Detection and Prevention of Post-Processing Container Handling Damage

G. R. BEE* and L. R. HONTZ

Microbiology and Processing Division, National Food Processors Association, 1133-20th Street, N.W., Washington, D.C. 20036

(Received for publication August 29, 1979)

ABSTRACT

Specific recommendations for detection and prevention of post-processing container handling damage are best established through a detailed on-site analysis of each conveyor line. Procedures for making such an analysis are given as well as general handling recommendations for most container handling systems.

The canning industry's use of lightweight metal containers and faster container conveyor speeds has led to an increased effort to minimize container damage. The reluctance of consumers to purchase damaged containers and increased emphasis by regulatory agencies are also reasons for renewed efforts in preventing handling damage.

This paper is primarily concerned with physical damage to hermetically sealed rigid metal and glass containers after thermal processing. It describes the types of damage to look for and suggests a program for regular examination of container handling equipment. In addition, general recommendations for most container handling systems will be presented. A greater emphasis will be placed on these aspects for metal containers than glass containers whose fragile nature imposes somewhat self-limiting procedures for their handling.

The significance of container damage has been emphasized in numerous publications. Perhaps the biggest problem resulting from container damage is spoilage of the processed product due to contamination during the loss of container integrity. Smith (7) stated that the three main factors in leaker type spoilage in metal cans were (a) the condition of the double seams, (b) improper installation or operation of post-processing can handling equipment leading to can abuse and (c) the presence of microbial contamination in container cooling water. Demsey (4) used a "Bio-Test" procedure to relate can abuse by specific post-cooling can handling equipment to leaker spoilage. Through in-plant studies Braun and Fletcher (3) and Bohrer and Yesair (2) showed that, despite the use of chlorinated cooling water, leaker spoilage can result when rough can handling occurs on contaminated container handling tracks and equipment. In review, Put et al. (6) described the mechanism of microbial leakage into a metal can and the influence of seam construction and can handling procedures upon its occurrence. Numerous recommendations for reducing container handling damage and related spoilage have been presented by Bohrer (1), Troy and Folinazzo (8), Troy et al. (9) and N.C.A. (5).

BENEFITS

The greatest benefit that can be realized from use of a comprehensive program to prevent can damage is one of the economics. The reluctance of consumers to buy dented or otherwise damaged containers adversely affects repeat sales and brand name acceptance. The yield and profit of an plant can be significantly affected when containers have to be discarded due to damage before shipment.

It is obvious that spoilage in the warehouse due to damaged containers is a direct economic loss. It is not as well recognized that such spoilage often causes the loss of sound product due to contact with product from bursting or leaking containers. Labor savings may also be accomplished by reducing the need to rework cases that have some damaged containers in them.

Spoiled product in the warehouse provides an attraction to insects and rodents. This could lead to increased costs of an extermination program and findings by regulatory officials of adulterated product.

Considerable expense would be involved if it became necessary to recall spoiled product due to container damage problems discovered after shipment.

DESIGN OF A PROGRAM

Occasional spot checks for container damage are of value, but may not provide the detailed examination needed to uncover the full extent of damage. Establishment of a organized container damage program may be a worthwhile effort for those that find there is a high level of damage in their operations.

Before such a program is established, an initial survey should be made to determine the extent of production loss due to container damage. Such a survey may only involve a comparison of incoming container or production figures with warehouse inventory and shipping records or it may be desirable to add to this a more detailed examination at each stage of container handling. The result of this initial survey should provide evidence of whether or not an organized container damage program is needed.
If it is found that such a program is needed, its establishment should begin with a designation of management responsibility. The overall plan should involve training of plant operating personnel, coordination with maintenance and purchasing and a schedule for regular examinations for damage on each line.

Training of plant personnel to be aware and watchful for abnormal and damaged containers will provide an opportunity for constant inspection. The abnormal containers removed from the lines should be saved in designated receptacles. These containers should frequently be examined by designated management for extent, type and similarities of defects. Such a plan can provide an early indication of damage problems and where they are occurring. Plant personnel should also be made aware that when a large number of damaged containers are found, they should immediately notify a designated person. Such a plan could prove valuable in preventing serious problems from developing.

Coordination of the program with maintenance personnel will aid in locating problem damage. This will also be helpful in finding out what container handling equipment requires frequent adjustments and repairs. Additional information will be provided to determine the types of equipment that perform best on a particular line. This information should be coordinated with those responsible for purchasing container handling equipment to establish the best type of equipment for a particular system.

