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Canada

R-NET

Canadian Association of Recycling Industries

RECYCLING TECHNOLOGY NEWSLETTER

VOLUME 5, ISSUE #1, JANUARY 2000

Currently, over 95 percent of all end-of-life vehicles are recycled. By weight, 75 percent of each car is recyclable, but there remains the difficult challenge of analysing and finding ways to use the remaining 25 percent. The ideal car of the future is frequently pictured as non-polluting, made of environmentally friendly materials, and fully recyclable. The automotive industry is expected to make this vision become reality.

Automobile manufacturers use an ecological Life Cycle Assessment to examine all stages of the product life cycle - from extraction of the raw materials, to assembly and service life, and finally to recycling and disposal. The work focuses on the development of recycling technologies, on the planning of disassembly and recycling processes, and on the design features that will improve the recyclability of components and encourage greater use of recycled materials. Today, the recyclability of a vehicle is already considered at the development stage of car design.

Ecology and economy need not be contradictory goals. Investment in integrated, sustainable environmental protection also brings a reduction in costs. At DaimlerChrysler the recycling of paint in their plant in Düsseldorf, Germany, reduced the consumption of new paint by 12 percent per year and decreased the amount of paint sludge requiring disposal by 70 percent.

DaimlerChrysler marked Earth Day 1999 with the unveiling of their Concept for Advanced Recycling and Environmental (CARE) car, a prototype Dodge Stratus. This car contains numerous items manufactured from recycled materials: tires, seats, trim, floor mats, sun visors, fuel tanks, air bag systems, door handles, carpeting, fascias, mirrors, and seat belts. Concepts showcased in the “green” Stratus may find their way into production vehicles within the next five years as part of DaimlerChrysler’s efforts to produce 85 percent recyclable products by 2002. By 2005 DaimlerChrysler expects new models to be 95% recyclable, with carry-over models being 90% recyclable.

Automotive recycling and automobiles built from recycled materials are an important step in the quest to conserve natural resources, potentially reduce air and water pollution, and make use of materials that would otherwise end up in landfills and scrap heaps.

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

VISIT R-Net’s HOME in cyberspace at **http://RNET.NRCan.gc.ca/** This bilingual web site contains current and previous issues. Bookmark this site and visit it often for interesting links and current event listings.

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.

Editor-in-Chief	Elizabeth Giziewicz
French Editor	Micheline DesRosiers
Research	Marko Sawchyn
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Abstracts	Madona Skaff
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Subscription Information:

For a free subscription, send your name and address to:

Elizabeth Giziewicz
555 Booth Street, Room 338 B
Ottawa, Ontario
Canada K1A 0G1

or send a request by e-mail to:
giziewic@nrcan.gc.ca

R-Net
Natural Resources Canada
555 Booth Street, Room 268
Ottawa, Ontario
Canada K1A 0G1
Telephone: (613) 996-1581
Fax: (613) 996-9041
http://RNET.NRCan.gc.ca
ISSN 1205-5549

PRINTED IN CANADA
IMPRIMÉ AU CANADA

Automotive Recycling

ELECTROSTATIC PLASTICS SEPARATION

By James D. Brown

A MAJOR ENVIRONMENTAL PROBLEM faced by the automotive industry is mixed plastics waste. This waste could be the result of trimmings during parts manufacturing or it could be the automotive shredder waste left after the recovery of steel and non-ferrous metals from scrap cars. While pure plastics can be recycled and used as substitutes for virgin polymers, mixed plastics, because of the incompatibility of polymer properties, have little or no value.

A dry electrostatic process to separate mixed plastics was developed by I. I. Inculet, J. D. Brown, and G. S. P. Castle in the Applied Electrostatics Research Centre at the University of Western Ontario. This patented process was shown to be capable of separating 50:50 mixtures of a number of plastics to above 99% purity with ~80% yields in a single pass. Commercial, continuous flow units with a capacity of one tonne/hour have been built and the results of the laboratory experiments were reproduced and even improved. Plas-Sep Limited was incorporated to commercialize this process and has obtained exclusive rights to the patent.

