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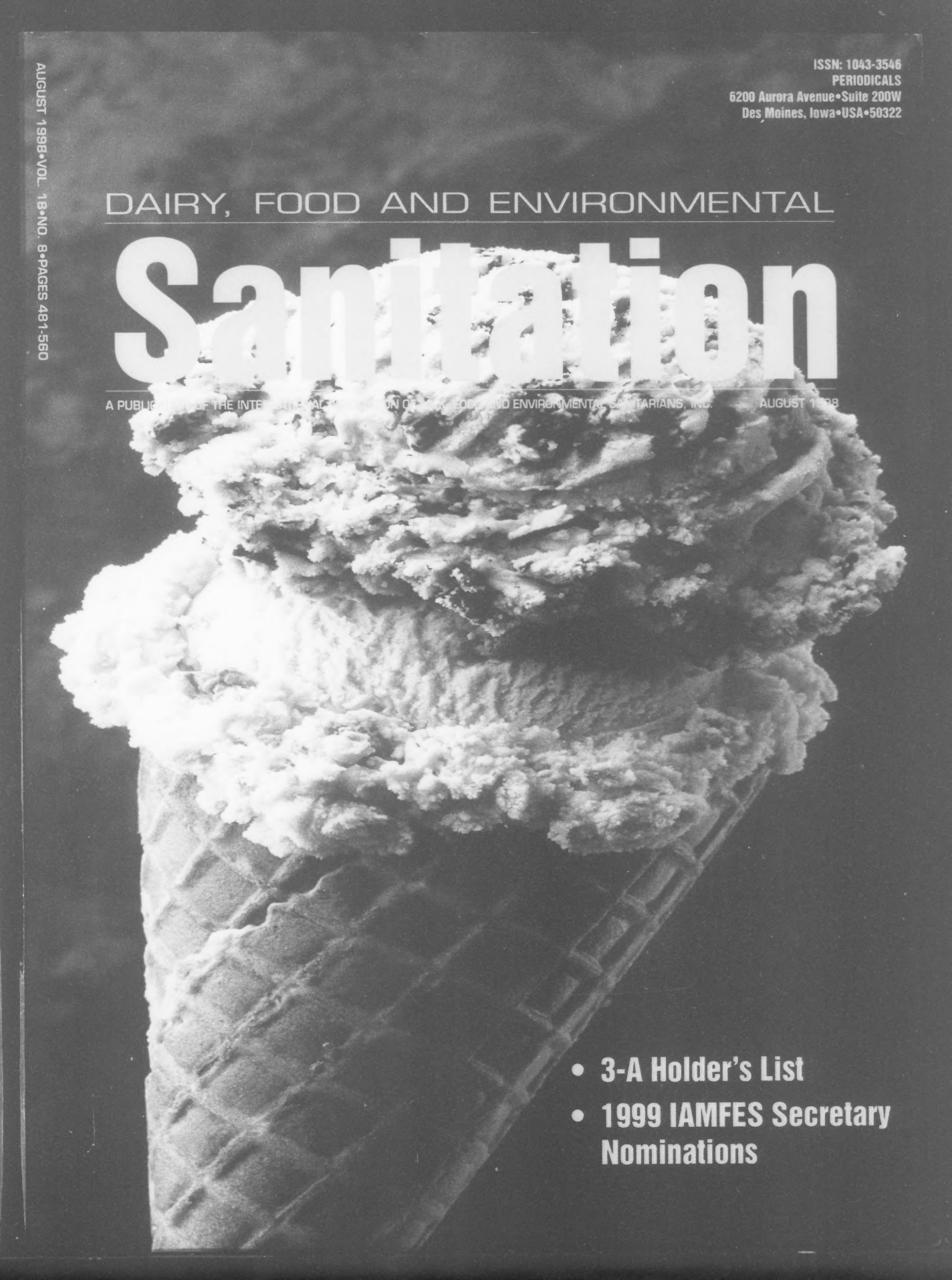
DAIRY, FOOD AND ENVIRONMENTAL

Sanitation

A PUBLICATION OF THE INTERNATIONAL ASSOCIATION OF MILK, FOOD AND ENVIRONMENTAL SANITARIANS, INC. AUGUST 1998



- 3-A Holder's List
- 1999 IAMFES Secretary Nominations

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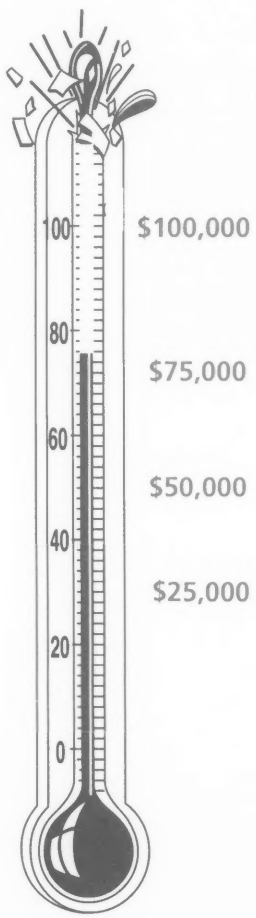

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ABOUT THE COVER...