The program should be established with a schedule for regular inspection of handling problems on each container line. The frequency of such a schedule depends upon the speed of the line, the extent of damage found on the initial survey or the last inspection, and when changes or repairs were made on the handling equipment. Scheduled inspections will be helpful in keeping the program viable, but most of all it will provide a preventative feature instead of a reactive one.

WHAT TO LOOK FOR

A container damage inspection will be of greatest value if the person making the inspection knows what to look for and has a guide to aid in determining acceptable and unacceptable damage. Assistance in preparing such a guide can be obtained from the information and illustrations in the National Food Processors Association (N.F.P.A.) bulletin 38-L (2nd edition) entitled, Guidelines for Evaluation and Disposition of Damaged Canned Food Containers. This bulletin is available from N.F.P.A., 1133-20th Street, N.W., Washington, D.C. 20036. Two audio visual tape-slide presentations entitled, Safe Can Handling for Cannery Employees and Can Handling, are available from the Food Processors Institute, 1133-20th Street, N.W., Washington, D.C. 20036. Additional assistance could also be obtained from your container supplier.

SOME EXAMPLES OF UNACCEPTABLE DAMAGE

Empty metal containers and ends
1. Fractures in the metal plate or pinholes
2. Cable cuts or fractures through the metal
3. Sharp dents and deformed body flanges
4. Deformed or out of round cans
5. Skips in the compound of metal ends

Filled metal containers
1. Leaking containers
2. Stained labels
3. Severe body dents
4. Buckled or swollen ends
5. Fractures or dents on the score lines of easy open cans
6. Pitting and heavy rust
7. Die code fractures
8. Crushed cans
9. Moderate to severe dents at the side seam junctures
10. Cable cuts or fractures through the metal
11. Open cut-overs at the side seam juncture
12. False seams
13. Incomplete seaming operation
14. Knocked down flanges
15. External vees or droops

Empty glass containers and caps
1. Cracked or fractured body
2. Chips or fractures in the finish and sealing surface
3. Inadequate gasket material in caps

Filled glass containers
1. Raised or cocked caps
2. Loose caps
3. Cracked or fractured body
4. Leaking containers
5. Stained labels
6. Improper application of caps

SOME EXAMPLES OF ACCEPTABLE IMPERFECTIONS

Metal containers
1. Flat rim dents in double seam not at side seam junctures
2. Minor body dents
3. Minor external rusting
4. Slight to moderate dents on or near the double seam
5. Slight to moderate paneling on the sides

Glass containers
1. Minor dents in center panel of caps
2. Small imperfections on the finish

The examples listed above provide a general guide of acceptable and unacceptable container defects. It should be recognized that variations in any of these examples could change their assigned category.

CONDUCTING AN INSPECTION

An organized procedure is required to perform a successful container damage inspection. A common sense approach to the inspection is most useful. Many areas of can handling damage are associated with elevated noise levels resulting from the impact of metal against metal. In other places, simple visual observation can readily detect handling operations which need to be smoothed out.

Inspection forms will aid in making the survey and also in interpreting its results. These forms should be individually designed for each plant. They should be simple to complete, but contain adequate detail to make the collected information useful. At a minimum, the
forms should allow distinction between production lines, show where defects are uncovered and indicate the magnitude and type of damage.

It is logical to begin an inspection in the finished product warehouse. Problems uncovered here will show the cumulative effect of all damage encountered during production from beginning to end, except for any gross damage which resulted in removal and disposal of containers during production.

The first things to look for in the warehouse will be obvious damage, such as that caused by improper fork lift truck operation or other forms of mistreatment of the finished goods. Frequently, can damage is easily recognized by wet cases which result in leakage or bursting of containers of spoiled product.

Less severe damage present in the warehouse will be found only by opening cases and sampling the cans within. Information on the sample size needed to uncover significant damage is available from statistical probability tables. Once the appropriate sample size is determined, random samples should be obtained. Containers of each size and from each production line should be included.

The sample cans should then be visually examined very closely for defects. The type and degree of damage should be recorded on the inspection forms. Particular note should be made of repetitive types of damage. The absence of damage should also be recorded on the forms, and in that event, the need for further inspection would not be indicated. However, if extensive major or even minor damage is uncovered in the warehouse or if significant numbers of damaged containers are removed from the line during production, the investigation should continue until the source of the damage is located.

Often information from the warehouse inspection or from observation of production line rejects will suggest that a particular piece of equipment is the source of a specific type of damage. At other times, a more systematic approach is necessary.