The separation procedure relies on the principle of triboelectric charging, which is the generation of electrostatic charges when two materials make contact or are rubbed together, then separated. During this process electrons are transferred from the surface of one material to the surface of the other material. The relative position of a substance in the Triboelectric Series (TS) predicts its charge polarity when brought into contact with another material. TS is a list of substances arranged in such a way that one can become positively charged when rubbed and separated from another farther down the list.

Small particles of dry, clean chopped plastics (5-10 mm) are fed into a rotating drum. The drum rotation causes the material to tumble, becoming charged by repeated contacts. The charged material then falls vertically into a strong horizontal electric field generated by two electrodes located in a separation tower. The charged particles are attracted by the electrode of the opposite polarity. Purified products fall near the positive and negative electrodes while the material which falls in the middle is collected for reprocessing.

Figure 1 presents a flow diagram for the separation of automotive dashboard waste representing scrap and off-spec waste from manufacturing. This material consists of a polyvinyl chloride (PVC) (or thermoplastic polyurethane (TPU)) surface layer backed by a polyurethane (PU) foam layer and a surlyn film. The separation scheme depends on whether PVC or TPU is the surface polymer on the dashboard. The two schemes are shown in parallel, and for an actual plant which produces both kinds of scrap, two separation units are required. These would switch from separation of PVC to separation of TPU from time to time as needed to keep up with the accumulation of the two kinds of scrap which are kept segregated in the plant. The final products from these processes have sufficient purity for recycling, replacing virgin materials.

First, the material is shredded and ground to approximately 10 mm size. During this process the PU foam and surlyn film are completely released from the PVC or TPU surface layer. The fines are removed by air elutriation. The ground material is then fed into the separation process. In the case of the PVC based material, the PU foam is collected at high purity on the initial pass through the separation, while the PVC and surlyn must be further separated to obtain pure products. In the case of the TPU surface layer, after the initial pass the PU foam is contaminated with about 10% TPU. However, this product is still useable for carpet backing. Again, a secondary separation is required to separate the surlyn film from the TPU to attain sufficiently pure streams for recycling.