Photo courtesy of the American Dairy Association.

DAIRY, FOOD AND ENVIRONMENTAL

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A PUBLICATION OF THE INTERNATIONAL ASSOCIATION OF MILK, FOOD AND ENVIRONMENTAL SANITARIANS, INC.

Articles

Association News

Editor's Note:

In the May issue of *Dairy, Food and Environmental Sanitation* on page 294, a sentence in the fourth paragraph of *Passivation of Stainless Steel* should have read: Although increase in the chromium fraction in the passive film is an important factor in the corrision resistance of steel, it has less influence on the ability of steel to repassivate following pit corrosion.

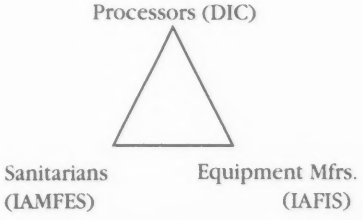
Departments

Extras

MARK OF COMPLIANCE

The 3-A Symbol Story

The 3-A Sanitary Standards Symbol Administrative Council, known throughout the industry as the "**3-A Symbol Council**," was organized in 1956. Its purpose is to grant authorization to use the **3-A Symbol** on equipment that meets 3-A Sanitary Standards for design and fabrication.



A Modern Concept

The modern concept of the 3-A program was established in 1944 when the Dairy Industry Committee (DIC) was formed. DIC is one of the three industry segments involved in the preparation of 3-A Sanitary Standards. These industry segments are:

- **Processors,** represented by DIC
- **Equipment Manufacturers**, represented by IAFIS
- **Sanitarians**, represented by IAMFES

Use of the Symbol

Voluntary use of the **3-A Symbol** on dairy equipment:

- assures processors that equipment meets sanitary standards
- provides accepted criteria to equipment manufacturers for sanitary design & fabrication
- establishes guidelines for uniform evaluation and compliance by sanitarians.

3-A Sanitary Standards Symbol Administrative Council

3020 Bluff Road

Columbia, SC 29209-3502

803-783-9258 phone **803-783-9265 fax**

Reader Service No. 228

INTERNATIONAL ASSOCIATION OF MILK, FOOD AND ENVIRONMENTAL SANITARIANS

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News Releases, Updates, Coming Events and Cover Photos: Correspondence for these materials should be sent to Donna A. Bahun, Publications Specialist, IAMFES, Inc.

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Membership Dues: Membership in the association is available to individuals. Dues include a 12-month subscription to **Dairy, Food ond Environmental Sanitation** at a rate of $85.00 U.S., $95.00 Canada/Mexica, and $110.00 International. Dues including **Dairy, Food and Environmental Sonitotion** and the **Journol of Food Protection** are $140.00 U.S., $165.00 Canada/Mexico, and $210.00 International. Student memberships are available with verification of student status. Student rates are $42.50 U.S., $52.50 Canada/Mexico, and $67.50 International for **Doiry, Food ond Environmentol Sonitotion**; $42.50 U.S., $57.50 Canada/Mexico, and $87.50 International for **Journol of Food Protection**; and $70.00 U.S., $95.00 Canada/Mexica, and $140.00 for International for **Doiry, Food ond Environmentol Sonitotion** and **Journol of Food Protection**. All membership dues include shipping and handling. No cancellations accepted.

Sustaining Membership: A sustaining membership in IAMFES is available ta companies at a rate of $525.00 per year. For more information, contact Rick L. McAtee, Director of Marketing and Member Services, IAMFES, Inc.

Subscription Rotes: Doiry, Food ond Environmentol Sonitotion is available by subscription for $175.00 U.S., $185.00 Canada/Mexico, and $200.00 International. Single issues are available for $24.00 U.S. and $33.00 all ather countries. All rates include shipping and handling. No cancellations accepted. Far more information contact Julie A. Cattanach, Membership/Meeting Coordinator, IAMFES, Inc.

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IAMFES Annual Meetings

1998

August 16-19

Renaissance Nashville Hotel

Nashville, Tennessee

1999

August 1-4

Hyatt Regency Dearborn

Dearborn, Michigan

2000

August 6-9

Atlanta Hilton and Towers

Atlanta, Georgia

DAIRY, FOOD AND ENVIRONMENTAL

Sanitation

"The mission of IAMFES is to provide food safety professionals worldwide with a forum to exchange information on protecting the food supply."

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COMMENTS

FROM YOUR PRESIDENT

By GALE PRINCE
IAMFES President

"It was a good year..."

