Attachment 5 - Environmental Assessment

1.	**Date**	July 10, 2003
2.	**Name of Applicant/Notifier**	E.I. duPont de Nemours and Company
3.	**Address**	All communications on this matter are to be sent in care of Counsel for Notifier, George G. Misko, Keller and Heckman LLP, 1001 G Street, NW, Suite 500 West, Washington, DC 20001. Telephone: 202.434.4170.

4. Description of the Proposed Action

The action requested in this Notification is to establish a clearance for 1,3-benzenedicarboxylic acid, 5-sulfo-, 1,3-dimethyl ester, sodium salt, polymer with dimethyl 1,4-benzenedicarboxylate, dimethyl pentanedioate, poly(ethylene glycol), and 1,2-ethanediol for use as components of food-contact articles. The purpose of the Notification is to permit the use of the subject polymer for use as a coating and as a film having a maximum thickness of 4 mils (0.004 inch) to fabricate food-contact articles in contact with (1) aqueous and acidic foods for use at temperatures up to 66°C for up to 30 minutes or up to 40°C for up to 2 hours and (2) dry and fatty foods under Conditions of Use D through G. Examples of food packaging materials that may be made from the food-contact substance include, but are not limited to, coatings used on clamshell containers intended for use in serving hot sandwiches and stand-alone films for use as hot sandwich wraps, in quick-service restaurants. Additional uses include bowls for soup and

chili used in food-service establishments, and bowls for dehydrated soup to which hot water will be added.

The Notifier does not intend to produce finished food packaging materials from the subject polyester. Rather, the copolymer will be sold to manufacturers engaged in the production of food-contact materials. Food-contact materials produced with the use of the polymer will be utilized in patterns corresponding to the national population density and will be widely distributed across the country. Therefore, it is anticipated that disposal will occur nationwide, with about 76% of the materials being deposited in land disposal sites, and about 24% combusted.[1]

The types of environments present at and adjacent to these disposal locations are the same as for the disposal of any other food-contact material in current use. Consequently, there are no special circumstances regarding the environment surrounding either the use or disposal of food-contact materials prepared from the subject polymer.

5. Identification of Substance that Is the Subject of the Proposed Action

The food-contact substance that is the subject of this Notification is 1,3-benzenedicarboxylic acid, 5-sulfo-, 1,3-dimethyl ester, sodium salt, polymer with dimethyl 1,4-benzenedicarboxylate, dimethyl pentanedioate, poly(ethylene glycol), and 1,2-ethanediol, *i.e.*, a copolyester produced from dimethyl terephthalate, dimethyl glutarate, sodium 5-sulfodimethylisophthalate, poly(ethylene glycol), and ethylene glycol. The polymer is a polyester derived from diols and diacids or dimethyl esters. Thus, the structure is one in which the polymer backbone consists of alternating units derived from diols and acids/esters. The material's tradename is or .

[1] *Characterization of Municipal Solid Waste in the United States: 1997 Update*, EPA 530-R-98-007, U.S. Environmental Protection Agency (5305W), Washington DC, 20460, May 1998.

[redacted]

Finally, the M_w and M_n for the substance are approximately 63,500 and 25,000, respectively, for a M_w/M_n of approximately 2.54.

6. Introduction of Substances into the Environment

Under 21 C.F.R. § 25.40(a), an environmental assessment ordinarily should focus on relevant environmental issues relating to the use and disposal from use, rather than the production, of FDA-regulated articles. Moreover, information available to the Notifier does not suggest that there are any extraordinary circumstances in this case indicative of any adverse environmental impact as a result of the manufacture of 1,3-benzenedicarboxylic acid, 5-sulfo-, 1,3-dimethyl ester, sodium salt, polymer with dimethyl 1,4-benzenedicarboxylate, dimethyl pentanedioate, poly(ethylene glycol), and 1,2-ethanediol. Consequently, information on the manufacturing site and compliance with relevant emissions requirements are not provided here.

