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College of Agricultural Sciences Cooperative Extension

Agricultural and Biological Engineering

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Resource Recovery: Turning Waste into Energy

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Plastic film has provided farming with many benefits, but film also contributes significantly to the growing municipal solid waste stream. Low density polyethylene (LDPE) is the most commonly used film in the agricultural industry because of LDPE's inertness, flexibility, and moisture barrier properties. In 1990, the agricultural community consumed 234 million pounds of LDPE film, which represents 3.6 percent of the total LDPE film consumed in the United States. LDPE film accounts for the largest amount of plastic consumed by the agricultural community, and this amount increases each year as more uses and benefits are found.

Currently, most farmers dispose of their used film by burning or burying it on the farm or sending it to be landfilled. Burning and burying are illegal in most areas, and many landfills are filling up and closing down. To deal with this solid waste dilemma, many members of the agricultural community are considering integrated waste management—an approach that balances different waste management options—to help reduce the burden of LDPE film on the waste stream. These options include source reduction, recycling, resource recovery, and landfilling.

Source Reduction: By using less and re-using, less waste and toxins enter the waste stream.

Recycling: Material is taken out of the waste stream and returned to the manufacturing process.

Resource Recovery: Wastes are incinerated in modern facilities designed to generate power and electricity from the heat that is given off.

Landfilling: Despite the drawbacks, landfills are needed to dispose of wastes that can't be safely or economically managed by reduction, recycling, or recovery.

To decrease the amount of LDPE film in the waste steam, source reduction and recycling are being encouraged. Agricultural film, which has been exposed to sunlight, heat, pesticides, dirt, grease, and rodents, is often so heavily contaminated that it can't be re-used or recycled. For example, it is not uncommon for mulch film to be contaminated by up to 50 percent of its weight by dirt, moisture, and vegetation. Resource recovery can reduce the amount of LDPE in the waste stream and gain valuable energy that would otherwise have been lost in a landfill.

The Resource Recovery Process

Resource recovery usually means heat recovery by incineration. An estimated 14-16 percent of the United States' waste stream is incinerated. (See Figure 1 to compare the amount of wastes managed by the different disposal methods.) Wastes are taken to a modern energy recovery facility where they are burned in combustion chambers or boilers. The high combustion temperatures help the waste burn thoroughly and create less ash for disposal. Modern air pollution control devices—such as electrostatic precipitators, dry and wet scrubbers and/or fabric

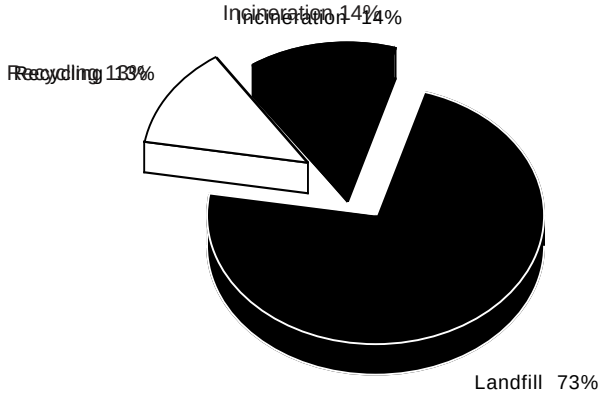

Figure 1: Current Waste Management in the U.S.

filters—are used to remove potentially harmful particulates and gases from the incinerator's emissions. Some facilities can reduce the amount of particulates by up to 99.9 percent. The end product from this process is heat energy that can be used to generate steam and electricity. The remaining ashes must be properly disposed of in a landfill.

The Benefits of Resource Recovery

By burning the solid wastes into ash, resource recovery reduces the volume of waste entering the landfill by approximately 90 percent and recovers valuable energy that benefits all parts of society. In addition, resource recovery is inexpensive and can be financed in two ways. One way is for the plant to require a tipping fee—a charge to tip the dump bed of the waste hauler truck—which is approximately equal to the fee charged at a landfill. Second, revenue can be generated by selling the resulting energy to local electric companies. Besides these benefits, capturing the energy value of *all* of the waste generated in the U.S. could save as much as 60,000 barrels of oil each day.

Incineration of wastes has led to a unique process called landfill reclamation: wastes that were buried in a landfill years ago are being excavated and incinerated. Although the Btu (energy value) of this waste has been lessened by approximately 40 percent, landfill reclamation helps to save valuable landfill space by reducing the volume of space that the buried wastes were taking up.