IAMFES had a good year with numerous accomplishments.

While our Annual Meeting continues to be a major focus of the Association, there are many other important activities throughout the year. IAMFES co-sponsored several food safety conferences including one with the International Life Sciences Institute, N.A. (ILSI) coming up this October. Last April we offered a HACCP workshop and we're presenting two workshops at the Annual Meeting. Additional workshops are on the drawing board to provide for the advancement of IAMFES Members and those industries served.

Last fall, we established a Web site on the Internet at www.iamfes.org for quick access to information about your Association. At this year's Annual Meeting, we introduced the IAMFES Fellows Award to recognize Members for their long and unheralded contributions to the Association.

The *Journal of Food Protection* and *Dairy, Food and Environmental Sanitation* are still the pride of the Association. The number of papers presented to the Association for publication increases as the journals become more recognized worldwide. The list of other publications IAMFES produces continues to grow. A revision of the very popular booklet *Procedures to Investigate Foodborne Illness* is nearly complete. This goes along with the revised version of *Procedures to Investigate Waterborne Illness* booklet. The IAMFES pamphlet, *Before Disaster Strikes... A Guide to Food Safety in the Home*, has been very timely and useful.

This year, Members of the Executive Board attended 15 Affiliate Association meetings around the U.S. and Canada. Board Members provided information about IAMFES while sharing their particular expertise on food safety. This program has been utilized very effectively for both IAMFES and our Affiliates.

We made progress on long-range positioning of the Association among food safety organizations and are moving forward in looking at a user-friendly name to reflect the Association Membership. We are in an era of globalization as our Membership grows and becomes more diverse while most segments of our industry become more concentrated and specialized. The Association needs to reflect that change in our Members' job responsibilities during this era without losing the foundation on which the organization was built.

Your favorable comments regarding the name change is best summarized by many of you who wrote to me. These comments were unanimously in favor of changing the Association name. Many of you used a similar statement "the time is right to change our name." We are moving ahead with the name change, and are currently conducting the legal review. At the 1999 Annual Meeting, the Membership will vote on the proposal to change IAMFES' name to the International Association for Food Protection. If approved, the name will carry us into the next millennium.

On August 19, 1998, I will turn the gavel over to Bob Brackett, your new IAMFES President, and I will become the senior citizen on the Executive Board. Thank you for allowing me to serve as a Member of the Executive Board. These past 13 months and 10 days as your IAMFES President have all gone so quickly. When I was asked five years ago to offer my name as a candidate for IAMFES Secretary, I did it for the love of the Association. It was a chance for me to give back to so many Members of the Association for the willingness to share their knowledge with me over the years. I am proud of IAMFES and the contributions of our Members in addressing global food safety challenges.

Thank you for all your E-mails, phone calls, and responses to my request for help to serve your Association. It is you, the Members of IAMFES, that push the Association to move forward towards providing an Association that will serve the needs of our Membership long into the future. The Executive Board is only the congressional body in carrying out the desires of the IAMFES Membership, as related to us directly and indirectly by Members, in the interest of what is best for the Association. The support of the IAMFES office staff was sincerely appreciated during this past year. I look forward to working with you as IAMFES continues to strengthen and grow.

ILSI North America Conference on the National Food Safety Initiative: Implications for Microbial Data Collection, Analysis, and Application

October 14-16, 1998

Doubletree Hotel National Airport
Arlington, Virginia

This conference will convene scientists from government, industry, academia, and the public health community to critically examine the relevance and role of microbial data in implementing the National Food Safety Initiative. Objectives of the conference are to assess the magnitude of the public health problem; examine current practice and experience in microbial data collection, analysis, and application; explore the links among food microbiology data, epidemiology, human health, and microbial risk assessment; discuss the role of microbial testing in HACCP validation and verification; identify key issues in the development of new food microbial testing strategies; and develop an agenda for future research and development.

This conference is organized by the International Life Sciences Institute North America (ILSI N.A.) and the ILSI N.A. Technical Committee on Food Microbiology, in collaboration with the Centers for Disease Control and Prevention, Food and Drug Administration, International Association of Milk, Food and Environmental Sanitarians (IAMFES), National Institutes of Health, U.S. Department of Agriculture, and others concerned with microbial food safety.

The meeting will be of interest to Food Protection and Public Health Professionals, including Microbiologists, Epidemiologists, Physicians, Health Policy Makers, and Researchers from academia, government, and industry.

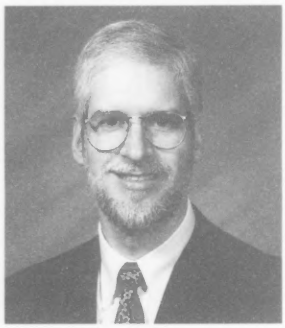
To receive program and registration information, contact: ILSI NFSI (National Food Safety Initiative) Microbial Data Conference, 6200 Aurora Avenue, Suite 200W, Des Moines, IA 50322-2863; Phone: 800.369.6337; 515.276.3344; Fax: 515.276.8655; E-mail: nfsi@iamfes.org.