No environmental release is expected upon the use of the subject polymer to fabricate packaging materials. In these applications, the polymer is expected to be used as a coating and as a film, and will be entirely incorporated into the finished food package. Any waste materials generated in this process, *e.g.*, plant scraps, are expected to be disposed of as part of the packaging manufacturer's overall nonhazardous solid waste in accordance with established procedures.

Disposal by the ultimate consumer of food-contact materials produced by the subject polymer will be by conventional rubbish disposal and, hence, primarily by sanitary landfill or incineration. Disposal by composting in the U.S. is not expected to be significant; thus, we do not anticipate any significant introduction of substances into the environment as a result of composting.

If the material is introduced into commercial compost sites, the polymer will degrade into smaller polymeric components, ultimately to carbon dioxide and water. Biodegradability testing

[redacted]

has been undertaken in accordance with European Committee for Standardization (CEN), DIN,[2] and American Society for Testing and Materials (ASTM) standards, as summarized below. The certification by DIN CERTO Gesellschaft für Konformitätsbewertung mbH is included in an attachment to this Environmental Assessment.

The subject polymer was tested in a controlled composting test in accordance with the proposed amendment ISO 14855:1999 DAM 1 (2001). The process takes 180 days in a controlled compost site operated at 136°F (58°C) under dry aerobic conditions. Using cellulose as a reference standard, the subject polymer fulfilled the requirements of ASTM D6400-99 by reaching a relative biodegradation above 60%, relative to cellulose, in 180 days. Furthermore, a film sample of the subject polymer, 49 microns (49 μm or approximately 2 mils (0.002 inch)) thick, was tested for disintegration in a pilot-scale composting test in accordance with ASTM D6400-99. The sample met the requirements of ASTM D6400-99, as the film had disintegrated sufficiently in 12 weeks, *i.e.*, at least 90% of the film was converted into pieces less than 2 mm.

The compost generated in the disintegration test was subjected to ecotoxicity testing by Organic Waste Systems N.V. (OWS), Belgium. No adverse ecotoxicity was observed in germination and growth of radish, summer barley, or water cress. In addition, the percentage survival of earthworms in the test compost/artificial soil mixtures was equal to or higher than the survival in blank compost/artificial soil mixtures. Further, no adverse ecotoxicity was observed in microbial population densities (fungal and bacterial) compared to controls. The ecotoxicity testing, *i.e.*, (1) plant germination and seedling emergence, (2) earthworm weight gain and mortality, and (3) microbial population (fungal and bacterial) density, conducted on this substance is summarized in an attachment to this Environmental Assessment.

[2] DIN CERTO Gesellschaft für Konformitätsbewertung mbH is the certification organization of DIN, the German Institutes for Standardization.

[redacted]

The subject polymer consists of carbon, hydrogen, oxygen, and sulfur. The combustion products are expected to be carbon dioxide and water; sulfur is a small component of the polymer (less than 0.23% by weight) and, therefore, is not expected to give rise to significant levels of sulfur-containing combustion products. Thus, no toxic combustion products are expected as a result of the proper incineration of the copolymer.

Only extremely small amounts, if any, of 1,3-benzenedicarboxylic acid, 5-sulfo-, 1,3-dimethyl ester, sodium salt, polymer with dimethyl 1,4-benzenedicarboxylate, dimethyl pentanedioate, poly(ethylene glycol), and 1,2-ethanediol constituents are expected to enter the environment as a result of the landfill disposal of food-contact articles, in light of the Environmental Protection Agency's (EPA) regulations governing municipal solid waste landfills. EPA's regulations require new municipal solid waste landfill units and lateral expansions of existing units to have composite liners and leachate collection systems to prevent leachate from entering ground and surface water, and to have groundwater monitoring systems. 40 C.F.R. Part 258. Although owners and operators of existing active municipal solid waste landfills that were constructed before October 9, 1993 are not required to retrofit liners and leachate collections systems, they are required to monitor groundwater and to take corrective action as appropriate.

