H_2O$ and Cl_2 was patented by the consortium carrying out the development work. The positive results prompted the partners to obtain two patents for possible industrial applications. The synthesis of alkali ferrates at an industrial scale will be performed at a Solvay facility.

General Observations

The workshop clearly highlighted the basic differences between the European and Canadian approaches to recycling. The European approach is research-driven in anticipation of changing legislation. The European Union commits substantial sums of money to develop new technologies and new ways of dealing with post-consumer and post-industrial products and by-products. At the time of the meeting, TRAWMAR managed a portfolio of 29 multi-company multi-national projects combined in three research clusters encompassing European Union members and aspiring European Union countries. The financed projects are multi-national, with specialized laboratories, pilot plants, and industrial facilities in many countries. An extensive legal process for distinguishing the ownership of intellectual property is being implemented. The Europeans believe that a substantial up-front investment will result in the development of low-cost, proven technologies for the recycling and reuse of scrapped, discarded and junked materials. Policies will be developed based on the available technologies.

This is in sharp contrast to the North American approach of leaving recycling to the mercy of market forces. A lack of direct authority (too many policy makers, such as federal and provincial governments and municipalities) and widely opened legislative loopholes often make recycling economically unattractive. This conclusion was emphasized again and again in the various presentations. Dumping hazardous waste in a landfill is widely practised in many Canadian provinces and some of the American states, despite the potential risks associated with this practice.

For additional information, please contact Elizabeth Giziewicz, by phone at (613) 996-1581, by fax at (613) 996-9041, or by E-mail: giziewic@nrcan.gc.ca

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Et cetera...

Natural Resources Canada Launches Recycling in Canada Web Site (www.recycle.nrcan.gc.ca)

Natural Resources Canada (NRCan) is pleased to announce the launch of a Recycling in Canada web site featuring a national database of over 3000 companies involved in metals recycling in Canada. The site also contains a draft analytical framework of commodities currently being recycled in Canada, numerous links to recycling-related web sites, and information on events related to recycling.

The goal of this web site is to promote and enhance recycling in Canada by providing information on the diverse range of recycling-related activities taking place in Canada today. As a first step, we have developed a metals recycling database to inform Canadians about the existence of recycling participants located throughout Canada and to assist generators, processors and sellers of recyclable metals and metal-bearing materials in identifying new sources, opportunities and buyers for their products. Over time, we intend to add information on the recycling of other commodities such as paper and wood fibre products, plastics, rubber/tires, liquids, chemicals and gases, glass and fibreglass, minerals, oils/petrochemicals, wood, organics, and textiles.

NRCan is committed to the sustainable development of Canada's natural resources. The recycling, re-use and recovery of products, materials and energy resources are fundamental to sustainable development, the protection of human health and the environment, and industrial competitiveness.

Contact Maureen Coulas by email at mcoulas@nrcan.gc.ca, by telephone at (613) 992-4093 or by fax at (613) 943-8450.

CARI's Corner

Canadian Association of Recycling Industries

ARE WE RECYCLING LITERATE?

By Leonard Shaw

Many people consider themselves good recyclers because they place certain articles in a blue box. Many societies believe that they are strong recyclers because they have residential curbside blue box programs, blue boxes in the schools, blue box and other collection programs in office buildings, and recycling collection programs in shopping centres. Unfortunately this is not recycling. It is material collection.

When asked to explain the value of recycling, most answer that there are environmental benefits. However, when asked to state the actual environmental benefits, most reply only that it saves natural resources and reduces materials that go to landfill. Many do not appreciate that recycling greatly reduces energy consumption, emissions into the air, emissions into water, and the amount of water used in, and the amount of waste solids generated in the production of primary materials. Similarly, they are unaware of the benefits of avoiding the creation of long-term problems such a leaching from landfill sites. Most are even less enlightened about the economic value of recycling.

Therefore, there really is still a great need to educate society about the benefits of recycling, both economic and environmental, but that is not the whole story. Even those people who believe that they are good recyclers, whether or not they know of all the benefits, fail to place all the materials that they can into the recycling stream.

What do they do with beer caps or the metal screw wine tops when the beer bottles are returned and the wine bottles are placed in the blue box? Even though their newspapers and corrugated cardboard boxes are put in the blue box, what happens to all of their other paper products, such as envelopes, old letters, and greeting cards? What happens to the toilet roll and kitchen roll cores? Excluding compostable waste, fibre product waste, in every form of paper, is the largest component still being sent to landfills. Therefore, in fact, there is an even greater need to educate the public about recycling.

But that is still not the whole answer. These two aspects focus only on the supply side of the recycling equation. What about the demand side? What about buying products that are recyclable or that have high recycled content? Would you pay $30,000 or $40,000 for a new car that is made from 100% recycled materials? Car manufacturers plan to reach this goal but do not promote the recycled content and recyclability in their advertising because of the public's perception of recycled products. Similarly, when a consumer buys a new house, does recycling enter into the equation? Do they know of and ask for steel framing and roofs made from 100% recycled steel, insulation made from recycled textiles or newspapers, or other products such as drywall from recycled gypsum board, carpeting from recycled nylon, windows from recycled aluminum and recycled glass, and wiring from recycled copper?

Are we recycling literate? No! To be recycling literate requires people to become knowledgeable about the benefits of recycling, to collect all materials and products for recycling, and to seek out recyclable and high recycled content products when buying. At best, today's society is really only semi-literate with regards to recycling.

For further information regarding the above article, or for information on CARI's activities and membership, please contact Dr. Leonard Shaw. He may be reached by phone (613) 256-8533, by fax (613) 256-8534, or E-mail len.shaw-cari@on.aibn.com