Lecture 13

End of Life Vehicles

Introduction

- An end-of-life vehicle is a car or a light commercial vehicle (carry max. 3.5 tons) which is to be disposed of by the registered owner.
- Sources of ELVs range from households to commercial and industrial uses.
- Vehicles normally reach the end of their useful lives, either due to age (typically 12-15 years) or because of heavy damage following an accident.
- Every year, ELVs generate between 8 and 9 million tonnes of valuable waste in EU.

Introduction

- Recycling of automotive materials can have a significant impact on the conservation of materials, domestic energy use, and emissions of greenhouse gases.
- As one of the largest consumers of materials, vehicles are also a significant source of recycled materials.
- Materials used in manufacturing of a vehicle include steel, Fe, Al, Mg, Cu, brass, Pb, Zn, plastics, composites, rubber coatings, textiles, fluids, lubricants, glass and other materials.

3/25

Introduction

- Over the past 15–20 years, automotive materials have changed in response to the demand for improved fuel economy, safety and performance.
- Increase in the cost of gasoline has raised the demand for lighter vehicles, because the lighter-weight materials improve the fuel efficiency of vehicles.
- In the future, increased use of lighter-weight materials, such as aluminum alloys, polymers and polymer matrix composites is expected.

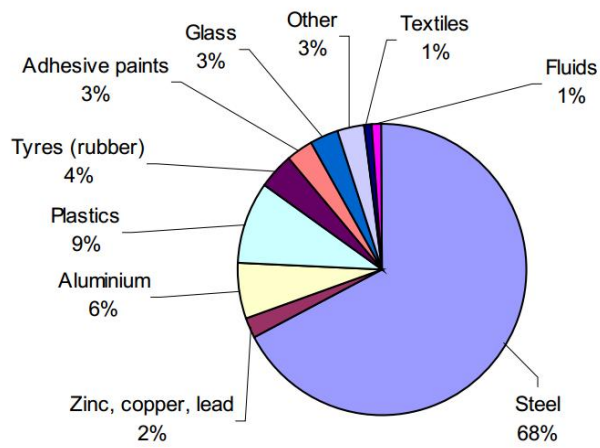
4/25

Introduction

- Replacing conventional steel, which is recyclable, with lighter materials will result in a reduction in the recycling rate of vehicles, even if the lighter materials are recycled at the same rate.
- If the lightweighting materials are not recycled, the drop in the recycling rate can be significant.
- Lightweighting and hybrid vehicle battery materials are expensive and, unless recycled, could become in short supply with constrained availability.

5/25

Composition of a car



6/25

Regulations

	Japan (Automobile Recycling Law)	E.U. (ELV Directive)
Schedule	Promulgated July 2002, to enter effect by January 2005	Effective from October 2000 legislation enacted in E.U. member states in 2002
Vehicle covered	Four-wheeled passenger cars and commercial vehicles (including everything from mini-cars to large trucks and buses)	Passenger cars with seating capacity of nine or less and commercial vehicles with gross vehicle weight of 3.5 t or less
Car manufacturer's obligations	Collection and disposal of fluorocarbons and airbags Collection and recycling of shredder residue Setting and publication of user charges	Establishment of ELV collection and recycling network From July 1, 2002: Newly registered vehicles. From January 1, 2007: All ELVs Prohibition of use of hazardous substances (lead, mercury, cadmium, hexavalent chromium). Covering all vehicles sold from July 1, 2003
	Design and manufacture of car models with consideration for environment and recycling	Recyclability rate 95% or more
Costs	Deposited by users (managed by fund management corporation) New vehicles: deposited at time of sale Old vehicles: deposited at time of automobile inspection (depending on country)	All or most of cost borne by car manufacturers

7/25

Targets of EU

2000/53/EC, EU directive on end -of life vehicles, 18/09/2000

Year	Recovery targets	Recycling targets	Collection targets
2006	85 % incl. reuse	80 % incl. reuse	100 %
2015	95 % incl. reuse	85 % incl. reuse	100%

- By 2006, min. 85% by weight of an ELV must be reused or recovered, including 5% energy recovery.
- By 2015, 95% of an ELV must be reused or recovered, including 10% energy recovery.