7. Fate of Emitted Substances in the Environment

(a) Air

No significant effect on the concentrations of and exposures to any substances in the atmosphere are anticipated due to the proposed use of 1,3-benzenedicarboxylic acid, 5-sulfo-, 1,3-dimethyl ester, sodium salt, polymer with dimethyl 1,4-benzenedicarboxylate, dimethyl pentanedioate, poly(ethylene glycol), and 1,2-ethanediol. The polymer is of high molecular weight and does not volatilize. Thus, no significant quantities of any substances will be released upon the use and disposal of food-contact articles manufactured with these polymers.

The products of complete combustion of the polymer largely would be carbon dioxide and water; the concentrations of these substances in the environment will not be significantly altered by the proper incineration of the polymer in the amounts utilized for food packaging applications.

(b) Water

No significant effects on the concentrations of and exposures to any substances in fresh water, estuarine, or marine ecosystems are anticipated due to the proposed use of the subject polymer. No significant quantities of any substance will be added to these water systems upon the proper incineration of the polymer, nor upon its disposal in landfills due to the extremely low levels of aqueous migration of polymer components.

(c) Land

Considering the factors discussed above, no significant effects on the concentrations of and exposures to any substances in terrestrial ecosystems are anticipated as a result of the proposed use of the subject 1,3-benzenedicarboxylic acid, 5-sulfo-, 1,3-dimethyl ester, sodium salt, polymer with dimethyl 1,4-benzenedicarboxylate, dimethyl pentanedioate, poly(ethylene glycol), and 1,2-ethanediol. In particular, the extremely low levels of maximum migration of components of 1,3-benzenedicarboxylic acid, 5-sulfo-, 1,3-dimethyl ester, sodium salt, polymer with dimethyl 1,4-benzenedicarboxylate, dimethyl pentanedioate, poly(ethylene glycol), and 1,2-ethanediol, demonstrated by the extraction studies, indicate that virtually no leaching of these substances may be expected to occur under normal environmental conditions when finished food-contact materials are disposed. Furthermore, the very low production of 1,3-benzenedicarboxylic acid, 5-sulfo-, 1,3-dimethyl ester, sodium salt, polymer with dimethyl 1,4-benzenedicarboxylate, dimethyl pentanedioate, poly(ethylene glycol), and 1,2-ethanediol for use in food-contact applications precludes any substantial release to the environment of their

components. Furthermore, as noted above in Section 6 of this Environmental Assessment, the subject polymer exhibited sufficient disintegration at the end of 12 weeks under controlled composting conditions. The compost generated in the disintegration test was subjected to ecotoxicity; no adverse ecotoxicity was observed in germination and growth of radish, summer barley, and water cress, and no adverse ecotoxicity was observed in the survival of earthworms or in microbial (fungal and bacterial) population densities. Thus, there is no expectation of any meaningful exposure of terrestrial organisms to these substances as a result of the proposed use of the polymer.

Considering the foregoing, there is no reasonable expectation of a significant impact on the environment due to the proposed use of 1,3-benzenedicarboxylic acid, 5-sulfo-, 1,3-dimethyl ester, sodium salt, polymer with dimethyl 1,4-benzenedicarboxylate, dimethyl pentanedioate, poly(ethylene glycol), and 1,2-ethanediol in the manufacture of articles intended for use in contact with food.

8. Environmental Effects of Released Substances

As discussed previously, the only substances that may be expected to be released to the environment upon the use and disposal of food packaging materials fabricated with the use of the subject polymer consist of extremely small quantities of combustion products and extractables. As discussed in Part III of the Notification, the polymer is expected to be safe when used as intended. Furthermore, none of the monomers used in the manufacture of the polymers are considered to be carcinogens.