Resource Recovery of Plastics

Plastics, which include contaminated LDPE film, have a higher energy value and heat content than most municipal solid waste materials. While taking up seven percent of the waste stream by weight and 20 percent by volume, plastics provide incinerators with 25 percent of the recoverable MSW energy. For example, a pound of polyethylene supplies 19,000 Btu, but corrugated paper packaging provides only 7,000 Btu (See Table 1 to compare the energy value of plastics to other municipal solid wastes and natural resources.) Three of the most commonly used plastics in the agricultural industry—polyethylene, polypropylene, and polystyrene—have

Table 1: Energy Value of Plastics, Municipal Solid Wastes, and Natural Resources

Plastic Material	**Energy Value**
Polyethylene Terephthalate	9,000-9,700
Polyethylene	19,900
Polyvinyl Chloride	7,500-9,000
Polypropylene	18,500-19,500
Polystyrene	17,800
Municipal Solid Waste Material	**Energy Value**
Newspaper	8,000
Textiles	6,900
Wood	6,700
Yard Wastes	3,000
Food Wastes	2,600
Average for MSW	4,500
Natural Resources	**Energy Value**
Fuel Oil	20,900
Wyoming Coal	9,600

(Adapted from the Council for Solid Waste Solutions' "The Solid Waste Management Problem: No Single Cause, No Single Solution" and ASAE Paper No. 924035)

energy values per pound that are equal to fuel oil and even greater than Wyoming coal. Because of their high Btu content, plastics can be incinerated as a municipal solid waste or used as a supplement with other municipal solid wastes to increase the combustion temperatures.

Concerns with Resource Recovery

Although the prospect of taking all of the agricultural community's heavily contaminated LDPE film and other plastics seems promising, there are several concerns and obstacles that must be addressed. The most obvious is the presence of a nearby waste-to-energy incinerator that will accept the farmer's used plastics. If there are no available facilities, it may not be financially or physically possible to incinerate the used plastics. The cost of building a facility is high—as much as 400 million dollars to build a large incineration plant. Depending on the facility's permit to operate, it may not be approved to accept agricultural wastes, which are usually classified as residual wastes—used materials that come from industrial, mining, or agricultural operations. Also, without a strong and stable market to accept the energy that is produced, processing the waste material may be economically inefficient.

Contaminated LDPE film presents some problems for incineration facilities. Baled or large clumps of LDPE film creates hot spots that damage the incinerator's boiler or grate. LDPE film contains such a high heat value per pound that the trash must move slowly through the process to balance the heat content and the amount of trash processed. The film must be unbaled and fed evenly into the combustion chambers to prevent these hot spots. This means slowing down the incineration process which also means slowing down the amount of trash that can be processed. Since many facilities do require a tipping fee, less trash means less profit. This often makes the facility reluctant to accept the large quantities of LDPE film that the agricultural community often generates.

Pesticide residue presents a unique problem for incinerating LDPE film. The effects of the quantity and types of pesticides in the incineration process has yet to be determined. It is very likely that the high temperatures and complete combustion would render any pesticide contamination harmless. *Properly rinsed containers are municipal solid wastes, not hazardous wastes*. Unfortunately, public misconceptions still perceive even properly rinsed containers as hazardous wastes, and facilities need special permits to accept hazardous wastes.

Another concern about incinerating plastics is the toxins, such as acid gas and dioxin/furan, in the emissions. Many plastics contain additives that have heavy metals such as lead and cadmium, which might increase the toxicity of the incinerator ashes. The metal content could cause the ashes to be classified as hazardous wastes, making disposal of the ashes more difficult.

In 1989, the U.S. Conference of Mayors formed an international panel of experts to discuss the health and safety of waste-to-energy facilities. The panel concluded that a properly equipped, operated, and maintained energy recovery facility can operate within existing regulatory standards for human health and safety. The Clean Air Act of 1991 provided additional security by tightening emission standards.

Before the waste-to-energy facility is permitted to landfill ashes, they are required to have controls on the pollutants in the air and in the ashes. The effect of certain metals in emissions and ashes has not been determined. Currently, incinerator ashes are not categorized as hazardous wastes and can usually be safely disposed of in properly equipped landfills. Research is underway to find alternate uses for incineration ashes, which could further reduce the volume of the waste.

Prospects for Resource Recovery

By the end of 1992, there were approximately 142 waste-to-energy facilities operating in the United States with another three under construction and 37 more in the developmental process. If all these facilities come into operation, an expected 21 percent of the United States' waste stream will be incinerated by the year 2000. A small incineration plant processes approximately 300 tons of waste each day while a large plant can process about 3000 tons. Combining the capacities of all the facilities currently operating in the U.S., 101,000 tons are processed each day. For many communities, incineration is a growing method of waste management.

Waste-to-Energy Facilities in Pennsylvania

Depending on the facility's permit, some of the waste-to-energy facilities in Pennsylvania are not approved to accept used agricultural materials. Also, a nearby incinerator might not be available in most Pennsylvania communities. However, incineration remains promising as a safe and environmentally sound method to manage used agricultural plastics.

For more information about resource recovery or to tour a waste-to-energy facility, contact one of the facilities listed below.

Please recycle this fact sheet

Dauphin County Incinerator
c/o John Luken
1670 South 19th Street
Harrisburg, PA 17104
(717)236-5361

Lancaster County
Resource Recovery Facility
c/o Katie Koncle
RD #1 Route 441 Southside
Marietta, PA 17547
(717)397-9968

Montgomery County Incinerator
1155 Conshohockan Road
Conshohockan, PA 19428
(215)940-1567

Westinghouse Incinerator
Delaware County
Resource Recovery Facility
c/o Leroy Carter
10 Highland Avenue
Chester, PA 19013
(215)497-8136

York Waste-to-Energy Incinerator
c/o Ellen O'Connor
2651 Blackbridge Road
York, PA 17402
(717)845-1066

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