8/25

Recycling of ELVs

❶ **END-OF LIFE VEHICLE**

❷ **ADVANCE DISMANTLING**
Improving the ease of removing batteries, extracting oils and other liquids and treating air bags

❸ **REUSED PARTS DISMANTLING**
Improving the ease of dismantling components to make them reusable

❹ **RECYCLED PARTS DISMANTLING**
Developing technologies to recycle not only metal but glass and plastic parts as well

❺ **SHREDDING-AUTOMOBILE SHREDDER RESIDUE (ASR*) RECYCLING**
Reducing ASR through optimal design of parts and recycling methods

❻ **FINAL PROCESSING (LANDFILLS)**

* ASR: automobile shredder residue

9/25

i. Advance dismantling

- Removal of fluids, batteries and other items:
  - Engine oils
  - Transmission oils
  - Coolant
  - Hydraulic oils
  - Screen washing fluid
  - Fuel tank
  - Catalyst
  - Removal air bags

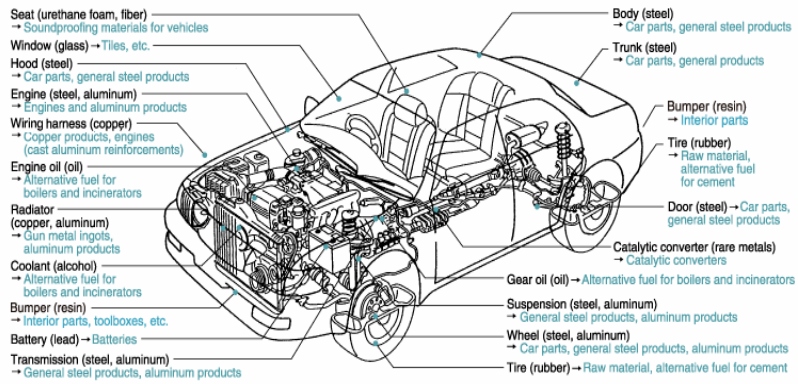
10/25

ii. Dismantling

- Variety of parts and all vehicle fluids and tires are removed for either:
- Direct reuse (e.g., body panels used to repair collision-damaged vehicles)
- Remanufacture (e.g., clutches, starters, engines)
- Recycle (e.g., fluids, batteries, catalytic converters, steel fuel tanks)
- Energy Recovery (e.g., tires)
- Disposal (e.g., plastic fuel tanks)

11/25

Parts being recycled from ELVs



12/25

iii. Shredding

- At the shredder, the vehicle hulk and other and other scrap iron and steel, are processed.
- A typical shredder can process 1-2 car hulks per minute.
- A shredder is a large (3,000–8,000 hp) hammer mill that tears up the auto hulk into fist-sized chunks of materials.
- Ferrous metals are recovered by using magnets, and nonferrous metals are typically recovered by using eddy-current separators.
- These materials are then recycled into new products.

13/25

iv. Material separation

- After shredding, the material stream is separated into two basic streams, using magnetic separation technology:
  - Ferrous metal (all iron and steel, except stainless steel)
  - Non-ferrous materials (both metals and non-metals)
- Following initial separation, the ferrous metal fraction is sent for recycling to steel smelters, which specialize in processing steel scrap.

14/25

iv. Material separation

- The non-ferrous material fraction is then typically separated out into:
  - Individual nonferrous metal streams (Al, brass, bronze, Cu, Pb, Mg, Ni, stainless steel and Zn).
  - ASR (automobile shredder residues) or ‘fluff’, consisting of remaining non-metallic materials -plastics, glass, rubber, foam, carpeting, textiles, etc.- along with dirt and metallic fines.

