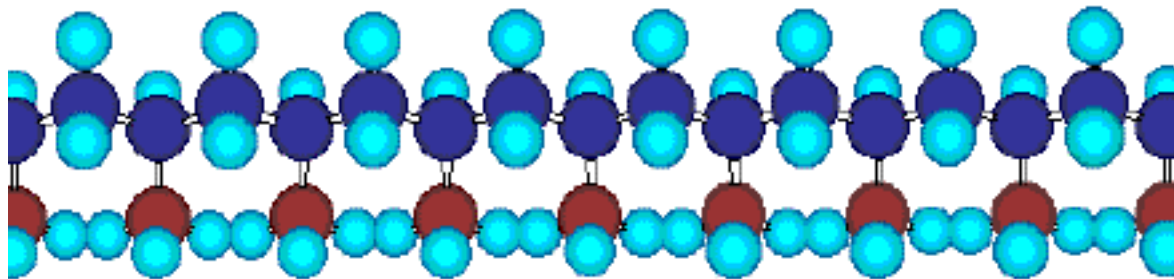
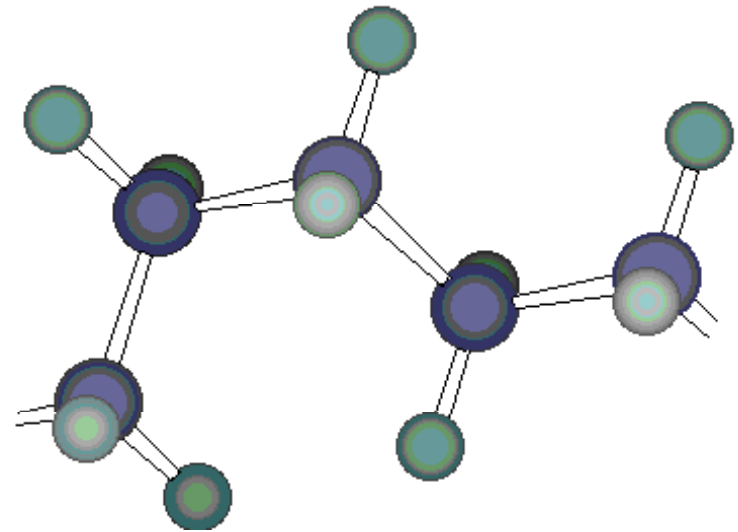


Polymer Science - the nightmare begins

There is bad news and bad news - - - - -

The metals part of Matse 259 is over!

And the polymer part starts today!



Outline - Today's Class

Introductions

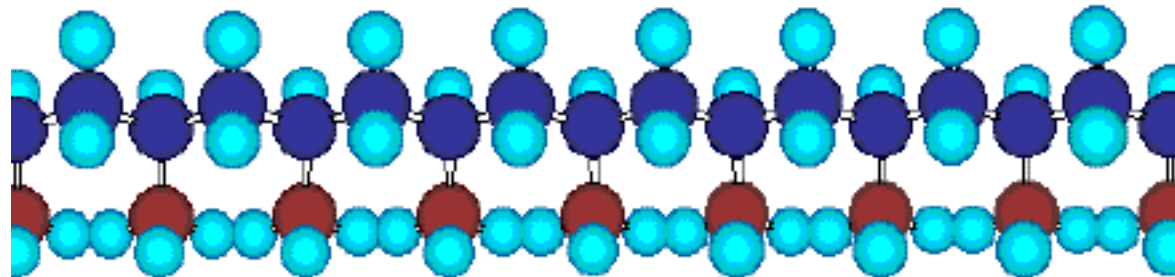
Course materials

Recommended books

Tests and grades

What is this course all about?

Why on earth should I bother to learn anything
At all about polymers ?



