R E P O R T

of

ITW HI-CONE

S U B M I T T E D

to

ENERGY AND NATURAL RESOURCES COMMITTEE

P U R S U A N T

to

P.L. 1991, Chapter 833

April 30, 1993

INTRODUCTION

The following report is submitted to the Energy and Natural Resources Committee by ITW Hi-Cone pursuant to Section 3 of P.L. 1991, c. 883 which states:

> **Sec. 3. Report; manufacturers and distributors.** Those persons who are manufacturers or distributors of products sold in the State in containers connected by plastic holding devices shall report to the joint standing committee of the Legislature having jurisdiction over energy and natural resource matters by May 1, 1993. That report must include a demonstration of a plastic holding device that breaks simultaneously with the removal of each container. If the device demonstrated to the committee is a prototype device that is not in commercial distribution, the report must indicate when the device could be commercially distributed in the State.

ITW Hi-Cone, a division of Illinois Tool Works Inc., is the patent holder and manufacturer of the Hi-Cone carrier, a plastic holding device used in Maine to connect containers.

BACKGROUND

The Hi-Cone plastic ring carrier was commercially introduced in 1962. Product manufacturers and distributors preferred it because the carrier was highly efficient and saved at least 90% of material over paperboard. Consumers preferred it for its ease in handling and storage and because the package remained intact after exposure to moisture or abuse.

During the past thirty years ITW Hi-Cone has continued to improve the ring carrier through material efficiencies, reducing overall environmental impact and to meet changing market demands. Throughout this period, twenty (20) new generations or variations of ring carriers have been developed.

To date, one of the most significant developments was the introduction of photodegradability of the carrier during the 1970s. Two approaches to degradability were studied. One involved material which can be attacked by bacteria and fungi and converted by them from a complex molecular structure to simple gasses and organic compounds (biodegradability). The second method involves using the ultraviolet energy from the sun to break down the plastic material's complex long-chain molecules into shorter chains (photodegradability).

Interestingly (and perhaps contrary to our intuitive feelings) photodegradability is preferrable for a material which is not being disposed of in a sewage disposal system. For a carrier which is exposed on the earth's surface (i.e., litter), the same ultraviolet energy which will breakdown a photodegradable carrier will inhibit bacteria and fungi from being present in significant quantity to allow for effective biodegradation of the carrier.

The photodegradable carrier is now used universally across the United States. That means that over time, a ring carrier exposed to the elements will break down. First the carrier material will become brittle and lose its ability to be elongated without breaking. Then further exposure in sunlight, wind and rain will cause the carrier to crumble into inert material which is not toxic or otherwise harmful. The amount of time required for degradation varies from one area of the country to another and from season to season.

The Hi-Cone ring carrier currently manufactured meets all state requirements regarding photodegradability. It also meets the newly proposed U.S. EPA degradability performance standards promulgated pursuant to the Marine Pollution Prevention Act of 1989 which requires, by federal statute, that plastic ring carriers be processed from a material that degrades quickly and does not pose a threat to wildlife.

Although Hi-Cone ring carriers meet all current or proposed standards for photodegradability, ITW Hi-Cone continues research in this area just as research is continuing in recycling, design changes and more efficient use of natural resources in the manufacturing process.

ITW'S CURRENT RESEARCH FOCUS

During the past two to three years the development of a carrier which automatically breaks with the removal of the container (Automatic Breaking Carrier) has been ITW Hi-Cone's top development focus. For although there is substantial evidence that since the

use of photodegradable material in plastic ring connectors the carriers pose little threat of entanglement to fish and wildlife, the perception that current carriers pose a threat persists. In addition to fighting the perception that the ring carrier is a major threat to wildlife, ITW Hi-Cone has continued to focus its resources on development of a new generation of carrier and the expansion of our national recycling program.

ITW Hi-Cone views the development of an Automatic Breaking Carrier as a continuation of its leadership as a market innovator in the area of container connectors. Toward this goal, Hi-Cone's Product Development team has been working on both carrier designs and the machine application designs necessary to meet the objectives that the carrier will break simultaneously with the removal of the can and the numerous other performance demands required of this type of packaging.

WHY IS IT SO HARD?

The totality of performance standards which the automatic breaking carrier must meet are unique and virtually inconsistent. The package must be sturdy enough to meet the rigors of manufacturing and distribution and also weak enough to break automatically when, and only when, the consumer wants to remove the container.

If the package breaks prematurely anywhere along the line-- in manufacturing, in distribution, on store shelves, in the grocery cart, in the grocery bag, on its way to or from the refrigerator-- then the connector is not sturdy enough. If the individual ring

will not consistently break simultaneously with the intended removal of the container by the consumer, then the connector is not "automatic."