Based on these considerations, no adverse effect on organisms in the environment is expected as a result of the disposal of articles containing the polymers. In addition, the use and disposal of the polymer are not expected to threaten a violation of applicable laws and regulations, *e.g.*, EPA's regulations in 40 C.F.R. Part 60 that pertain to municipal solid waste

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combustors and Part 258 that pertain to landfills. Finally, the subject polymer exhibited sufficient disintegration under controlled composting conditions and the compost generated indicated no adverse ecotoxicity, if such composting were to occur. The ecotoxicity testing conducted on this substance is summarized in an attachment to this Environmental Assessment, as previously noted.

9. Use of Resources and Energy

As is the case with other food packaging materials, the production, use, and disposal of 1,3-benzenedicarboxylic acid, 5-sulfo-, 1,3-dimethyl ester, sodium salt, polymer with dimethyl 1,4-benzenedicarboxylate, dimethyl pentanedioate, poly(ethylene glycol), and 1,2-ethanediol involves the use of natural resources such as petroleum products, coal, and the like. However, the use of the subject polymer as a coating and as a film is not expected to result in a net increase in the use of energy and resources, since the copolymer is intended to be used in materials which will be used in place of similar materials now on the market for use in food-contact articles. Specifically, as discussed in Item 4 above, the proposed use in this Notification for the subject polymer is as a coating and as a film to fabricate food-contact articles. Polymers currently used in such applications include, but are not limited to, polyester and polystyrene.

The partial replacement of these types of materials by 1,3-benzenedicarboxylic acid, 5-sulfo-, 1,3-dimethyl ester, sodium salt, polymer with dimethyl 1,4-benzenedicarboxylate, dimethyl pentanedioate, poly(ethylene glycol), and 1,2-ethanediol is not expected to have any adverse impact on the use of energy and resources. Manufacture of the polymer, and its conversion to finished food packaging materials, will consume energy and resources in amounts comparable to the manufacture and use of other polymers. Moreover, similar substances to the substance that is the subject of this Notification currently in use for food packaging are not recovered for recycling to a significant extent but are disposed of by means of sanitary landfill

and incineration; bottles, the types of containers that are recovered for recycling to a significant extent, are not of interest to the Notifier at this juncture. Packaging materials produced from 1,3-benzenedicarboxylic acid, 5-sulfo-, 1,3-dimethyl ester, sodium salt, polymer with dimethyl 1,4-benzenedicarboxylate, dimethyl pentanedioate, poly(ethylene glycol), and 1,2-ethanediol are expected to be disposed of according to the same patterns when they are used in place of the current materials. Thus, there will be no impact on current or future recycling programs.

10. Mitigation Measures

As shown above, no significant adverse environmental impacts are expected to result from the use and disposal of food-contact materials fabricated from the subject polymer. This is primarily due to the minute levels of leaching of potential migrants from the finished article; the insignificant impact on environmental concentrations of combustion products of the polymer; and the close similarity of the subject polymer to the materials they are intended to replace. Thus, the use of the polymer as proposed is not reasonably expected to result in any new environmental problem requiring mitigation measures of any kind.

11. Alternatives to the Proposed Action

No potential adverse environmental effects are identified herein which would necessitate alternative actions to that proposed in this Notification. The alternative of not approving the action proposed herein would simply result in the continued use of the materials which the subject polymer would otherwise replace; such action would have no environmental impact. In view of the excellent qualities of 1,3-benzenedicarboxylic acid, 5-sulfo-, 1,3-dimethyl ester, sodium salt, polymer with dimethyl 1,4-benzenedicarboxylate, dimethyl pentanedioate, poly(ethylene glycol), and 1,2-ethanediol for use in food-contact applications, the fact that the polymer constituents are not expected to enter the environment in more than minute quantities upon the use and disposal of finished food-contact articles, and the absence of any significant

environmental impact which would result from its use, the establishment of an effective Food Contact Notification to permit the use of 1,3-benzenedicarboxylic acid, 5-sulfo-, 1,3-dimethyl ester, sodium salt, polymer with dimethyl 1,4-benzenedicarboxylate, dimethyl pentanedioate, poly(ethylene glycol), and 1,2-ethanediol as described herein is environmentally safe in every respect.