Matse 259

INSTRUCTOR - PROFESSOR PAUL PAINTER

320 STEIDLE

865-5767

painter@ems.psu.edu

**CD - "Painter and Coleman on Polymers"
Available at Bookstore**

OVERHEADS - On Free CD-ROM

Course Outline

LECTURE 1: Introduction

LECTURE 2: Early History

LECTURE 3: The Dawn of Understanding

LECTURE 4: Polyolefins 1

LECTURE 5: Polyolefins 2

LECTURE 6: Natural Rubber

LECTURE 7: Structure and Morphology

LECTURE 8: Crystallization and Melting

LECTURE 9: Glassy Polymers

LECTURES 10 and 11: Mechanical Properties

LECTURE 12: Viscoelasticity

Tests

TWO on-line tests - multiple choice

November 24 - 26

December 10 - 11

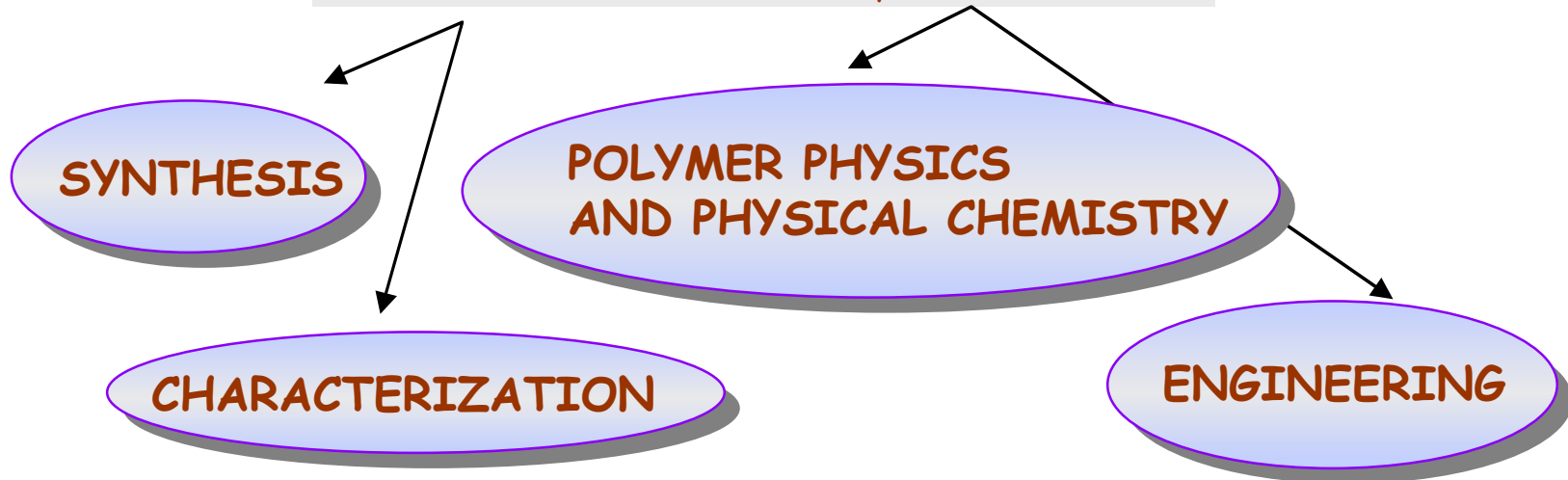
PRACTICE TESTS ON FREE CD

POLYMER SCIENCE AND ENGINEERING - WHAT IS IT ?