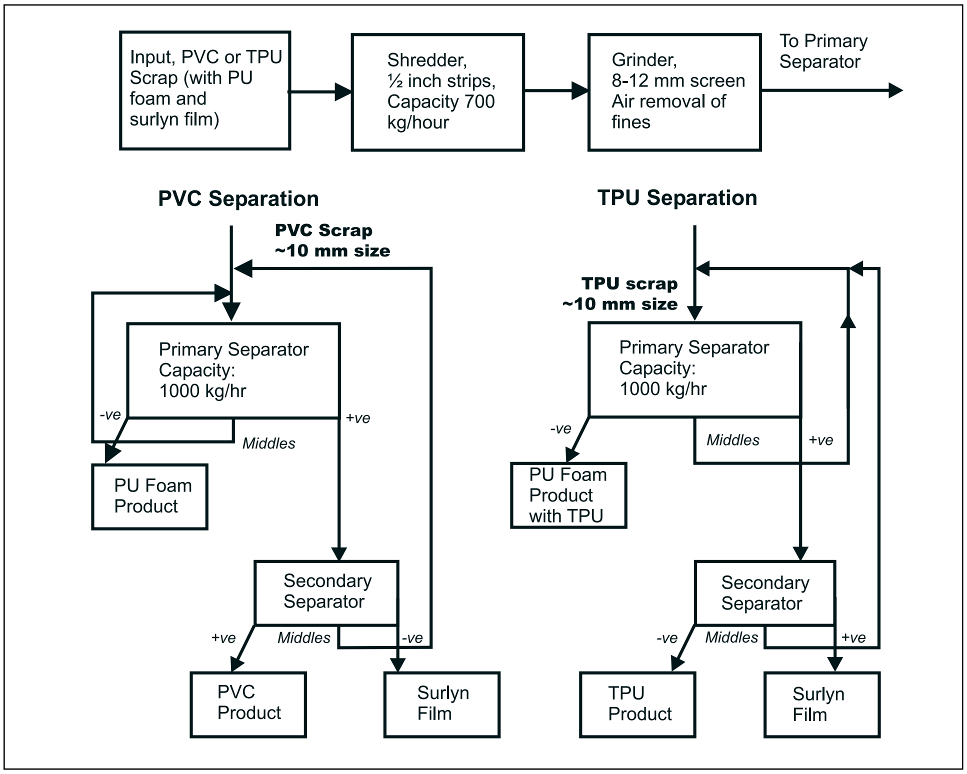


Figure 1. Flow diagram for separation plant for automotive dashboard scrap.

Another example is the separation of polyethylene (PE) from polypropylene (PP). An initial 50:50 mixture can be separated into 99.7% pure PP with an 80% yield and 99.8% pure PE with a 70% yield in a single pass through the process. Overall this represents a 75% efficiency. Even for these low value plastics (September 1999: US $0.07 and US $0.16 per pound for recycled PP and PE respectively) a strong economic case can be made for profitable operation of a separation plant. An even stronger case can be argued on the basis of savings achieved by substitution of purified recycled material for virgin material, thus lowering production costs.

Recycling of mixed plastics has been limited because of the lack of an economically viable means of separating mixtures. The dry electrostatic process offers the promise of transforming an industry with very thin profit margins and little economic incentive into a highly profitable sector.

For more information please contact Dr. Jim Brown, at Plas-Sep Limited, by phone at (519) 660-0287, by fax at (519) 660-6913 or by E-mail: jamesd.brown@sympatico.ca.

Literature

Reclamation of Urethane Foam from Automotive Seats
Martel B.
*Proceedings of the Polyurethanes World Congress **1997**, Sept. 29-Oct. 1, Amsterdam, The Netherlands, 588-597 (Eng)*
A two-part study was conducted to design a process for isolating the components of automotive seats into polyurethane foam, steel, and fabric and other coverings. In the first phase, a variety of size-reduction equipment was evaluated. This included a shear shredder, a rotary grinder, and a ring mill. After studying the advantages and disadvantages of each piece of machinery together with a cost analysis, it was concluded that a stand alone ring mill is the most economical option for primary size reduction of auto seats. The second phase of this study addressed the foam separation process, its economics and logistics regarding process location. A preliminary plant design was completed for a fixed auto seat recycling plant, which should be located at a large dismantler facility. Capital costs for fixed and portable plants were also evaluated, though a portable plant was not deemed viable.

Nonferrous Metal Recovery from Automotive Shredder Residue Using Eddy Current Separators
Gesing A.J., Reno D., Grisier R., Dalton R., Wolanski R.
*EPD Congress **1998**, 973-984 (Eng). Edited by Mishra B., TMS, Warrendale, Pa., ISBN 0-87339-388-0*
Eddy current rotor (ECR) separators are increasingly used by auto shredder operators to remove non-ferrous (NF) metals from automotive shredder residue. The following topics are covered in this article: operation of ECR separators (with case study illustrating the effect of the choice of the ECR operating point on shredder economics), material recovery, grade of NF metal concentrate, feed rate, and system optimization (defined as net earnings per tonne of input). In the system optimization section, the authors discuss the use of multiple ECRs put in series

and in parallel as well as pre-concentration of the ECR feed. This is a very detailed work demonstrating the economic importance of maximizing metal recovery in the shredder system. It is complemented by numerous graphs, equations, photographs, and references.

