Plastics:
recyclable or waste?

Mei-Ling Shek

presentation

To the EcoGreen Group of Silicon Valley

May 19, 2016

Speaker bio:

* I have worked as consultant and as scientist in both academic and industrial (telecom & solar energy) startup settings. Background in surface science, materials & optics.

Besides my scientific interests, I seek ways to contribute to environmental preservation.

* I became an environmentalist while I lived in the Pine Barrens surrounding Brookhaven National Lab (Long Island) , where I was a staff scientist till 1998. There I joined 3 others to collect and redeem soda cans & bottles, and we donated the money to Little Flower, a charity for children.

My struggle with Plastics:

Recyclable, or Waste?

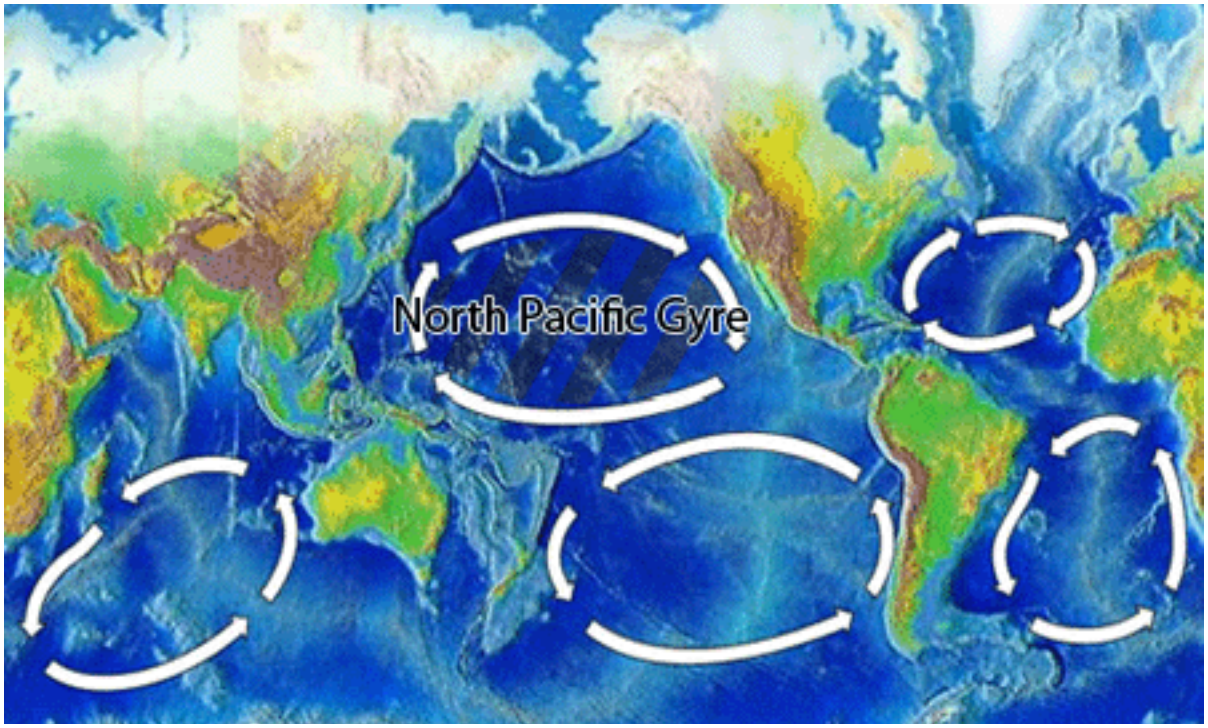
- Plastics identification
- Recycling of plastics

(How to do it right?)

Plastics not accepted for recycling

- How to make plastics “disappear”?
- Some of the new substitutes

Plastic, plastic everywhere



By Fangz (talk) - Fangz created this work entirely by himself in Photoshop, using materials in the public domain., Public Domain, https://commons.wikimedia.org/w/index.php?curid=5077997

https://marinedebris.noaa.gov/info/patch.html

https://youtu.be/7c9mSVPXYxU

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Resin Identification Code

Resin Identification Number	Resin	Resin Identification Code –Option A	Resin Identification Code –Option B
1	PET Polyethylene-terephthalate	1 PETE	01 PET
2	HDPE High-density Polyethylene	2 HDPE	02 PE-HD
3	PVC Polyvinyl chloride	3 V	03 PVC
4	LDPE Low-density Polyethylene	4 LDPE	04 PE-LD
5	PP Polypropylene	5 PP	05 PP
6	PS Polystyrene	6 PS	06 PS
7	Other resins	7 OTHER	07 O

ASTM D7611 / D7611M - 13e1 (2013)
Standard Practice for Coding Plastic Manufactured Articles for Resin Identification