- THE SCIENCE OF LARGE MOLECULES

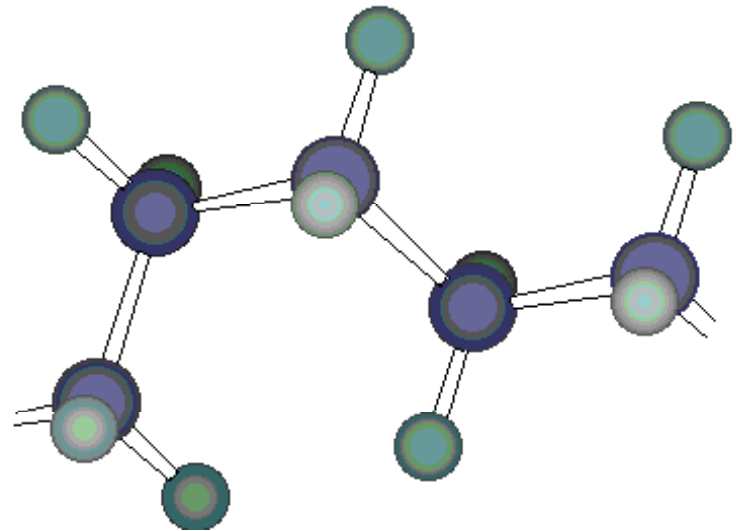
I am inclined to think that the development of polymerization is, perhaps, the biggest thing that chemistry has done, where it has the biggest effect on everyday life

LORD TODD
President of the Royal
Society of London



What Are Polymers And Why Are They Important ?

- *Long Chain Molecules*
- *Extraordinary Range Of Physical Properties*
- *Many (Not All) Are Cheap*
- *They Are Just Damn Interesting!!!!*



What is a Polymer ?

Poly.....mer

many units



or



• POLYMER

A large molecule made up of small building blocks

• MONOMERS

The building blocks

• HOMOPOLYMER

What you get if the building blocks are all the same

• COPOLYMER

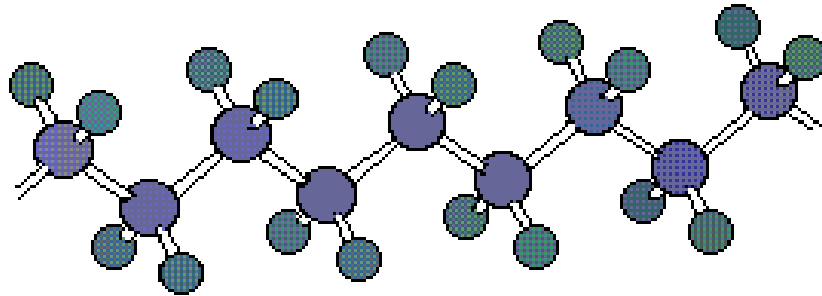
A polymer made up of different monomers

• BLEND

A mixture of different polymers

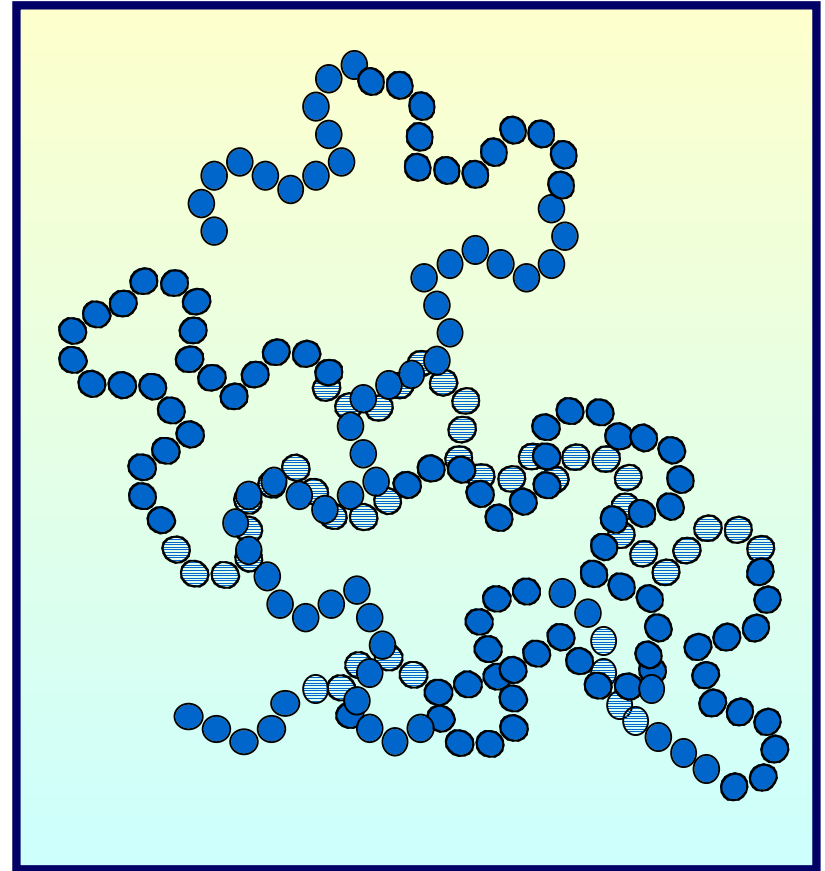
How big are Polymers ?