Program and registration information is available on the ILSI Web site: www.ilsi.org/conference. html#6.

Questions concerning the conference should be directed to Ms. Catherine Nnoka, at 202.659.0074; Fax: 202.659.3859; E-mail: cnnoka@ilsi.org.

COMMENTARY

FROM THE EXECUTIVE DIRECTOR



By DAVID W. THARP
IAMFES Executive Director

"We, as an Association, owe a great deal to many individuals"

I'm sure you have all seen various encouraging phrases and inspirational-type messages. Today, I would like to share one that I refer to often. It is a list of important words beginning with the six most important words, followed by the five most important, then four; you see where it's going I'm sure. Here they are beginning with six: "I admit I made a mistake"; "you did a good job"; what is your opinion?"; "If you please"; "thank you"; and the one most important word: "WE!" They also point out the least important word is "I". I must agree! Think about that concept for a moment. If we concentrated on what was best for "us" instead of what is best for "me", just think what WE could accomplish.

From the preceding paragraph, you should be able to tell that working together and sharing credit with everyone involved is very important to me as is providing a proper "thank you" where appropriate. How many times in the last few months can you remember someone sharing a sincere "thank you" with you or telling you that "you did a good job"? Think about your position at work (or at home). Do you take time to thank co-workers and tell them that you appreciate the job they have done? How about at home? This can make all the difference to people that you associate with. Maybe if you are not currently practicing this method of pleasantry, today can be the day that you change your practices!

To build on this idea, I want to sincerely thank the IAMFES staff for the outstanding work they are doing. I can truly state that our staff performs at 110% effort year round. That percentage only increases immediately preceding and during the IAMFES Annual Meeting. Since these columns are written a month in advance of publication, I am writing this column about four weeks prior to the beginning of the IAMFES 85th Annual Meeting.

The office is abuzz with activity. Registrations are coming at a rapid pace; final touches are being put on the Program Book – printing begins next week; communications with exhibitors are ongoing; details with the hotel and convention center have to be finalized; and more details need to be coordinated with the Tennessee Affiliate. The bus company, golf course, Grand Ole Opry, Wildhorse Saloon, and audiovisual company all have final details that need to be confirmed. Now is when our months of planning and preparing come together to create the Annual Meeting.

Also, I want to thank the Program Advisory Committee, and Susan Sumner as Chairperson, for the excellent work they have done in preparing the program for this year's Meeting. Committee members give willingly of their time and expertise in pulling together the program. Many hours of time and effort go into this detail and for that we offer our hardiest "Thank You" to everyone involved. Not only should this thank you go to committee members, but we want to include all session convenors and our Professional Development Groups who work long and hard to see that the leading food safety professionals are involved with the IAMFES Annual Meeting. We, as an Association, owe a great deal to many individuals.

Another group to thank for their great effort is the Local Arrangements Committee from the Tennessee Association of Milk, Water and Food Protection. Co-Chairpersons, Ann Draughon and Ruth Fuqua have done a superb job of organizing their members in preparation for the Meeting. We couldn't do it without the help of so many willing volunteers.

Today, it seems strange to think that by the time you read this column, the Annual Meeting will be concluded. We are confident that this year's Annual Meeting will exceed all expectations and provide a top quality educational opportunity for every attendee, no mater what your interest in food safety is.

"I", the least important word, want to thank each individual that makes up the "we" of the IAMFES staff. Donna Bahun, Julie Cattanach, Bev Corron, Nina Dao, Lisa Hovey, Karla Jordan, Carol Mouchka, Rick McAtee, Tami Schafroth, Tanya Smith, and Pam Wanninger. You have all done a great job!

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Reliability of Coliform Bacteria as an Indicator of Postprocessing Contamination in Yogurt Manufacture

S. Abd El Ghani, Zeinab I. Sadek, and Fatma A. Fathi

SUMMARY

Reliability of coliforms as an indicator of postprocessing contamination in yogurt manufacture was investigated. *E. coli* isolated from commercial yogurt were inoculated into Tryptone Soya Broth (TSB) and sterilized milk (SM) having initial pH of 3.5, 4.0, 4.5 or 5.0. Growth at 37°C was monitored at 0, 24 and 48 h by measuring changes of optical density (OD) and pH in the TSB and changes of pH in SM. For comparison, *E. faecium* was also inoculated in a similar manner as for coliforms. Heat resistance of both bacteria was determined at 63, 75, 80 and 90°C for 30 min, 15 sec, 10 sec, and 5 sec, respectively. Experimental yogurt was inoculated by coliforms or enterococci at two levels of contamination (10^2 and 10^5 colony forming units (CFU/per ml). Fate of the two indicators was monitored daily during 15 days storage at refrigeration temperature (8 to 10°).