Is the Pyrometallurgical Recovery of the Inorganic Material an Option for Automobile Shredder Residue?
Reuter M.A., Pieterse M.V., Dalmijn W.L.
REWAS'99 Global Symposium on Recycling, Waste Treatment and Clean Technology ***1999****, vol.2, 1787-1797 (Eng). Edited by Gaballah I., Hager J., Solozabal R., published by TMS and INASMET, ISBN Global 84 923455 63*
The authors evaluated high temperature, ~1500°C, recovery of inorganic materials contained in automobile shredder residues (ASR), as an alternative to landfilling. In the Netherlands, 150 000 tonnes of ASR is sent to landfill annually. ASR was subjected to a high temperature smelting process under equilibrium conditions. The following parameters were varied: slag basicity, reaction time, process temperature, and composition of the feed. The authors examined off-gases, the slag phase, and the copper content in the iron-rich metal product, also documenting the distribution of manganese, silicon, copper, and sulphur between metal and slag phases. The authors were able to produce a clean slag using high temperatures and low oxygen partial pressure. Unfortunately, to produce a copper-free metal phase, lower temperatures and higher partial pressure were required. The authors conclude that the two contradictory objectives make it rather difficult to devise a pyrometallurgical treatment for ASR to simultaneously produce environmentally harmless slag and desired metal products. They suggest that rather than have an "end-of-pipe" approach, it is better to have an entire system of interconnected processes working together.

Recycling of Shredder Dust
Ochi S., Yaoita K., Nakao S.
ib., REWAS'99, 1807-1816 (Eng)
Japan produces 1.2 million tonnes of shredder dust annually from automobile scrap and electric appliances. This paper looks at ways

Municipal Solid Wastes

Stimulation of Landfill Gas Production
Martin D.J. , Potts L.G.A. , Reeves A.
Jubilee Research Event, Two-Day Symp. ***1997****, Vol.1, 65-68 (Eng), Institution of Chemical Engineers: Rugby, UK*
The authors claim that they have replicated waste degradation in landfills using 10 litre lysimeters in a laboratory environment. They modelled the organic fraction of municipal solid waste with a mixture of paper (56%) and foodstuffs (44%) and studied the production of biogas. Four lysimeters were used. An inoculum, a buffer, and a phosphate source were added to two lysimeters. There was no leachate recycling nor pH correction at any stage. High-rate methanogenesis (260 litres of methane per year per kilogram of waste) was achieved in 34 weeks and was maintained for 17 weeks.

RECYCLABLE MATERIALS VERSUS WASTE

By Leonard Shaw

Recyclable Materials	Waste
are secondary sources of commodity materials	are taken out of commerce
are used to manufacture goods	are not used to manufacture goods
save natural resources	consume natural resources
save energy	consume energy
reduce air emissions	generate air emissions
reduce water usage	consume water
reduce water emissions	generate water emissions
reduce mining wastes (tailings)	generate mining wastes
reduce land fill needs	create land fill needs
have value	have little or no value
are sold by recyclers (revenue)	require disposal fees (expense)
are traded internationally: LME, Chicago Board of Trade (Oct. 95)	have no international indexing
on a per tonne basis, create more than 10 times as many jobs as disposal*	on a per tonne basis, create 1/10th the number of jobs as recycling*
on a per tonne basis, generate revenue greater than that from disposal ($120)*	on a per tonne basis, generate revenue primarily from tipping fees ($40)*
when manufactured into products, generate even higher revenue ($1,140)*	are not used in end products ($40)*
are not a direct environmental problem	present environmental problems (leaching)

* New Jobs and Profits from Recycling Old Materials - The Institute for Local Self-Reliance

Post-Consumer Products

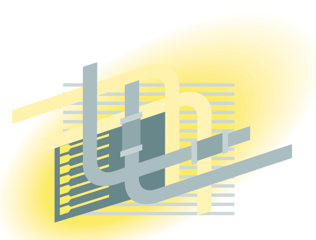
Plastics Resource, an Internet site maintained by the American Plastics Council, has a number of publications available for downloading at: **http://www.plasticsresource.com/**
Some of them are:

Understanding Plastic Film; Its Uses, Benefits and Waste Management Options *(Eng)*
Plastic film can be produced with a variety of resins to achieve specific properties. The report explains composition, properties, and applications of plastic films as well as the management of film wastes. It describes various recycling processes and reviews the recycling equipment. The report also includes examples of successful film recycling endeavours, where large volumes of like film (i.e., film made with the same resin) with low rates of contamination are generated (i.e., at warehouse and distribution centres).