Check out the chain of beads on the right.
Imagine each bead is an ethylene unit;



Then because there are only 200 ethylene units in this chain (ie it is a 200 - mer), its molecular weight is only 5,600 (= 28 x 200).

Question; if a chain has a molecular weight of 420,000, how many ethylene units does it contain ?



- A. 30,000*
B. 15,000
C. 150,000
D. I don't know and I don't care!

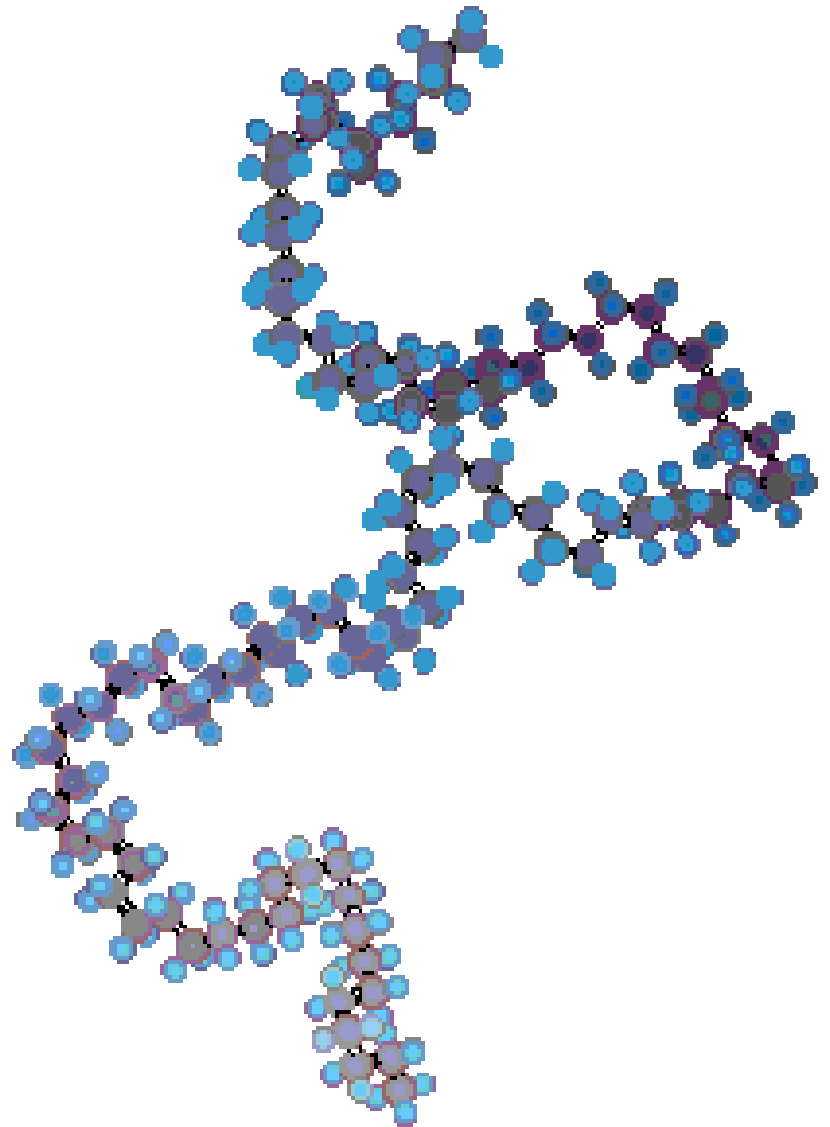


Even more molecular weight !