Overall results indicated that coliforms were more reliable than enterococci as an indicator of postprocessing contamination in yogurt manufacture. Coliforms withstood lower pH values for longer times than enterococci, in TSB, SM and yogurt.

INTRODUCTION

The use of coliform counts as an indicator of postprocessing contamination in the dairy industry, including yogurt manufacture, has long been established. Recently, other reports have cast doubt on the validity of coliform counts as a reliable indicator *(7, 9, 15, 19)*. Souring of milk is a potent mechanism for prevention of the growth of coliforms in yogurt *(3)*. Both live yogurt bacteria and the acid environment of the product exhibited some bactericidal activity *(11, 17)*. However, it was later reported that the effectiveness of utilizing pH as a microbial inhibitor/bactericidal agent would have to be reexamined because of the possibility that some pathogens (including *E. coli* O157:H7) adapt to survive in low acid environments for periods of time longer than previously observed *(13)*. Such coliform strains can survive in products with a pH as low as 3.7 *(5)*. Other stains of *E. coli* could adapt to the presence of lactic acid and might also be viable in natural yogurt *(17)*. Collectively, the subject of coliforms in yogurt has become important

TABLE 1. Mean log_{10} counts of coliforms and enterococci and pH values for 6 brands of commercial yogurt

Brand*	Coliform			Enterococci			pH
	Log_{10} count	No. positive samples	Percent positives	Log_{10} count	No. positive samples	Percent positives	
1	2.18	3/10	30	3.60	2/10	20	4.76
2	2.20	5/10	50	4.40	1/10	10	4.35
3	0	0/10	0	0	0/10	0	4.37
4	2.38	2/10	20	0	0/10	0	4.32
5	3.04	6/10	60	3.30	4/10	40	4.33
6	1.88	4/10	40	0	0/10	0	4.42

* Each brand was represented by 10 samples

for a number of reasons. First, yogurt is a very popular food commodity worldwide *(4)*. Second, the occurrence of coliforms in yogurt is a violation of regulatory standards in many countries. Last, there is the possibility of punitive action being applied by authorities if coliforms are detected in yogurt. Thus, the intention of the present study was to investigate the subject comprehensively, from two directions. The survival of coliform and enterococci in acidified synthetic medium and sterilized milk was studied first, and their heat resistance was determined. The fate of coliforms and enterococci in experimental yogurt artificially inoculated with these bacteria was also traced. Both groups of bacteria were observed daily during refrigerated (8 to 10°C) storage of yogurt for up to 15 days.

MATERIALS AND METHODS

Coliforms and enterococci in commercial yogurt

Sixty samples of plain yogurt representing 6 different commercial brands were randomly withdrawn from groceries in Cairo and analyzed for coliforms, enterococci and pH value. Methods and media used were according to Marshall *(14)*. Certain isolates were confirmed by standard criteria *(12)*. The pH values were determined using a computerized digital pH meter (Hannah, Portugal).

Coliforms and enterococci in acidified Tryptone Soya Broth (TSB) and sterilized milk (SM)

A strain of *E. coli* isolated and identified during this study was used. *Enterococcus faecium* (Chr. Hansen, Denmark) was also selected for the purpose of this investigation.

Both bacterial strains were propagated separately at 37°C for 24 h. in Tryptone Soya Broth (TSB) supplemented with 0.5% yeast extract. Working cultures were added (1% v/v) to tubes containing 10 ml of either TSB or SM previously adjusted with HCL to pH 3.5, 4.0, 4.5 or 5 and incubated at 37°C for 24 and 48 h. Growth in TSB was monitored by measuring the optical density (OD) at 620 nm with a Spekol 11 colorimeter (Karl Zeiss, Jena) and by measuring pH at 24 and 48 h. Tubes of SM were examined for pH changes at the same time intervals.

Coliforms and enterococci in experimental yogurt using two levels of additions

Raw buffalo milk (6 per cent fat) was heated to 90°C and held at that temperature for 10 minutes, cooled to 45°C, and inoculated with 2 levels of coliforms and enterococci; 2 per cent (v/v) of yogurt culture (Chr. Hansen-Denmark) was added. Inoculated milk was agitated and distributed into plastic tubs, after which the tubes were covered and incubated at 40°C for about 4 h until the milk was coagulated.

Yogurt was kept refrigerated at 8 to 10°C and sampled daily for up to 15 days for total coliform counts, enterococci counts, and pH values. Low and high levels of contamination equalled 10^2 and 10^5 counts/per ml milk, which were considered to resemble possible product contamination on an industrial scale. Working cultures of coliforms and enterococci were added in quantities needed to contaminate yogurt milk to the desired degree mentioned above.