In this situation, the investigation should proceed from the warehouse countercurrently to container flow along the production line. At each equipment discharge along the way, statistically sound numbers of samples should be taken and examined, with the results being recorded. The examination should continue upstream to a point where the type of damage being observed is no longer found or where there are no damaged cans in the sample. The source of the damage should be located between this point and the previously sampled point. Once the cause of the damage is discovered, appropriate steps can be taken to correct the problem.

**GENERAL HANDLING RECOMMENDATIONS**

Each container handling system is different in some aspects from another and no set of specific recommendations will be suitable in all instances. However, there are some general procedures that do apply to most handling systems for rigid containers.

Containers rolling down conveyors at high speed are particularly susceptible to damage. This damage usually occurs when the containers contact each other, especially if there is a sudden stop at the end of the line. Retarders made of non-porous material should be used to slow the speed of the containers and reduce impact. Keeping containers separated from each other on the conveyor line and adjustment of transfer points from one piece of equipment to another will also prevent impact damage.

Container elevators should be adjusted to take containers away faster than they are fed to it. This will reduce damage from container contact. These elevators should also be constructed with non-porous shock absorbers to prevent flat rim dents.

Lowerators, especially the zig-zag type, are often the cause of rim dents. The best way to prevent this is to lengthen the horizontal runs, increase the radius of the curves and thereby reduce the number of direction changes.

Container track adjustments and guide clearances should be as narrow as possible to prevent seam-to-body contact denting. The larger the radius of track curves, the easier this is to accomplish.

These recommendations do not include all types of handling equipment that may be encountered. Direct consultation with manufacturers of container conveying equipment will often be useful in solving problems of container damage.

**SUMMARY**

A systematic and organized container damage inspection program will be helpful in detecting rigid metal and glass container handling problems. The establishment of a guide of acceptable and unacceptable defects and the use of inspection forms to record the results will provide uniformity in the program. Coordination of such a program with the equipment maintenance and purchasing departments under management control will be valuable in preventing serious container damage problems. Training of all operating personnel to practice gentle container handling will be the most important factor in producing the greatest number of defect-free containers.

**ACKNOWLEDGMENTS**

This paper was presented during the symposium, "Prevention of Post-Processing Microbial Contamination of Thermally Processed Foods in Hermetically Sealed Containers," at the 39th Annual Meeting of the Institute of Food Technologists, St. Louis, MO, June 10-13, 1979.

**REFERENCES**

transport, the number of contaminated packs does not increase if they are properly cartoned. We therefore conclude that it is possible to produce sterilized products packed in semi-rigid containers or flexible pouches which will reach the consumer in excellent condition.

ACKNOWLEDGMENTS

The authors wish to thank Messrs. v.d. Beck; Baks and Post for their help. This paper was presented during the symposium, "Prevention of Post-Processing Microbial Contamination of Thermally Processed Foods in Hermetically Sealed Containers," at the 39th Annual Meeting of the Institute of Food Technologists, St. Louis, MO, June 10-13, 1979.


damaged the surfaces tested.

A second method involved rolling a small, plastic hand roller across the polyethylene film on the soiled surface. This method was undesirable as the force applied to the polyethylene film varied from sample to sample because the operator of the roller had to apply pressure, which could not be accurately duplicated, to effect transfer of lipid to the polyethylene film from the food contact surface. This method eventually led to the method used in all further work which was to use a relatively heavy roller and apply no pressure to it while taking the samples.

One other method of artificially soiling the food contact surfaces was also investigated. This method involved dissolving a known amount of lard in a known volume of petroleum ether. Open-ended plexiglass cylinders approximately 6 cm high were placed on the food contact surface. One millilitre of the lard-ether solution was placed on the food contact surface within the center of the cylinders. The ether was allowed to evaporate and the cylinders were removed, leaving a film of lipid on the food contact surface. One problem with this method was that the lipid was not deposited evenly over the food contact surface. A second problem was that the lard-ether solution was not totally contained within the cylinders, thus the exact area soiled was not known. Applying vacuum grease or vaseline to the edges of the cylinder was not acceptable since residues of these materials were extremely difficult to remove from the food contact surfaces, and could have had an influence on the properties of the food contact surface.

With further development, the method described in this paper may be well suited for use in routine quality control measurements of lipid residues on previously cleaned equipment in food handling plants. It is quite sensitive to the presence of small amounts of lipid especially on HDPE, stainless steel and glass. This method is also rapid, safe and simple to perform and samples can be easily obtained in the field with a minimum of equipment.

REFERENCES