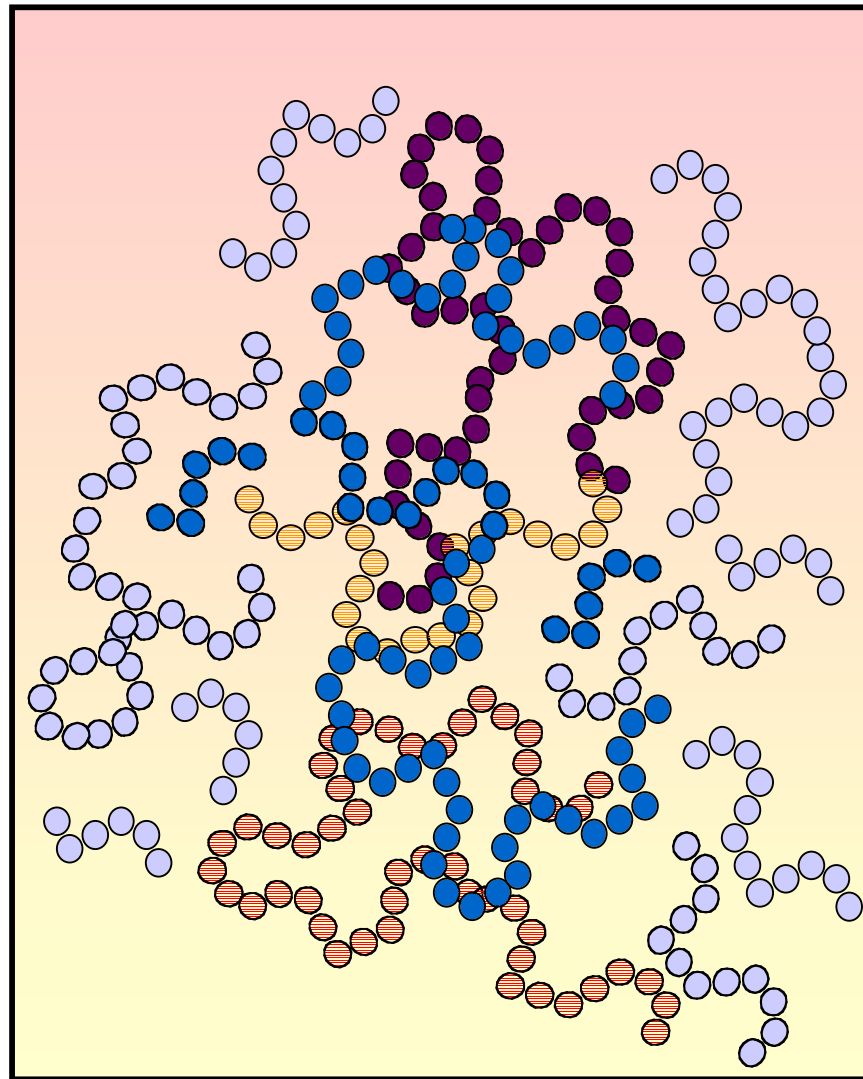
Commercially produced polyethylene's often have molecular weights in the hundreds of thousands. To give you a feel for this, imagine that each ethylene unit has a length of 1 inch instead of a couple of angstroms,



then the length of a fully stretched out chain of molecular weight 420,000 would be almost one quarter of a mile !
These are very big molecules indeed.



A last (for now !) comment on molecular weight



Applications

- Packaging/films
- Everyday household stuff
- Paint
- Adhesives
- Structural materials
Auto's,aerospace,etc.
- Fibres
- Electronic applications
- Elastomers

Have Polymers Improved Our Lives?