Heat resistance of coliforms and enterococci

One milliliter aliquots of *E. coli* and *Enterococcus faecium* were pipetted separately into sterile test tubes (7 × 105 mm) placed in an oil bath at temperatures of 63, 73, 80 and 90°C for 30 min, 15 sec, 10 sec, and 5 sec, respectively. The tubes

TABLE 2. Fate of coliforms and enterococci in acidified TSB and SM after 24 and 48 hr at 37°C

Coliforms									Enterococci								
TSB					SM				TSB					SM			
OD			pH			pH			OD			pH			pH		
1	2	3	1	2	3	1	2	3	1	2	3	1	2	3			
0.028	0.655	1.042	5.0	4.5	4.4	5.0	4.6	4.65	0.012	0.67	1.233	5.0	4.05	4.15	5.0	4.7	4.7
0.028	0.48	0.97	4.5	4.3	4.3	4.5	4.35	4.45	0.012	0.605	0.855	4.5	4.1	4.05	4.5	4.1	4.3
0.028	0.355	0.4	4.0	3.8	3.9	4.0	3.7	3.9	0.012	0.012	0.012	4.0	4.0	4.0	4.0	4.0	4.0
0.028	0.028	0.028	3.5	3.5	3.5	3.5	3.5	3.5	0.012	0.012	0.012	3.5	3.5	3.5	3.5	3.5	3.5

TSB = Tryptone Soya Broth medium (Oxoid)

SM = 12% sterilized milk tubes

1 = initial 2 = after 24 h at 37°C 3 = after 48 h at 37°C

were then cooled and the surviving cells were counted by the pour plate method with use of a nutrient agar medium and incubation at 37°C for 24 h *(16)*.

RESULTS AND DISCUSSION

Incidence of coliforms and enterococci in commercial yogurt samples

Twenty out of 60 (33.3%) yogurt samples examined were positive for coliforms. Positive samples were distributed in 5 out of 6 brands (83.3%) analyzed. In contrast, enterococci were found in 7 out of 60 samples (11.7%) in only 3 brands (50%), which had coliform counts ranging from 0 (not detected) in brand 3 to log 3.04 in brand 5. Enterococci were either not detected (brands 3, 4 and 6) or detected at levels as high as log 4.40 (brand 2), and the pH value ranged from 4.32 (brand 4) to 4.76 (brand 1), as recorded in Table 1. Use of coliform counts as an indicator of postprocessing contamination in yogurt manufacture is a well established practice, and recommended by authorities of public health departments worldwide. During the past two decades, this theory has been weakened *(2, 9, 19)* and some limitations have even been put on this test *(15)*. Moreover, other groups of bacteria, such as enterococci have been suggested to replace coliforms in this regard *(9)*. Nevertheless, this controversial topic has been brought up again for discussion *(3, 11, 18)* and scientists have been asked to further investigate the acid resistance of some coliforms in fermented milk *(5)*.

Fate of coliforms and enterococci in acidified Tryptone Soya Broth (TSB) and sterilized milk (SM)

Table 2 summarizes the fate of coliforms and enterococci in synthetic medium and milk. Growth of bacteria was monitored by measuring optical density (OD) and pH initially, and after 24 and 48 h incubation at 37°C for both types of bacteria in TSB medium. In the case of sterilized milk, pH values were monitored initially and after 24 and 48 h incubation at 37°C, as an indirect measure of bacterial multiplication. Table 2 indicates that at pH 3.5, for coliforms and enterococci, there was no difference between initial OD and OD after 24 or 48 h. The same observation with respect to pH was made for SM. Apparently, some bactericidal action occurred at pH 3.5.

Coliforms tolerated an initial pH of 4, but with little reproduction as evidenced by only a slight increase of OD in TSB at the three time intervals and little change of pH in TSB and SM during the same time periods. In contrast, growth of enterococci was diminished at initial pH 4 (see Table 2). This indicates that coliforms can survive much better than enterococci at lower pH values of the environment, whether in broth medium or milk. This finding provides strong evidence for the reliability of coliforms over enterococci as indicators of post contamination in yogurt. Although initial pH values of 4.5 or 5.0 inhibit both groups, the growth response was not equal. These results indicated the greater acid tolerance of coliforms over enterococci. Therefore, acidity alone is not enough to control the growth of coliform in foods. This conclusion supports those of other investigators *(6, 11)*.