12. List of Preparers

Lester Borodinsky, Ph.D., Staff Scientist, Keller and Heckman LLP, 1001 G Street, N.W., Suite 500 West, Washington, D.C. 20001.

Ann L. Hriciga, Ph.D., DuPont, DuPont, Barley Mill Plaza, 26/1172, 4417 Lancaster Pike, Wilmington, Delaware 19805.

Thomas P. Price, Ph.D., Senior Regulatory Specialist, DuPont, Dupont Packaging and Industrial Polymers, Chestnut Run Plaza, Post Office Box 80713, Building 713, 4417 Lancaster Pike, Wilmington, Delaware 19880-0713.

* * *

The undersigned official certifies that the information provided herein is true, accurate, and complete to the best of his knowledge.

Date: July 10, 2003

George G. Misko
Counsel for E.I. duPont de Nemours and Company

Attachments

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DIN CERTCO

Gesellschaft für Konformitätsbewertung mbH

NOTIFICATION OF REGISTRATION

The company

DuPont
1007 North Market Street
WILMINGTON, DE 19899
U S A

hereby receives confirmation that the product

Compostable material

of the type

conforms to

ASTM D 6400:1999
Certification scheme products made of compostable materials

Registration No.:

This Notification of Registration is valid in connection with above stated Registration No. for an unlimited period and becomes ineffective only upon termination.

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See annex for further information.

DIN CERTCO Gesellschaft für Konformitätsbewertung mbH

2003-02-14

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Annex

to the Notification of Registration with Registration No. 7W0044, dated 2003-02-14

Technical data

max. layer thickness: 49 µm

Testing laboratory / Inspection body

Organic Waste Systems n.v.
4, Dok Noord
9000 GENT
BELGIEN

Test report

No. R-JMS-18/2b dated 2002-11-15
No. R-RNB-1a dated 2002-02-05
No. JMS-21-ex dated 2002-11-06
No. R-RNB-2/1 dated 2001-12-26
No. R-RNB-2/2 dated 2001-12-26
No. R-JMS-20 dated 2002-05-15

Summary of tests used to obtain DIN CERTCO certification. all Work Conducted by OWS (Organic Waste Systems Gent, Belgium)

Biodegradability

_____ was tested for biodegradability under dry, aerobic conditions in a controlled composting test according to the proposed amendment ISO 14855:1999 DAM 1 (2001). Composting conditions were kept at 58 C and test was performed under GLP conditions. Biodegradation is determined by monitoring CO2 evolution compared to a blank reactor. A cellulose reference is run to make sure the test is running properly. fulfilled the requirements of ASTM D6400-99 by reaching a relative biodegradation percentage (relative to cellulose) above 60% in 180 days.

Disintegration Summary

film 49 microns thick was evaluated for disintegration in a pilot-scale aerobic composting test in accordance with ASTM D6400-99. The conclusion of the evaluation was that with a thickness of 49 microns does meet the requirements of ASTM D-6400-99. This means that in 12 weeks time the film had disintegrated to a point that 90% of the pieces were less than 2 mm.

Ecotoxicity Summaries

Earthworm tests

Range finding test

The results of the range finding test are summarized as follows:

Artificial soil:	100% survival
Blank compost (20%):	100% survival
Blank compost (40%):	100% survival
Blank compost (80%):	0% survival

Based on these results 3 concentrations were chosen to cover a range of 0% to 100% mortality. The set-up of the definitive test is as follows:

concentration compost in artificial soil: 45%, 60% and 75%

Definitive test

Table 1 and Figure 1 show the average percentage of survival at the end of the test. In Table 1 also the live weight yield is given in g per worm and as a percentage of the start weight.

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The figure shows that the percentage survival of the earthworms in the test compost/artificial soil mixtures is equal or higher than the survival in the corresponding mixtures of blank compost/artificial soil.