Recovering Plastic Film from a Mixed-Waste Material Recycling Facility: A Case Study *(Eng)*
This report provides the results of a case study assessing the feasibility of plastic film recovery at a mixed-waste Material Recovery Facility (MRF). The report discusses system changes needed to accommodate plastic film recovery, the quantity and quality of recovered plastic, and the economic viability of plastic film recovery.

Stretch Wrap Recycling - A How-To Guide *(Eng)*
A step-by-step guide showing the design and implementation of a stretch wrap recovery program, complete with locating markets, developing a collection system, and an analysis of costs and revenues associated with recovery and avoiding disposal. Four case studies demonstrate stretch wrap recycling at Pepsi-Cola Allied Bottlers Inc., Target Stores, Anheuser-Busch Companies Inc, and at Spartan Stores Inc.

Metal Scrap Recycling



Zinc Recycling Minimises Wastes
Stuart C.
*REWAS'99 Global Symposium on Recycling, Waste Treatment and Clean Technology **1999**, vol.2, 1287-1296 (Eng). Edited by Gaballah I., Hager J., Solozabal R., published by TMS and INASMET, ISBN Global 84 923455 63*
The author describes the zinc product cycle and identifies the major sources of scrap and the different ways in which it is recycled into various products. The author makes a clear distinction between process scrap and post-consumer scrap. Process scrap encompasses intermediate use process scrap (residues and waste products generated during the galvanising and diecasting processes) and end use process scrap (scrap generated during the manufacturing of final products, e.g., vehicles from galvanised steel). Post-consumer scrap includes diecasting, rolled zinc, and galvanised steel. Because of the longevity of zinc's major end-use products, especially rolled zinc traditionally used in European countries as material for roofing, guttering, and drainpipes, the relevant comparison for recovery of post-consumer scrap should be not with current consumption but with consumption 15-20 years ago, which was nearly 40% lower. The author examines the recovery of zinc from steel electric arc furnace (EAF) dust. Only Japan has adequate capacity to treat all of its EAF dust; worldwide capacity is insufficient to process all of the EAF dust generated annually by the steel industry.

of reducing the cost of dealing with shredder dust either by improving handling and transportation, or by recycling. The authors used combustion processes (i.e. dry distillation) to retrieve copper and to reclaim carbon, contained in organic materials, as an energy source. After the metals are removed, the dust is sent to a compression machine where, at the optimal temperature of 150 - 190°C, it is compressed to 1/3 of its original volume. Plans have been made to build a demonstration pilot plant, due to be completed by 2002 with a capacity of 400 kg/day of dry distillation residue. The plant is projected to recover 70% of Cu and further concentrate it to a smelting grade of 30%. The recovered carbon, with a caloric value of 4500 kcal/kg, can be used in the furnace as fuel.

Cu Recycling from low Cu Containing Waste
Yoshida T., Tateiwa H., Tanno F., Kahata M., Seto H.
ib., REWAS'99, 1799-1806 (Eng)
The authors examine the production of 99.9% pure copper from automotive shredder residue (currently landfilled waste). The work was conducted in Japan under the auspices of several Government Agencies. Copper waste is enriched to more than 93% (by mass) pure copper by phase separation of iron and copper under carbon-saturated conditions. The enriched material contains various impurities that are subsequently extracted by pyrometallurgical methods. A two-step flux system with Cu_2O-SiO_2-Fe_2O_3 (or Na_2CO_3) is used to remove Zn, Sn, Sb, Pb, and Ni. The authors claim that copper produced by their method does not need electrorefining and can be directly used for the production of wires, brass, and casting materials. The process is discussed in detail, complete with graphs, charts, and tables.