More specifically and technically an Automatic Breaking Carrier must do the following:

- The carrier must be applied at high speeds, approximately 2400-3000 cans per minute, to keep up with today's canning lines;
- The carrier must maintain the same physical properties to allow it to be applied to the containers and hold them securely to enable the carrier to work as a package;
- The carrier must pass through the current distribution channel and withstand distribution abuse;
- The carrier must hold containers together through the retail sales channel and transportation by the consumer without premature tearing; and
- The carrier must automatically break when the consumer wants to remove the container.

DEVELOPMENT AND TESTING OF AUTOMATIC BREAKING CARRIER DESIGNS

To date, in ITW Hi-Cone's effort to identify and develop the new technology necessary for an automatic breaking carrier, the project team has sought help and expertise from a wide variety of sources including:

- Several ideas and specific invention submissions from outside inventors were closely reviewed.

- One outside inventor's patents, which showed promise, were licensed as potential solutions. Communication continues with this inventor so that any new concepts and ideas may be considered, although none are currently capable of being produced commercially.
- Top creative engineers from several of ITW's 250 business units participated in different creative sessions.
- ITW's Technology Center, a division of ITW separate and distinct from Hi-Cone, has worked on a project to develop an automatic breaking carrier.
- Two successful ITW Hi-Cone retirees, who collectively have 132 patents to their credit, are under contract to pursue additional concept design work.

Since March 1992, testing of the Automatic Breaking Carrier design prototype shown to this Committee, plus more than twenty (20) other promising designs, have moved through the evaluation process and some designs have undergone full testing. Such testing included initial laboratory tests and field tests.

The laboratory tests simulate the following packaging requirements (Specific test methods in Appendix):

- High speed application to cans
- Truck and rail car shipment simulations
- Distribution, handling and mishandling conditions
- Consumer handling/mishandling of individual packages

Designs which showed promise after laboratory testing were then tested in actual field conditions. The actual field tests on the various packages included the following:

- Each sample design was applied to 12 oz. cans in pallet load quantities. Each pallet was stretch-wrapped for transit.
- Pallets were loaded on a semi-trailer for shipment to a distribution center. Upon arrival, the pallets were unloaded in the distribution warehouse.
- Pallets were loaded on a delivery truck and driven 75 miles on a typical distribution route.
- Each pallet was evaluated for damage and ring breakage after return to the warehouse.
- As is normal procedure, six-pack cases were unloaded from the pallet and stacked in cases of 10. The stack was loaded on a hand truck and taken through store simulation.
- Each six-pack was stacked on shelves simulating a grocery store environment.
- The six-packs were then opened by sample groups of 35 people to evaluate the ability of each ring to break with the removal of each can.

RESULTS OF FIELD TESTS

Field tests simulating actual application, distribution and consumer usage were conducted on seven (7) different designs. All of these designs had die cuts in the rings in an effort to achieve the automatic breaking feature. Three designs also had slits in the

rings made after the ring has been applied to the container in order to increase the likelihood that the container would break automatically for the consumer.

- Of the four carriers tested which only had die cuts, each remained sturdy during the manufacturing and distribution phases of the tests, but when tested by consumers for simultaneous breaking of each ring, few of the rings broke.
- Of the three carriers tested which had die cuts and slits on each ring, the consumer testing showed that approximately 75% of the individual rings broke when the consumer removed the container. However, each of these carriers showed unacceptable levels of breakage during the distribution and handling tests before the carrier was used by the consumer. Specifically one or more rings broke prematurely in more carriers than is acceptable. To be a commercially viable premature package breakage must be reduced to zero.

SUMMARY

Although ITW Hi-Cone has considered hundreds of designs, developed numerous designs into actual samples and field tested seven (7) designs, no connector has yet passed all performance standards for an Automatic Breaking Carrier. Regretfully ITW Hi-Cone currently knows of no plastic holder device which will endure the rigors of manufacturing and distribution and break simultaneously with the removal of each container. Research and development effort is continuing but ITW Hi-Cone will not predict

whether an Automatic Breaking Carrier can ever be commercially viable and ITW Hi-Cone can not indicate to the Committee when such a device could be in commercial distribution even though prototypes of automatic breaking containers have been developed.

APPENDIX

Laboratory testing of Automatic Breaking Carrier designs--

- High speed carrier application to cans;
- Carrier stress evaluation utilizing polarized sheets cross-sectioned to identify excess stretching that can occur during application;
- Vibration tests, both vertical and horizontal, to simulate track or rail car vibration;
- Flat drop from 13" to simulate the impact of distributors or consumers dropping packages;
- Drop-jolt tests, per National Soft Drink Association guidelines, to simulate consumer abuse and handling. Each package is dropped 1 1/2" and stopped in mid-air. The package must be able to handle at least 25 drops at temperatures of 40°, 70° and 100°.

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