Furthermore the decrease in weight was for higher in the blank compost mixtures compared to the corresponding test compost mixtures. It can be concluded that after composting in a 10% concentration, no residuals are left that exert an negative effect on the survival of worms.

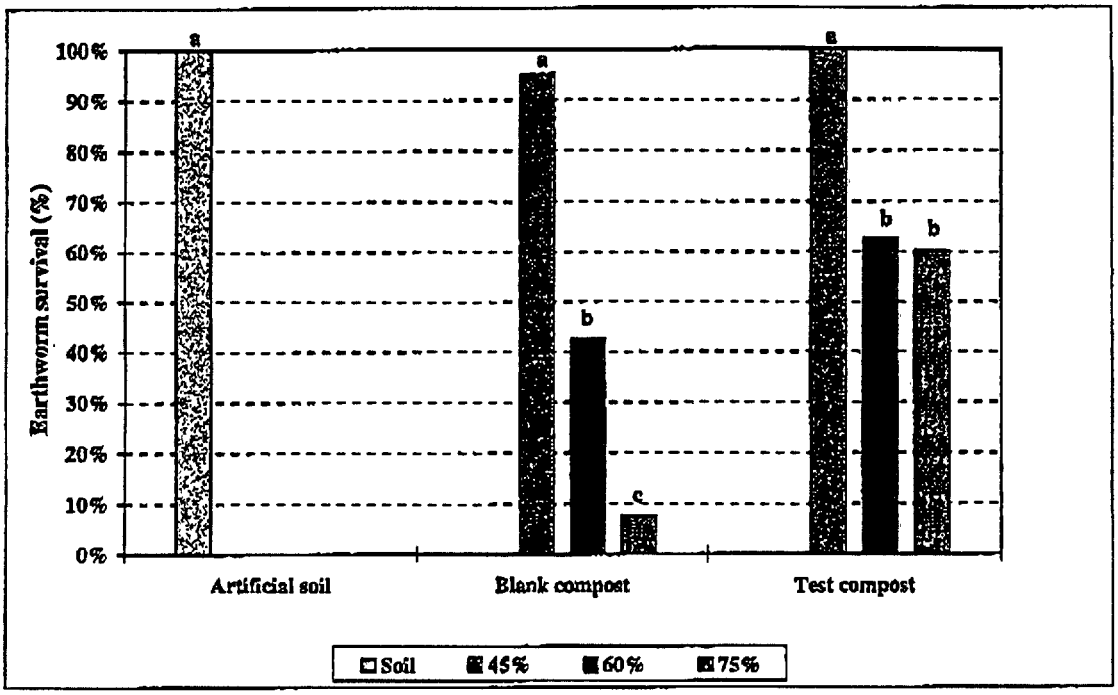

Figure1. Average survival of earthworms. Bars which have at least one letter in common, are not significantly different from each other at the P□0.05 level of significance (Anova single factor Test).

Cress Test

A cress test, which is representative for dicotylenonous plants was performed on 1-1 compost, obtained at the end of a pilot-scale composting test, in which test item 1-1 was added in a 10% concentration to biowaste at start of the composting. The pilot-scale composting test is reported in report R-JMS-13.

The test is executed according to the following standard: CEN norm EN 13432 *"Requirements for packaging recoverable through composting and biodegradation - Test scheme and evaluation criteria for the final acceptance of packaging".*

No negative effect was seen on the germination and growth of cress in 25% and 50% 1-1 compost/reference substrate mixtures compared to the corresponding mixture of blank compost.

According to CEN norm EN 13432 the germination rate and the plant biomass of the test compost should be more than 90% of those from the corresponding

blank compost. This pass value was easily reached for the 1-1 powder for both mixtures.

In conclusion, it can be stated that after composting 1-1 powder in a 10% concentration, no residuals are left such as metabolites, undegraded components and inorganic components that exert a negative influence on germination and growth of cress plants.