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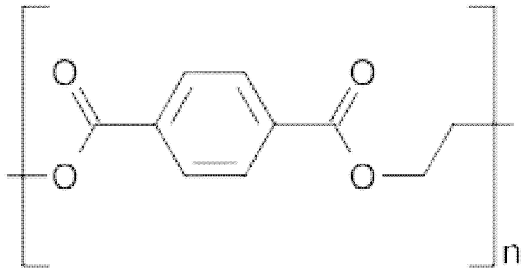
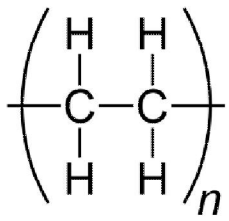
1: PET (Polyethylene terephthalate)



PE (Polyethylene) – most widely produced synthetic plastic



2: HDPE density > 0.941g/cm^3

milk jugs, opaque bottles

4: MDPE density 0.926–0.940 g/cm^3

gas pipes & fittings, bags, shrink films

4: LLDPE density 0.915–0.925 g/cm^3

saran wrap, films for packaging. $40 B in 2013

4: LDPE density 0.910–0.940 g/cm^3

rigid containers, films, bags $33 B in 2013

By ljfa-ag Diskussion - selbst erstellt mit BKchem, Public Domain, https://commons.wikimedia.org/w/index.php?curid=8406661

By Magmar452 - Own work, CC0, https://commons.wikimedia.org/w/index.php?curid=32715423

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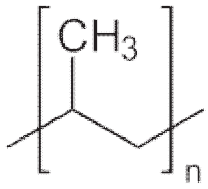
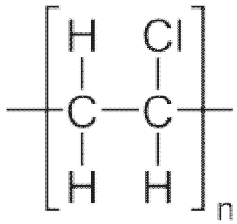
5: PP (Polypropylene)



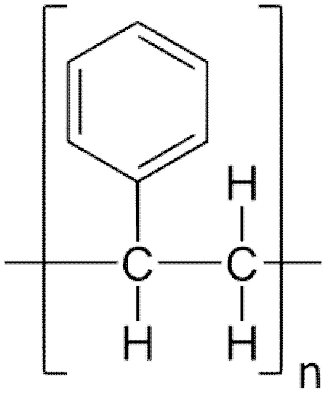
By NEUROtiker - Own work, Public Domain, https://commons.wikimedia.org/w/index.php?curid=3784898

3: Poly(vinyl chloride)



By NEUROtiker - Own work, Public Domain, https://commons.wikimedia.org/w/index.php?curid=3813303

6: Polystyrene



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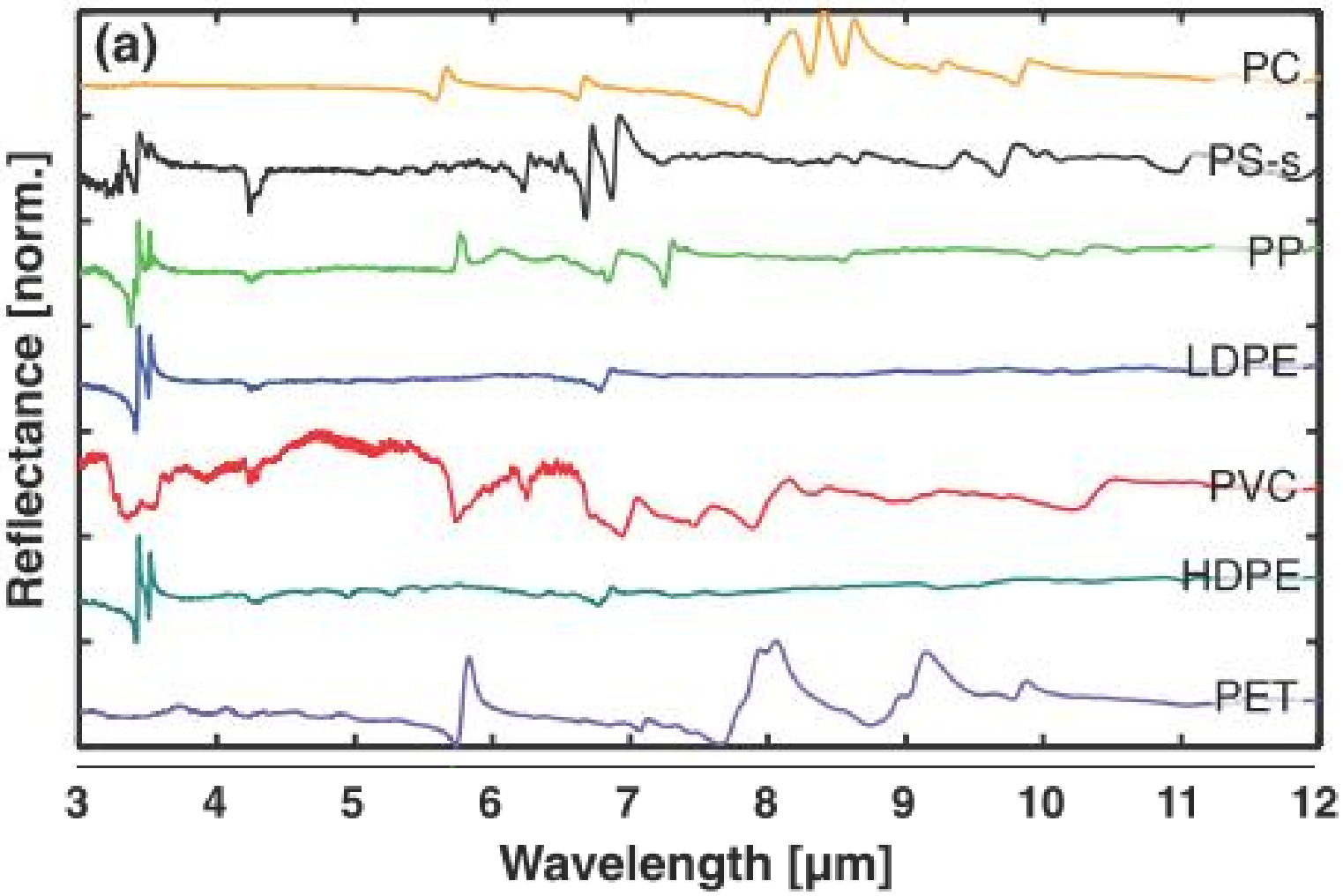
Multi-spectral infrared spectroscopy for robust plastic identification