Sustainable Product Design: Recycling of Automotive Components and Composite Material
Langner J.
ib., REWAS'99, 1817-1823 (Eng)
The article discusses the concept of sustainable product and process design. This includes environmental and economic aspects of the complete life-cycle of a com-

ponent, from the production of the raw material, to the re-utilization of the recycled material. The author gives an example of a Mercedes headlight, which currently contains 16 separate components and may be 95% recycled, though only at a prohibitive cost. The author makes several suggestions for lowering the cost, such as a reduction of the number of materials used and the use of talcum-filled plastic to replace glass fibre reinforced plastics (FRP). How the components are recycled, either chemically, thermally, or mechanically, should also be considered in product design. A two year project by DaimlerChrysler research into the recycling of carbon fibre epoxy resins into new composite materials was carried out. A pilot plant was then set up to do a cost benefit study for FRP, the results of which have not been finalized.

Et cetera...

Letter to the Editor

As a subscriber to NRCan's R-Net newsletter, I was quite happy to see an issue dedicated to construction and demolition debris management/recycling. I would have been even happier if more of the coverage would have dealt with Canadian C&D initiatives and programs. The NAHB has developed good information materials over the years and has done some good research projects, however, Canadian programs would probably be more relevant to your readers.

The Greater Vancouver Regional District (GVRD) has launched its Job Site Recycling Program in early 1997. Since then we have made great strides in getting builders, developers, architects, and demolition contractors to reduce, reuse, and recycle C&D materials. Our free information materials can be viewed and downloaded at
http://www.gvrd.bc.ca/waste/bro/dlcgde.html

Thomas Mueller
Construction/Demolition Recycling Advisor
GVRD Policy & Planning Department

Mining and Metal Processing Waste

Acid Based Separation Process for Remediation of Lead Contaminated Firing Range Soils

Misra M., Halbe D., Nay M.

*EPD Congress **1998**, 433-448 (Eng). Edited by Mishra B., The Minerals, Metals & Materials Society, Warrendale, Pa., ISBN 0-87339-388-0*

The authors compare the effectiveness of two different extraction processes based on hydrochloric and acetic acids, in conjunction with conventional physical separation methods, for lead removal from the army firing range soil material at Fort Polk, Louisiana. The HCl leaching at a pH of 1.5-3 dissolves lead into solution as lead chloride, which is then precipitated as lead hydroxide at a pH of 8.5. Ninety five percent of total lead and 93% of soluble lead were removed. The results of lead removal by acetic acid leaching were not consistent, proving the removal process unreliable. The publication contains 11 figures, one table describing total and soluble levels of Cu, Sb, and Zn in untreated and treated (by HCl leaching) range soils, and 11 references.

Construction and Demolition

Staying Close to Home

Taylor B.

*C&D Recycler **1999**, Summer, 23-26 (Eng)*

The article reviews the recycling of asphalt roadways and asphalt roofing shingles. Roadway asphalt recycling is a widely accepted practice. The following techniques are used, depending on the nature of the project: full-depth reclamation, hot recycling, hot in-place recycling, cold recycling, and cold planing. The recycling of asphalt roofing shingles, however, is not popular because of the poor availability of equipment suiting to their processing and also because of unproven end markets. Currently, shingles can be ground to be used in asphalt mixes.

CARI's Corner

Canadian Association of Recycling Industries

DESIGNING FOR RECYCLING

By Leonard Shaw

ALTHOUGH TODAY automobiles are the second most recycled product after lead acid batteries, with a recycling rate greater than 90 percent, every major car manufacturer has initiated some type of design, disassembly, and/or recycling program. Why?