Radish Test

A radish plant growth test, which is representative for tuberous plants, was performed on compost, obtained at the end of a pilot-scale composting test, in which test item was added in a 10% concentration to biowaste at start of the composting. The pilot-scale composting test is reported in report R-JMS-13. This is the third plant test executed on the compost. Also the summer barley plant growth test (see report R-RNB-2/1) and cress test (see report R-RNB-2/2) were performed successfully on the compost.

The method is executed according to the OECD Guideline for testing of chemicals 208 (1984) "*Terrestrial Plants, Growth Test*" as requested by ASTM D 6400-99 *'Standard Specification for Compostable Plastics'*. For practical aspects the CEN norm EN 13432 of September 2000 *"Requirements for packaging recoverable through composting and biodegradation - Test scheme and evaluation criteria for the final acceptance of packaging"* was followed.

There was no significant difference between the germination and growth of radish plants in 25% and 50% compost/reference substrate mixtures compared to the corresponding mixtures of blank compost and thus the requirements of ASTM D 6400-99 *'Standard Specification for Compostable Plastics'* are fulfilled.

According to CEN norm EN 13432 the germination rate and the plant biomass of the test compost should be more than 90% of those from the corresponding blank compost. This pass value was easily reached for both mixtures of compost.

In conclusion, it can be stated that after composting n a 10% concentration, no residuals are left such as metabolites, undegraded components and inorganic components that exert a negative influence on germination and growth of radish plants.

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Summer Barley

A summer barley plant growth test, which is representative for monocotyledonous plants, was performed on 1-1 compost, obtained at the end of a pilot-scale composting test, in which test item 1-1 was added in a 10% concentration to biowaste at start of the composting. The pilot-scale composting test is reported in report R-JMS-13.

The test is executed according to the following standards: CEN norm EN 13432 *"Requirements for packaging recoverable through composting and biodegradation - Test scheme and evaluation criteria for the final acceptance of packaging"* and DIN V 54900 *"Prüfung der Kompostierbarkeit von Kunststoffen"*. The test was stopped after 11 days, which is within the prescribed time interval of *'Methodenbuch 1998, Kapitel II: 5. Pflanzenverträglichkeit – Bundesgütegemeinschaft Kompost e.V.'*.

No negative effect was seen on the germination and growth of summer barley plants in 25% and 50% 1-1 compost/reference substrate mixtures compared to the corresponding mixture of blank compost. The germination and dry weight plant yield of the 1/1 mixture of 1-1 compost/reference substrate was even significantly higher than the corresponding mixture of blank compost.

According to CEN norm EN 13432 the germination rate and the plant biomass of the test compost should be more than 90% of those from the corresponding blank compost. This pass value was easily reached for both mixtures of 1-1 compost.

In conclusion, it can be stated that after composting 1-1 in a 10% concentration, no residuals are left such as metabolites, undegraded components and inorganic components that exert a negative influence on germination and growth of summer barley plants.

[redacted]

Summary of Ecotoxicity Testing Conducted on

- **Plant Germination and Seedling Emergence**

Cress

No negative effect was seen on the germination and growth of cress in 25% and 50% Biomax® 4026 compost/reference substrate mixtures compared to the corresponding mixture of blank compost.

According to CEN norm EN 13432 the germination rate and the plant biomass of the test compost should be more than 90% of those from the corresponding blank compost. This pass value was easily reached for the powder for both mixtures.

Radish

There was no significant difference between the germination and growth of radish plants in 25% and 50% compost/reference substrate mixtures compared to the corresponding mixtures of blank compost and thus the requirements of ASTM D 6400-99 *'Standard Specification for Compostable Plastics'* are fulfilled.

According to CEN norm EN 13432 the germination rate and the plant biomass of the test compost should be more than 90% of those from the corresponding blank compost. This pass value was easily reached for both mixtures of compost.

Summer Barley

No negative effect was seen on the germination and growth of summer barley plants in 25% and 50% compost/reference substrate mixtures compared to the corresponding mixture of blank compost. The germination and dry weight plant yield of the 1/1 mixture of 1-1 compost/reference substrate was even significantly higher than the corresponding mixture of blank compost.

