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Degradable Plastics: Standards, Research and Development

Statement of
Flora H. Milans, Associate Director
Resources, Community and Economic
Development Division

Before the
Committee on Governmental Affairs
United States Senate

Mr. Chairman and Members of the Committee:

We are pleased to be here to discuss our report on degradable plastics, which was requested by this committee and which is being issued today. As requested, our report (1) identifies the extent of federal and private sector efforts to develop standards for degradable plastics and (2) describes federal agencies' support of degradable plastics R&D.

Overall, we found that only limited federal and private sector efforts are being made to develop standards for degradable plastics. There is a growing interest in commercializing degradable plastics. With this has come a general recognition by scientists and management officials in both government and industry that standards for degradable plastics need to be developed before their widespread use can occur. Such standards would include uniform definitions and methods of testing to evaluate product performance. They would help assure consumers of a satisfactory product and facilitate manufacturers' compliance with existing and potential legislation mandating the use of degradable plastics.

We also found that federal agencies' support of degradable plastics R&D has been limited. Federal expenditures total $1.7 million for 12 projects in fiscal year 1988 and emphasize the development of new degradable plastic materials rather than standards development. These projects include very basic research and applied R&D intended for specific uses. The federal agencies supporting these activities, however, are not among those that would be most appropriate to develop standards. In addition, virtually no testing of degradable plastics to determine degradability and safety of the end products in different environments has occurred; what limited testing is planned or being conducted may help to evaluate degradability and safety but does not in itself ensure the establishment of needed standards.

BACKGROUND

Before discussing these matters further, I'd like to provide some background information. The mounting problems posed by the permanency of plastics in municipal solid waste, litter, and marine pollution have led to a search for solutions, including the use of degradable plastics. Unlike traditional plastics, which may persist in the environment for centuries, degradable plastics are intended to disintegrate in a matter of months through degradation by sunlight (photodegradation) or microorganisms (biodegradation). They thus may be able to reduce the life span of litter in the landscape and at sea; they may also diminish the amount of plastics accumulating at landfills. In addition to their potential environmental benefits, degradable plastics offer new opportunities for the use of agricultural commodities instead of petroleum in the manufacture of plastics. Cornstarch in particular is a leading ingredient.

THE NEED FOR STANDARDS REGARDING DEGRADABLE PLASTICS

Widespread concern exists among federal and private sector officials and scientists about the current lack of standards. Definitions of such basic terms as photo- and biodegradation have not yet been agreed upon, nor have uniform methods of testing been developed. The director of the plastics department at Dow Chemical USA described the overall situation of degradable plastics as "a state of chaos." A scientist conducting federally sponsored research on degradable plastics at the Massachusetts Institute of Technology described the problem as follows: "Most of the biodegradability studies are very ill-defined, not quantitative and not standardized as to what is biodegradable. The community in this area has not reached satisfactory standards or procedures allowing for uniform comparison of biodegradability. There is a

need for further development of policies and procedures for this critically important area."

In developing standards, two important technical uncertainties associated with degradable plastics remain to be addressed: the rate of degradation and the safety of the end products. Issues relating to the rate of degradation include the possibility that degradation may occur before the product has served its purpose or that it may occur too slowly to provide an effective solution to environmental problems. Safety-related issues include the potential toxicity of chemicals leaching from degradable plastics and the size of the plastic fragments resulting from degradation, which may pose a threat to wildlife or compound the litter problem.

Standards, according to various officials in the federal and private sectors, are needed as a basis for effective legislation. Officials are concerned that the current lack of standards may lead to unenforceable or confusing laws. Current legislation in 16 states requiring the use of degradable plastics for six-pack beverage container yokes tends to corroborate this concern. Laws in 9 of these states provide no definition of degradability; 10 states specify no time frame for degradability; and 11 states provide no requirements regarding the safety of the end products. The definitions, when provided, refer mainly to general processes, including photo- and biodegradation, while giving no further details. Time frames, when specified, vary between 120 days in Florida and 5 years in Minnesota. Of the 5 states with end product safety requirements, only 2 states require that both the particle size and chemical composition of degradable plastic fragments be established as safe but neither provide criteria for judging safety.

Federal Activities to Develop Standards for Degradable Plastics Are Limited

There are 3 primary government agencies with the capability to test and develop standards for new materials and products--the Environmental Protection Agency, National Institute of Standards and Technology (formerly called the National Bureau of Standards), and Food and Drug Administration. These agencies reported few or no activities involving degradable plastics. Each of these agencies is discussed briefly in the following material.