Because at the moment only 70 to 80 percent of the components are easily recycled: the metal components. The remaining portion, which ends up as shredder fluff is composed of plastics, glass, rubber, carpet, dirt, etc. Over the last 30 years the ferrous content of cars has decreased, and non-ferrous metal, plastic and other fluff material use has increased. The difficulty with plastics is that a car may have up to 40 different plastic resins that are selected from 120 different thermoplastics and thermosets. Unfortunately, these different plastics are usually incompatible for recycling together. In addition, the paints and solvents used on many plastic parts contaminate parts that could be recycled.

A number of European car manufacturers have implemented processes that generate some plastic component that is used for fuel in operations such as cement kilns. Mercedes-Benz has eliminated shredding. They remove as many components as they can to recycle or recondition and then bale the remaining car hulk with its tires and some remaining plastics for feed into a natural-gas-fired steel smelter. In North America we have the Vehicle Recycling Program (VRP), a joint program with GM, Ford, and Chrysler, but also including participants from scrap recyclers, parts suppliers, plastic and dismantling industries, universities, and government laboratories. They are looking at such design concepts as:

- easing the removal of automobile parts
- eliminating non-recyclable or hazardous materials (eg.,Cd)
- reducing the variety of plastics used in parts (currently 120 - ideal is 1)
- using recycled and recyclable materials
- reducing the number of parts used for assemblies
- reducing the number of fasteners
- avoiding parts that combine incompatible materials, such as plastics and metals, or ensuring that these different materials are easy to separate
- making plastic parts easier to identify by resin type

Already in today's vehicles, 2 litre polyethylene terephthalate (PET) bottles are being used for such parts as door handles, trunk carpeting, roof rack rails, and parking brake wells. Polypropylene is used for battery trays, PVC for door watershield, polycarbonate (compact discs) for sunroof cover retainers, and other plastics for fenderliners, tail lamps and engine splash shields. This uptake of recyclable materials helps to develop the essential market demand.

Designing for recycling is a reality. Designing for recycling is a life cycle concept that promotes the designing and manufacturing of products that, at the end of their useful lives, can be safely and efficiently recycled. This encompasses such activities as the selection of materials that are already recycled (creating the absolutely necessary market demand) and materials that are recyclable, reducing the number of different materials in a product, examining how parts are joined, eliminating hazardous constituents wherever possible, anticipating product disassembly, and marking of components.

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, or by fax (613) 256-8534.

GLOBE 2000
March 22-24, 2000
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http://www.globe.ca/globe2000/abglobe.htm

2000 World ITRA Expo
International Tire and Rubber Association
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Nashville, Tennessee, USA
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Fax: (502) 964-7859
E-mail: itra@aol.com
http://www.itra.com

Biocycle National Conference; A Summit On The Future of Composting And Organics Recycling
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Orlando, Florida, USA
Tel: 610-967-4135
Fax: 610-967-1345
E-mail: biocycle@jgpress.com

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Recycling Council of British Columbia Annual Waste Reduction Conference
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Penticton, British Columbia, Canada
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SWEMP 2000
6th International Symposium on Environmental Issues and Waste Management in Energy and Mineral Production
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Fax: (403) 284-4184
E-mail: mastroh@ucalgary.ca
http://www.geocities.com/CapeCanaveral/Lab/5617/swemp.html

"If They Could See Us Now" - CARI's 59th Annual Convention and Exhibition
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Fax: 905 426-9314

R'2000 Recovery Recycling Re-integration 5th World Congress and Envirotech Canada Trade Show
June 5-9, 2000
Toronto, Ontario, Canada
Tel: (905) 479-7750
Fax: (905) 479-7763
E-mail: rmark@oak.net
http://www.RRR2000.com/