Fate of coliforms and enterococci in experimental yogurt during refrigerated storage

Table 3 summarizes the results of incorporating two levels of coliform and enterococci contamination in yogurt. Low level (LL) and high level (HL) corresponded to counts of about

TABLE 3. Fate of coliforms and enterococci in experimental yogurt during refrigerated storage for 15 days

Time	Coliforms				Enterococci			
	HL		LL		HL		LL	
	Log count	pH	Log count	pH	Log count	pH	Log count	pH
0	5	4.8	3	4.8	5.0	4.8	3.0	4.8
1	9.85	4.6	6.9	4.7	8.95	4.7	5.85	4.75
2	8.3	4.65	5.85	4.6	9.48	4.6	6.9	4.6
3	7.7	4.55	3.95	4.55	7.78	4.6	6.3	4.55
5	6.78	4.4	2.3	4.5	4.6	4.5	2.78	4.5
7	4.7	4.3	Nil	4.4	2.48	4.4	Nil	4.43
10	3.78	4.18	Nil	4.3	Nil	4.2	Nil	4.35
12	2.0	4.05	Nil	4.2	Nil	4.0	Nil	4.1
15	Nil	3.9	Nil	3.85	Nil	3.9	Nil	3.9

HL = High level inoculum $\approx 10^5$/ml

LL = Low level inoculum $\approx 10^2$/ml

10^2 and 10^5 CFU/per ml, resembling the situation that might occur on a commercial scale in industry *(4)*. With HL coliforms, the counts were doubled after one day and slightly decreased on the second day; counts continued to decrease during the storage period. Finally, coliforms were not detected on day 15 but were still present in appreciable numbers up to 12 days after manufacture. The pH values decreased because the combined effect of starter bacteria and coliforms. The same trend was clearly observed with LL counts, except that the coliforms survived for only 5 days and were not detected after one week of storage. In contrast, enterococci at HL survived for only one week compared with 12 days for coliforms at HL. In the case of LL counts, the same trend was observed, with enterococci surviving for 5 days as did the coliforms. From Table 3, it is evident that coliforms at HL resist acidity in associative culture with yogurt starter bacteria for 12 days with an end pH of 4.05, while enterococci at HL resist for only 7 days at the higher pH value of (4.4). In the case of LL both coliforms and enterococci survived for 5 days at a pH of 4.50, after which they were no longer detectable. As shown in Table 2 and Table 3, the contaminant bacteria die at somewhat higher pH values in yogurt than in acidified broth media. This could be attributable to the antibacterial action of starter bacteria in yogurt cultures. Starter bacteria are known to produce, in addition to acids, hydrogen peroxide *(8)* and antimicrobial substances called bacteriocins *(1)*. Such substances produced by lactobacilli are active against many Gram negative and positive microorganisms *(20)*.

Heat resistance of coliforms and enterococci

Table 4 indicates that at higher temperatires (80 and 90°C) for 10 and 5 sec, respectively, coliforms and enterococci were killed. At a temperature of 73°C for 15 sec, used during HTST pasteurization by the dairy industry, coliforms were eradicated, while appreciable numbers of enterococci survived. After treatment of 63°C for 30 min, only 6 colonies/ml of coliforms could be counted, whereas for enterococci, 71 colonies/ml were detected. Therefore, we recommend higher temperatures (80°C or 90°C) rather than 73° in yogurt manufacture, not only to ensure complete killing of undesirable bacteria but also because higher temperatures produce some chemical changes in milk that result in growth enhancement of starter bacteria *(21)*. The temperature used in HTST pasteurization, it appeard from our results, is too low to destroy enterococci in the resultant yogurt. Dairy manufacturers are encouraged to apply high temperatures (80° or 90°C) to ensure enterococci eradication. Recently, some enterococci have been reported to be vancomycin resistant, thereby causing nosocomial infections in patients undergoing broad-spectrum antibiotic therapy and long-term

TABLE 4. Heat resistance of coliforms and enterococci at different temperature and time combinations

Treatments	Coliforms CFU/ml	Enterococci CFU/ml
(1) 63°C for 30 min	6	71
(2) 73°C for 15 sec	0	300
(3) 80°C for 10 sec	0	0
(4) 90°C for 5 sec	0	0

hospital care *(22)*. *Enterococcus faecium's* heat resistance, concluded from this study, has also been reported elsewhere *(10)*.

In conclusion, data obtained during this study support the opinion that coliforms are still a valid indicator of postprocessing contamination in yogurt. Moreover, the presence of coliforms indicates postprocessing contamination, because they are unable to survive the heat treatments applied during yogurt manufacture. The same is not true for enterococci, which are more heat resistant than coliforms unless higher pasteurization temperatures (above 80°C for 10 sec) are used during yogurt processing.