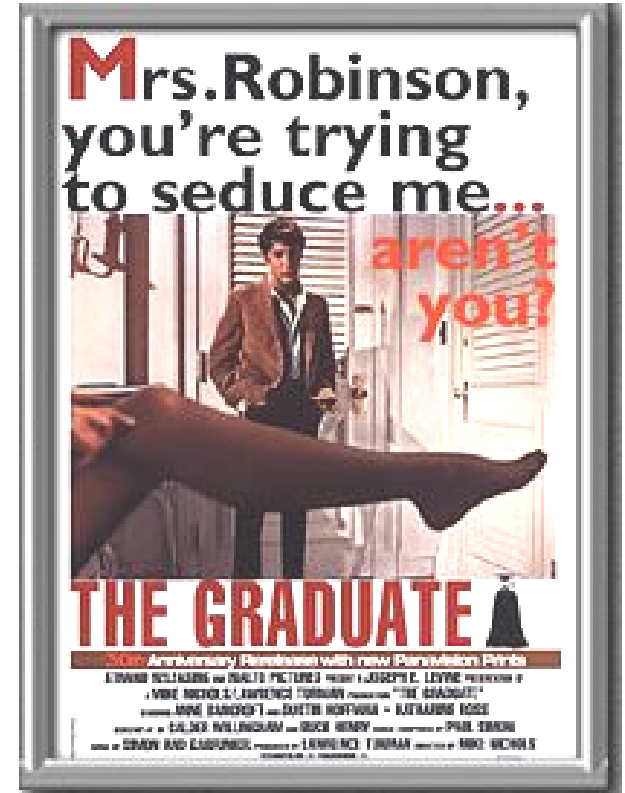
Are Plastics Synonymous with:

- The Cheap and Nasty
- Synthetic and Artificial Substitutes
- All that is Wrong with the Environment ?

"In the five decades since the end of World War II, plastic has crept increasingly, and often invisibly, into our homes, cars, offices, even our bodies. Some of us have plastic hearts, joints, valves, limbs....."

Plastic has become the defining medium of our Synthetic Century precisely because it combines the ultimate twentieth century characteristics — artificiality, disposability and synthesis—all rolled into one.

The ultimate triumph of plastic has been the victory of package over product, of style over substance, of surface over essence."



Have Plastics Got a Bum Rap?

Are they really synonymous with:

The Cheap and Nasty?



Hazardous Materials?



Wasteful Excesses?



Inferior Synthetic Alternatives?



Environmental Foe?



Plastics – Cheap and Nasty?



SALE! Get A New Hose Now... It'll Be The Last You'll Ever Buy!

Run over it with your lawnmower or car, or leave it exposed for years... no matter, these garden hoses are still **unconditionally guaranteed** by the mfr. against failure, forever! Look at these features! Kink-resistant and extremely flexible, even in cold weather, yet has 500-psi burst strength. Protective collar resists kinking at the faucet. Heavy-duty machined-brass couplings, with built-in O-ring washers.

The manufacturer, Gilmour®, offers this amazing unconditional guarantee: if this 5/8"-dia. hose ever fails, just cut off both brass couplings and send them back to them, and they will promptly send you a new length of hose, free of charge!

172659 - 25' Flexogen® Lifetime Hose ~~\$19.99~~ **\$17.97**
 172667 - 50' Flexogen® Lifetime Hose ~~\$32.99~~ **\$29.97** (\$3)
 172676 - 100' Flexogen® Lifetime Hose ~~\$64.99~~ **\$59.97** (\$4)



Labels in diagram: Six-layer outer construction, Inner liner tube, Brass coupling, Protective collar.

Reinforced with 2 layers of tough polyester cords for strength.

Close Out While Supplies Last!