Plastic **S**orting **W**ith **C**hemical **I**maging

Recovery of:

- Polypropylene (PP)
- Polystyrene (PS)
- Polyethylene terephthalate (PET)
- Polyethylene (PE)
- Acrylonitrile butadiene styrene (ABS)
- Polyvinyl chloride (PVC)
- And many more

http://www.hyperspectral-imaging.com/plastic-sorting.html

Chemical Imaging - Plastic Sorting Sensors

VIS/NIR	NIR	SWIR
0.4 - 1.0 µm	1.1 - 1.7 µm / 0.9 - 1.7 µm	1.4 - 2.4 µm / 1.3 - 2.3 µm

?

http://www.hyperspectral-imaging.com/plastic-sorting.html

Plastic Recycling

Plastic Recycling: The Truth Behind the Myths

Published on Mar 28, 2012

Patty Moore, of Moore Recycling Associates debunks some of the common myths associated with plastic recycling.

https://www.youtube.com/watch?v=68_F4BiBOjw (12:13)

Mike Biddle: We can recycle plastic

Less than 10% of plastic trash is recycled -- compared to almost 90% of metals -- because of the massively complicated problem of finding and sorting the different kinds. Frustrated by this waste, Mike Biddle has developed a cheap and incredibly energy efficient plant that can, and does, recycle any kind of plastic. July 2011

https://www.youtube.com/watch?v=RD07GkmM2fc (10:58)

Recyclable or waste?
Reality: determined by municipal recycling

In Sunnyvale:

MATERIALS	COLLECTION		PREPARATION AND SORTING REQUIREMENTS
	Yes	No	
Plastic Containers (#1-#7)	X		Plastic bottles, jugs, tubs and jars, all colors. Recycle plastic bags at local grocery stores.
Polystyrene (Plastic #6)		X	#6 Ketchup bottles only. No expanded polystyrene (foam) accepted.

So it turns out that … resin codes don't necessarily mean locally recyclable!

from **Sunnyvale Recycling** 1 year ago | more

No #1 clam shell, no plastic cups, nothing with hinges, no black plastic…

Recycling Polystyrene and Expanded Polystyrene

https://www.youtube.com/watch?v=UAYl8zrOQZo&feature=youtu.be
(11:06)

(I took some styrofoam blocks to Elizabeth….)

Recycling plastic bags, films, wraps

http://www.plasticfilmrecycling.org/

FAQs and More Info on Recycling
Film Beyond Bags

Find a Drop Off Location in the US and Canada

Return clean, dry, empty plastic bags/film/wrap to recycling drop off locations
Look for recycling bins near store entrances

Enter your postal code

94087

Get Involved!

Learn How Your Company Can Support Plastic Film Recycling

- Get involved in the Flexible Film Recycling Group: Resin Suppliers, Converters, Brand Owners, and Recyclers working to grow PE film recycling
- Designing a new film package or product?
- Seeking a credible recycling label?

Set Up a Collection Program

Tools to help you set up an efficient plastic film recovery program.

- Learn what's recyclable
- Calculate the benefits of recycling
- Find recyclers
- Model bale specifications
- Download FREE tip sheets and signage

Recycled Film and Bags products

Search this NEW directory for bag and film products made from recycled postconsumer plastic.