15/25

v. Final processing and disposal

- Because 40-55% of ASR includes materials such as plastics, rubber, fibers, wood, paper, tar and oils, the amount that needs to be disposed of can be reduced by:
  - Separation and recovery of recyclable materials by reprocessing of the fines fraction.
  - Conversion to liquid and gaseous fuels via pyrolysis or gasification of its organic content.
  - Incineration with heat recovery. The heating value of ASR varies from about 4,000 to 6,500 Btu/lb

16/25

Composition of ASR

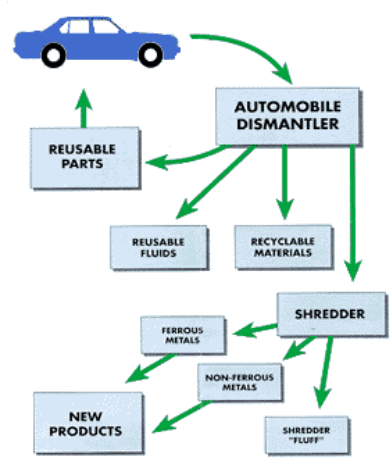
Fraction	Average wt. (%)	Range wt. (%)
Oversized heavies (metals and rocks)	5	2-8
Oversized polyurethane foam	2	0.5-5
Fines	39	24-60
Ferrous fraction	2	1-4
Nonferrous rich	4	3-7
Mixed material fraction	5	10-20
Polymer concentrate	25	20-45
Loss due to moisture and other materials	18	10-30

- The noncombustible fraction, which contains glass, dirt, moisture and residual metals, can also be reduced by separating and recovering the metals and perhaps glass

17/25

v. Final processing and disposal

- ASR is usually considered non-recoverable waste material and sent to landfills for disposal.



18/25

Recovery of individual components

METALS:

- App. 76% by weight of the average car is metal, most of which is comprised of sheet steel.
- The overall metal content of cars has declined rapidly by an increase in the proportion of non-ferrous metals used in their manufacture, such as aluminium and magnesium.
- Currently about 98% of the metals in a car are recycled.
- These metals are recovered by the vehicle shredding industry and subsequently utilized by steel industry, re-smelting plants.

19/25

Recovery of individual components

PLASTICS:

- Today a car contains around 11% plastics.
- They are used for their impact and corrosion resistance, in addition to low weight and cost.
- Due to their light weight properties, the use of plastics can lead to considerable energy savings.
- However, plastics recycled from ELVs is extremely low.
- PVC, which is relatively difficult to recycle makes up about 12% of the plastics content of an average car.

20/25

Recovery of individual components

PLASTICS:

- Alternative disposal methods such as incineration have raised a number of environmental concerns including dioxin emission during incineration.
- Therefore, automobile manufacturers are currently looking for alternatives to PVC.

21/25

Recovery of individual components

VEHICLE OPERATING FLUIDS:

- Lubricating oil has the greatest pollution potential.
- Much of the waste oil collected for recovery used as a fuel burnt in heavy industry and power stations.
- The preferred option for lubricating oils is re-refining for reuse as a base lubricant.

22/25

Recovery of individual components

GLASS:

- Glass constitutes app. 3% of a vehicle by weight.
- It is sent to landfill and only a small proportion is recycled.
- There are two types of glass used in the auto industry, toughened and laminated.
- Toughened glass is easy to remove from vehicles after shattering.
- Laminated glass, however, doesn't shatter and will need to be removed manually, which is time-consuming.

23/25

Recovery of individual components

TIRES:

- Tires account for 3.5% of the weight of an average ELV.
- In Europe, tires 22% were recycled, 8.3% went to energy recovery, 9.9% were retreaded, 16% were reused and 3.3% were used in landfill engineering.
- The remainder (app. 40%) is landfilled, stockpiled or illegally disposed of.

24/25

Videos-Animations

- Scrap Car Disposal Process
  http://www.youtube.com/watch?v=Xn_QQ8OmkDk
- SIMS ELV Management
  http://www.simsmm.co.uk/News-and-resources/Resources
- ELVs shredding
  http://www.bir.org/assets/eolv/shred_en.html

25/25