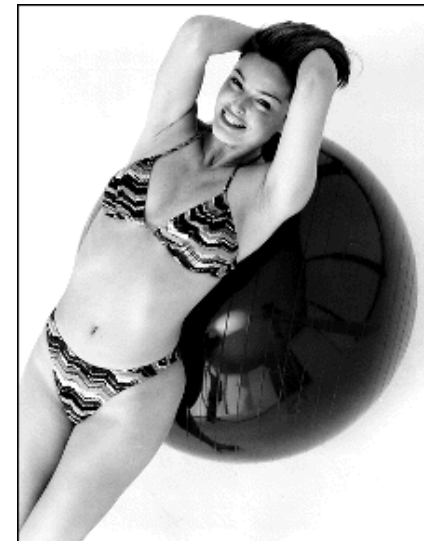
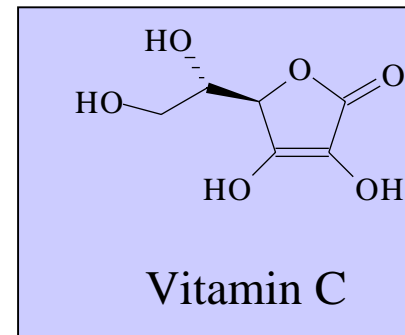
★ ★ ★ ★ ★ ★ ★ ★
 ★ **Fairlawn** ★
 ★ **Hose** ★
 ★ 5/8" x 50' ★
 ★ **\$6⁹⁹** ★
 ★ ★ ★ ★ ★ ★ ★ ★

★ ★ ★ ★ ★ ★ ★ ★
 ★ **"Better" Quality** ★
 ★ **Soft and** ★
 ★ **Supple Hose** ★
 ★ Heavier rubber ★
 ★ vinyl construction ★
 ★ 5/8" x 50' ★
 ★ **\$13⁹⁹** ★

Plastics – Inferior Synthetic Materials?



Early Applications of Bakelite



Lycra® bathing suit. Source: DuPont.

Do Traditional Materials Get a Break?



An English milk cart hauling milk in glass bottles.



The Yellowstone park fire of 1988 – wood is flammable!

Hazardous Materials?

From “*The Poison Plastic*” published by Greenpeace (www.greenpeace.org):

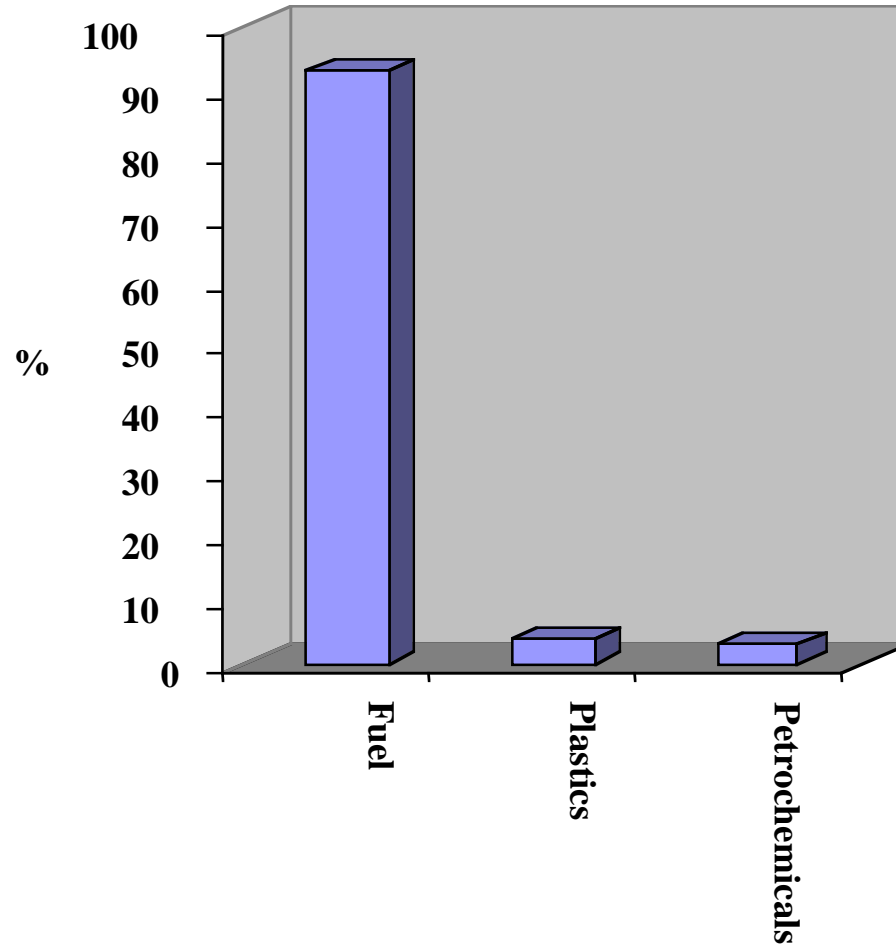
“Most common plastics pose serious threats to human health and the environment. The problems of plastics include extreme pollution from production, toxic chemical exposure during use, hazards from fires, and their contribution to the world’s growing waste crisis. But one plastic stands alone; PVC, throughout its lifetime, is the most environmentally damaging of all plastics.”