- Search for bag and film products made from recycled plastic.
- Email us to add your company

Add Your Location

Place recycling bins in well-marked locations and let consumers know they can recycle plastic film at your stores.

- Add your company to our list of participating stores
- Download FREE signage to instruct consumers about materials to recycle with shopping bags

Get Listed

Connect with businesses and other commercial generators of plastic scrap film by listing in our Film Recycler Directory.

- Find Markets/Recyclers for Film
- List in Film Recycler Directory so others can find you
- Download FREE Recycling Posters

4 LDPE (Low Density Polyethylene)

High clarity, moderate stretch & strength

4 LLDPE (Linear Low Density Polyethylene)

Moderate clarity, slight tacky feel to the touch

4 MDPE (Medium Density Polyethylene)

Moderate clarity, poor stretch and strength

#2 HDPE (High Density Polyethylene)

Some opacity, crinkle to the touch

grocery bags, bread bags, case overwrap, dry cleaning bags, newspaper sleeves, ice bags, wood pellet bags,
ziplock & other re-sealable bags, produce bags, bubble wrap, salt bags, and cereal bags
All materials must be clean, dry and free of food residue

http://www.trex.com/recycling/

Recycling plastic bags, films, wraps

Recycled polyethylene → composite lumber

https://www.youtube.com/watch?v=7zEBEXPB4c0 (2:36)

It takes 2,250 plastic bags to make a standard 16-foot composite lumber board.
http://www.wastedive.com/news/pilot-program-aims-to-divert-plastic-bags-eliminate-clogged-machinery/404633/

Recycling plastic bags, films, wraps

Plastic packaging material without resin identification number?

Yes Safeway will accept HDPE and LDPE and also many packages may not have a polymer designation on them e.g. many paper towel, bathroom tissue etc. packaging but they are ok. We do give examples on our website on this page < http://www.plasticfilmrecycling.org/s01/s01dropoff.html > but if you are concerned about recycling a certain item please don't hesitate to contact us.

help@plasticfilmrecycling.org

How about recycling lawn signs?

Yes every election cycle I start getting questions regarding the campaign lawn signs and have yet to find a solution and in fact I still have some in my own garage that I am trying to find at least a re-purposing use for (dart board if the person changed policies after election ?). ***PP is a sought after material but these signs are just not collected by municipalities of which I am aware. The sought after PP is usual in the form of tubs/lids and pill bottles but/and I am not certain what the issue is with the signs.***

http://www.calrecycle.ca.gov/plastics/

Resources Plastics Recyclers Search.
Find plastic recyclers near you.

CalRecycle Staff Contacts

How to biodegrade synthetic plastic?

Plastic-eating bacteria

Two enzymes are used by the bacteria (*Ideonella sakainesis*) to break down PET and use the carbon for energy . (2016)

https://www.youtube.com/watch?v=L1L2NtGXe3U

Waxworm Bacteria
Could Recycle Plastic Trash

polyethylene

https://www.youtube.com/watch?v=DG58V0PWX_E (1:59)

Mealworms munch polystyrene foams

https://www.youtube.com/watch?v=1QJTsgx1YW0 (2:11)

Other worms also work

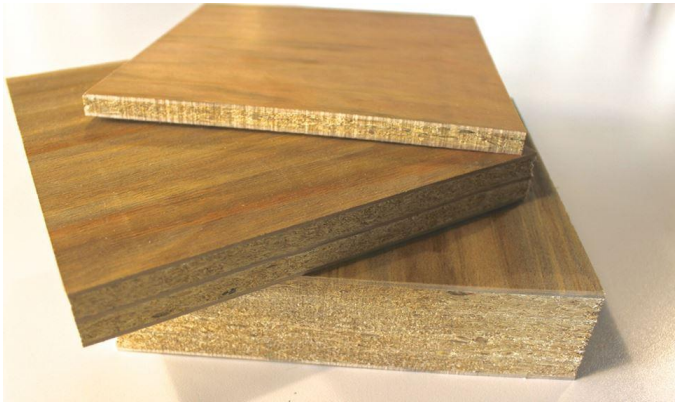
https://www.youtube.com/watch?v=TS9PWzkUG2s (5:52)

Some of the new substitutes

Fungus: The Plastic of the Future

https://www.youtube.com/watch?v=jnMXH5TqqG8 (11:01)

https://www.youtube.com/watch?v=JoMpFbKEaG0
Eben Bayer (PBS 2013, 3:42)



http://www.ecovativedesign.com/

Recycling Carbon Dioxide to Make Plastics

May 20, 2013 - 1:31pm

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Novomer

http://energy.gov/fe/articles/recycling-carbon-dioxide-make-plastics