EPA's Activities

EPA's Office of Research and Development contains at least 4 laboratories capable of conducting needed tests, but none is currently underway. A senior EPA official told us that testing degradation rates and end product safety would be consistent with EPA's previous work. He indicated that such a task would be relatively easy to perform and could be conducted in either a cursory or a very thorough manner, as necessary.

Several of EPA's laboratories described their ability to address the technical uncertainties. The Gulf Breeze Laboratory (Gulf Breeze, Florida) would be able to evaluate the biodegradation of plastics. The Environmental Research Laboratory (Athens, Georgia) could address both bio- and photodegradation. The Robert S. Kerr Environmental Research Laboratory (Ada, Oklahoma) conducts research on the mechanisms and rates of degradation of chemicals in groundwater and could apply this expertise to degradable plastics in general. A fourth EPA laboratory, the Risk Reduction Engineering Laboratory (Cincinnati, Ohio), conducts a program involving the biodegradation of hazardous wastes. In fact, it has evaluated various plastics, including samples used in food packaging, for their biodegradability. This evaluation, however,

occurred almost 20 years ago in the early 1970s, and the laboratory has performed no subsequent work in this area.

EPA is currently conducting a study on methods to reduce plastics pollution, as mandated by the Marine Plastics Pollution Research and Control Act of 1987. As part of its study, EPA is required to investigate the feasibility of making articles from degradable plastics, taking into account the rate of degradation and safety of the end products. However, EPA is planning no involvement by its laboratories in this assessment. Instead, it plans to review relevant technical literature and monitor certain private sector efforts to develop definitions and methods of testing for degradable plastics.

EPA officials said that, although the laboratories possess the capability, no tests of degradable plastics are currently underway because of other research and testing priorities. As a result, they expect that any future effort involving degradable plastics would probably be limited. An EPA official directing the development of new methods of testing for other chemicals told us that the responsibility for progress toward standardization resides with the private sector, unless the federal government mandates the use of degradable plastics and the standards they must meet. At that point, according to this official, EPA would have to become more involved in activities relating to standards development.

NIST's Activities

The Polymers Division within the National Institute of Standards and Technology, has about 40 scientists with expertise in plastics. It is planning to undertake one very small-scale project to test degradable plastics. A scientist in this division has requested samples and is planning a limited amount of testing. He will bury starch-based degradable plastics in soil and expose them to selected strains of microorganisms.

According to a senior official within the Polymers Division, one of three developments would have to occur for NIST to expand its testing: (1) the designation of a lead agency for degradable plastics and that agency providing funding to NIST, (2) an internal budget initiative from NIST, or (3) a congressional mandate. The Chief of the program office said that no determination has yet been made whether NIST would undertake an expanded degradable plastics program. However, she added that, since NIST receives more than 40 percent of its funding from other agencies, it might be able to obtain funding elsewhere to support an effort in this area.

FDA's Activities

The Food and Drug Administration has not approved any materials that are intended to increase the degradability of plastic food-packaging. However, the agency has recently been contacted by, and is working with, companies that are interested in food-packaging uses of degradable plastics. A senior agency official told us that FDA's assessment of food safety includes concerns about the shelf life of degradable packaging and potential food contamination. The agency also has responsibilities for assessing the environmental impacts of degradable plastics; its evaluation in this area would focus on the issues already mentioned, the time frame for degradability and the safety of the end products. FDA places the burden of proof for the safety and functionality of a new product as well as the analysis of environmental impact on the manufacturer. The agency will determine the extent to which FDA resources are needed to help develop testing methods for predicting the environmental impact of degrading plastics.

Private Sector Activities to Develop Standards for Degradable Plastics Are Limited

Private sector activities to develop standards for degradable plastics are being planned primarily through the American Society for Testing and Materials (ASTM). These activities are limited and their eventual contribution to standards development is difficult to evaluate at present.

ASTM is a scientific and technical organization that develops standards on the characteristics and performance of materials and products. It describes itself as the world's largest source of voluntary consensus standards. One of its numerous technical committees, known as the D-20 Committee on the Permanence Properties of Plastics, is chiefly responsible for ASTM's recent efforts to develop standards for degradable plastics. The subject was introduced for the first time at a committee meeting in March 1988. Members have agreed that they would like to develop a set of standards and methods for testing that would conform with ASTM's criteria. Two officials were appointed at the March meeting to work on definitions, standards, and methods of testing.