Source: Exxon.

Wasting Energy?

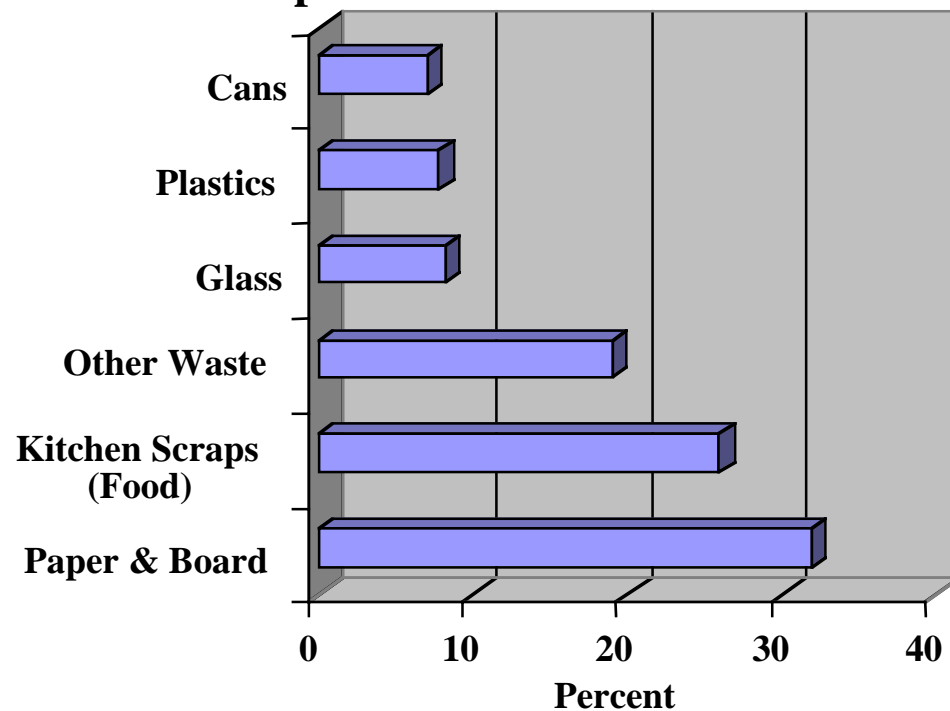
Crude Oil Usage



Plastics and the Environment?

“You can do four things with garbage: you can bury it, you can burn it, you can recycle it or you can send it on a Caribbean cruise”—Ed Koch (NY mayor emeritus).

Approximate Composition of European Household Waste



No Need to Apologize!

“From packaging materials, through fibers, foams and surface coatings, to continuous extrusions and large scale moldings, plastics have transformed almost every aspect of life. Without them much of modern medicine would be impossible and the consumer electronics and computer industries would disappear. Plastic sewage and water pipes alone have made an immeasurable contribution to public health worldwide.”