International Trade Fair for Recycling and Waste Disposal
June 26-29, 2000
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Tel: (416) 598-3343
Fax:(416) 598-9185
E-mail: entsorga@KoelnMesse.de
http://www.koelnmesse.de/entsorga

Recycling Metals from Industrial Waste A short course focusing on plant practice (8th year)
June 27-29, 2000
Golden, Colorado, USA
Tel: (303) 273-3321
Fax: (303) 273-3314
E-mail: space@mines.edu
http://www.mines.edu/Outreach/Cont_Ed/

10th Annual National Composting Conference; "The Future Starts Here ... Compost!"
September 27-30, 2000
Edmonton, Alberta, Canada
Tel: (416) 535-0240,
Fax: (416) 536-9892,
E-mail: ccc@compost.org
http://www.compost.org

4th International Symposium on Recycling of Metals and Engineered Materials
October 22-25, 2000
Pittsburgh, Pennsylvania, USA
Tel: 1-800-759-4867 (USA)
(724) 776-9000, ext. 243
Fax: (724) 776-3770
E-mail: mtgserv@tms.org.

By Elizabeth Giziewicz

http://frontpage.automotiverecyclersassociation.aa.psiweb.com/
The Automotive Recycling Association's (ARA) home on the Internet features:

- Current ARA press releases and industry statistics
- The ARA Marketplace, including an Online Buyer's Guide
- Governmental and regulatory affairs news alerts
- An online database of member facilities and services with links to members' websites.

Approximately 2,000 direct and associate members as well as 3,500 other companies affiliate themselves with the ARA through 50 Affiliate Chapters in 19 countries worldwide.

http://www.oara.com/
The main attraction of the Ontario Automotive Recyclers Association (OARA) website is *The Auto Recycling Story*. It explains all of the efforts that go into vehicle reutilization and recycling. The site also houses an array of links with various industry associations, manufacturers, parts locators, vehicle donation programs, and governments, as well as general automotive links and links to OARA member's home pages.

http://www.anl.gov
Argonne National Laboratory, of the U.S. Department of Energy, conducts basic experimental and theoretical scientific research in the physical, life, and environmental sciences. Under ***Research, facilities and capabilities*** there are fourteen pages of links to Argonne Research Programs and National Scientific Facilities. Clicking on ***Transportation Technology*** under ***Energy Resources*** links to Argonne's Transportation Technology R&D Center at **http://www.transportation.anl.gov/**
Once there, use the site map for easy navigation. ***Technology Briefs*** feature a factsheet *Recycled Plastic Makes the Grade*. The ***Vehicle Recycling*** section contains two factsheets: *Recovering Usable Plastics from Automotive Scrap* and *Recovering Zinc from Automotive Scrap*, as well as a brochure *Recovering and Recycling Automotive Waste*.
The ***Publications*** section contains numerous presentations, online papers, and reports. In this section there are three articles of particular relevance to automotive recycling, under the heading ***Lightweight Materials***:

- *Life-Cycle Analysis: Uses and Pitfalls*, by L. Gaines and F. Stodolsky.
- *Life-Cycle Energy Savings Potential from Aluminum-Intensive Vehicles*, by F. Stodolsky, A. Vyas, R.Cuenca and L. Gaines.
- *Potential Automotive Uses of Wrought Magnesium Alloys*, by L. Gaine, R. Cuenca and S. Wu

http://www.wcshome.demon.co.uk/caremain.htm
The Consortium for Automotive Recycling (CARE) is a British collaborative project of ten car manufacturers and a growing number of dismantling and recycling operations. CARE operates on the basis of mutual co-operation between its motor industry members and the participating dismantlers. In order to display and use the CARE logo, a dismantler has to meet the group's minimum standards in terms of environmentally responsible processes and professional business management. CARE's goal is to reduce the amount of vehicle weight going to landfill by 5% by the year 2015. The CARE site contains numerous factsheets on dealing with end-of-life vehicles, through recycling and energy recovery. It also links to CARE members' Internet sites.