The official responsible for definitions is focusing on five principal terms, including biodegradability and photodegradability. The official concerned with standards and methods of testing sent a letter to about 40 companies and individuals inquiring whether they have or are aware of any standards relating to degradable plastics. He found no relevant standards but wanted to establish this fact as a starting point for further ASTM efforts.

ASTM provides a peer review process through which new methods of testing can be suggested, made known to other scientists, and evaluated for effectiveness. A plastics industry spokesperson believes that scientists need to identify specific conditions (such

as landfills and marine environments) to be replicated for degradable plastics testing; he would like to see a variety of methods developed and subjected to ASTM review.

In summary, officials in the private and federal sectors recognize the need for degradable plastics standards, but relatively little effort to achieve this objective soon is underway. EPA, NIST, and FDA report few or no activities in this regard. ASTM's efforts are just getting underway and their outcome is uncertain.

FEDERALLY FUNDED R&D FOR DEGRADABLE PLASTICS

In addition to studying the need for standards, we identified the federally funded projects involving degradable plastics. We found that four agencies are conducting or supporting basic or applied research related to degradability of plastics and product development. The Departments of Agriculture (USDA), Defense (DOD) Energy (DOE), and the National Science Foundation (NSF) are supporting 12 R&D projects at a total funding level of $1.7 million in FY 1988. These projects are focused mainly on developing and improving new degradable products rather than addressing the need for standards regarding degradable plastics.

USDA is spending $941,000 on 4 projects for degradable plastics research aimed at developing new nonfood, nonfuel uses for agricultural commodities, particularly corn. The focal point for USDA's activities is the Northern Regional Research Center in Peoria, Illinois, where two projects involving degradable plastic films and molded products are funded at a total of $900,000. Two much smaller projects at universities are exploring the degradation rates of agricultural mulching films. The extensive use of plastic mulching films in agriculture and the high cost of their removal

from fields have led USDA to evaluate degradable plastics for this purpose.

DOD's R&D program, accounting for $575,000, is focusing on alternatives to nondegradable plastics primarily for use at sea. Most of DOD's activities are concentrated on the use of microorganisms to produce degradable plastics. Two Navy projects and an Army project are experimenting with selected strains of bacteria and fungi capable of producing a variety of these biodegradable plastic materials. Practical applications are probably several years away; potential uses include degradable food packaging. An additional Navy project is exploring the use of cornstarch in a biodegradable plastic trash bag.

DOE has provided $150,000 to the Solar Energy Research Institute of Golden, Colorado to work with wood- and starch-based substitutes for petroleum-based plastics. The institute has awarded three subcontracts to explore innovative, inexpensive, lightweight materials. One of the subcontracted projects should increase the amount of degradable material in the finished product. Currently finished products can usually include no more than 6 to 10 percent of the degradable material. Products that have attempted to include a higher percentage have lost a proportionate amount of durability. The DOE project has boosted the percentage of degradable materials to levels as high as 25 to 35 percent with no loss of strength. NSF is also supporting this project with a $63,000 grant.

Scientists conducting federally funded R&D recognize the technical uncertainties associated with degradable plastics and the need for standardization. As a result, a few have begun to incorporate testing in their R&D; others are planning tests within the next year. This testing, as mentioned earlier, may help to evaluate product performance but does not in itself ensure the development of appropriate standards for degradable plastics.

OTA's Study of Municipal Solid Wastes and Plastics

We coordinated our work with the Office of Technology Assessment, which began a study of municipal solid wastes in late 1987 and is due to report to Congress in March 1989. OTA's study is focusing on the federal role in municipal solid waste management, including opportunities for waste reduction and recycling and for making incineration and landfilling safer. Efforts to promote the use of degradable plastics, according to an OTA official, should take into account their effectiveness in reducing solid waste and their compatibility with alternative approaches.

MATTER FOR CONSIDERATION BY THE CONGRESS

If the Congress wishes to promote degradable plastics, it may want to consider the following approach: select an agency (or agencies) which, in cooperation with the private sector, would undertake the development of standards, including uniform definitions and methods of testing. EPA and NIST would be appropriate agencies for such activities because of their extensive experience in testing for environmental effects and product performance.

This concludes my statement, Mr. Chairman. I would be happy to answer any questions that you or other Committee Members might have.