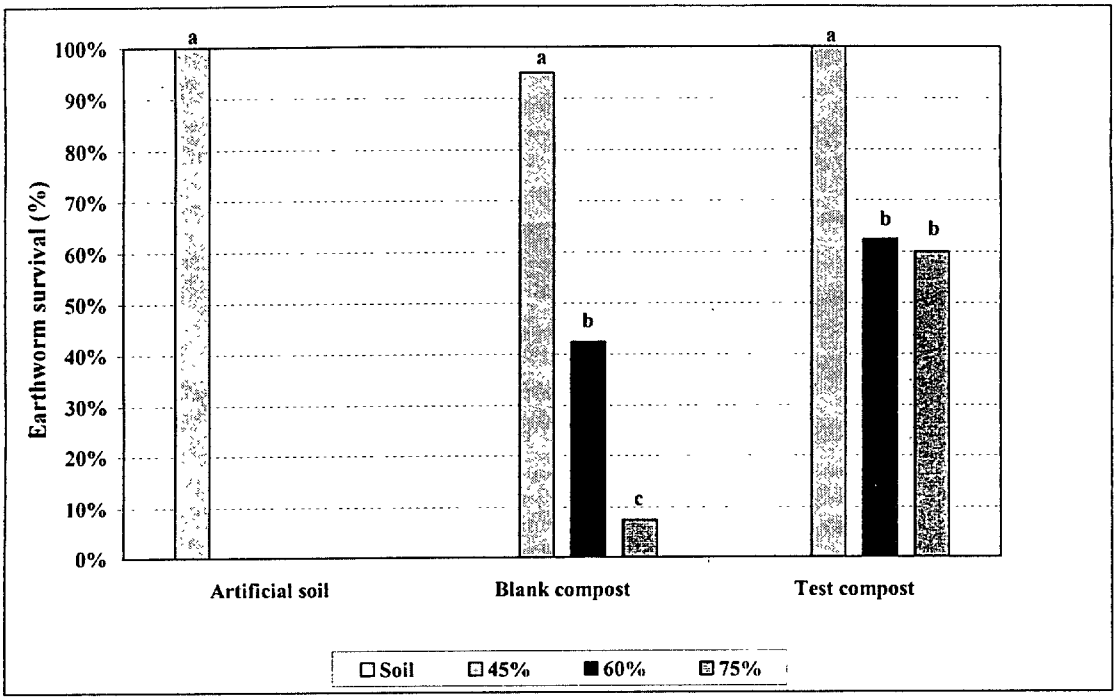
According to CEN norm EN 13432 the germination rate and the plant biomass of the test compost should be more than 90% of those from the corresponding blank compost. This pass value was easily reached for both mixtures of compost.

- **Earthworm Weight Gain and Mortality**

The figure shows that the percentage survival of the earthworms in the test compost/artificial soil mixtures is equal or higher than the survival in the corresponding mixtures of blank compost/artificial soil.

Furthermore the decrease in weight was higher in the blank compost mixtures compared to the corresponding test compost mixtures. It can be concluded that after composting in a 10% concentration, no residuals are left that exert an negative effect on the survival of worms.

[redacted]



- **Microbial Population (Fungal and Bacterial) Density**

Densities of soil bacteria and fungi were monitored to detect any negative effects on microflora.

Samples were prepared, as before, at .1 and 1.0% level by incorporating samples into sandy loam forest and agricultural soils. Moisture was adjusted to 25% and samples were incubated at 25 C on days 7 and 30, contents of each soil plate were extracted with deionized H2O and bacterial and fungal colony forming units were quantified on four isolation media.

Summary: None of the polymeric test materials produced a negative impact on the fungal and bacterial densities, compared to controls. Jute and kraft paper showed an immediate and significant stimulatory effect on the fungal colonies.