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First in a series of articles related to *"Spoilage of Acid and Acidified Foods by Sporeforming Microorganisms"* presented at the Institute of Food Technologists 1997 Annual Meeting held in Orlando, FL

Alicyclobacillus — Historical Perspective and Preliminary Characterization Study

Isabel Walls and Rolenda Chuyate

SUMMARY

Alicyclobacillus acidoterrestris are acidophilic sporeforming microorganisms that can survive a typical heat process given to fruit juices and then germinate, grow, and cause spoilage in acid products. The main spoilage attribute is a "medicinal" or "phenolic" off-flavor or off-odor. Juice may appear normal or have a light sediment. Gas is not produced. In a survey, 35% of respondents reported having experienced spoilage attributed to growth of acidophilic sporeformers in their products, but as a rare event. The problem occurred seasonally, in spring or summer, and most commonly in apple juice. Strains of acidophilic sporeformers were found to be motile, endospore-forming, rod-shaped organisms. Spores were oval and, in most instances, swelled the sporangium. Central, subterminal, and terminal spores were observed. Colonies were round, creamy white, translucent to opaque, and 3 to 5 mm in diameter after 5 days growth on K medium, pH 3.7, incubating at 35°C. The Gram-stain reaction was positive, with a tendency towards Gram variability. Most strains were catalase positive, and all were VP negative and produced acid from D-mannitol. Results were variable for acid production from D-glucose, L-arabinose, D-xylose, and D-trehalose. All strains were indole negative and dihydroxyacetone negative, utilized citrate but not propionate, did not hydrolyze starch, were negative for deamination of phenylalanine, and did not reduce nitrate. They did not grow in the presence of 0.001% lysozyme, but most grew in the presence of 0.02% azide. Strains did not grow in the presence of 5% NaCl. Six strains were identified by ribotyping as *Alicyclobacillus acidoterrestris*.

INTRODUCTION

Acid and acidified foods (pH≤ 4.6) generally are not heat processed sufficiently to destroy all bacterial spores. A thermal process may be given that is capable of destroying pathogens such as *Escherichia coli* O157:H7 or non-sporeforming spoilage organisms such as yeasts, molds, or lactobacilli. A heat process sufficient to eliminate spores may adversely affect the quality of the product and is not necessary, as most spores will not germinate and grow in such products. *Alicyclobacillus* are of concern because they can germinate, grow, and cause spoilage of products with a pH previously considered below the range for growth of sporeforming bacteria. In this paper, a historical perspective of the species and a preliminary characterization study are presented.

HISTORICAL OVERVIEW

Acidophilic sporeformers were first isolated in 1967 from hot springs in Japan *(8)*. The pH range for growth was 2.3 to 5.0 over a temperature range of 45-71°C. Based on morphological and cultural characteristics, these organisms were originally classified as *B. coagulans*, which can grow at 55°C at pH 4.2. In 1971, similar organisms were isolated from acid

thermal environments in the U.S., including hot springs in Yellowstone National Park *(2)*. The pH range for growth was 2.0 to 6.0 over a temperature range of 45 to 70°C. Based on their DNA base compositions, these organisms were not classified as *B. coagulans* but were considered a new species. The authors proposed the name *Bacillus acidocaldarius*.

In 1981, acidophilic sporeformers were isolated from soil, indicating a more widespread distribution for these organisms *(5)*. They were shown to be different from *B. acidocaldarius*, in their lower optimal growth temperature, biochemical characterization and DNA base composition. The pH range for growth was 2 to 5 over a temperature range of 22 to 62°C. Cells formed subterminal to terminal endospores, that slightly swelled the sporangium. Deinhard *(3)* later undertook further characterization studies and proposed a new name *B. acidoterrestris*, for these organisms.

The first reported spoilage incident caused by acidophilic sporeformers occurred in aseptically packed apple juice (pH 3.15) in Germany in 1982 *(1)*. The spoilage organism was shown to be the same as Hippchen's isolates from soil, i.e., *B. acidoterrestris*. Spoilage was manifested as a bad taste and light cloudiness. The pH range for growth of the organism in laboratory media was 2.5 to 5.5 over a temperature range of 26 to 50°C. The organism was an obligate aerobe. A $D_{90°C}$ of 15 min was reported.

In 1992, the creation of a new genus, *Alicyclobacillus*, was proposed *(10)* to comprise the species *Alicyclobacillus acidocaldarius*, *A. acidoterrestris,* and *A. cycloheptanicus (4)*. Comparative rDNA sequence analyses showed that the three strains were sufficiently different from other *Bacillus* spp. to warrant reclassification in a new genus. Also, *Alicyclobacillus* are unique in their fatty acid profiles, containing ω-alicyclic fatty acid as the major natural membranous lipid component.

At NFPA, our first encounter with *Alicyclobacillus* spp. was around 1990, when a member company had a spoilage problem with an unusual sporeforming bacterium in a shelf stable juice product. The organism was isolated on acidified Potato Dextrose Agar (PDA), pH 3.5, from water and the activated charcoal filter used to filter water, but not from raw materials or environmental swabs. The temperature range for growth from spores was found to be 30 to 55°C over a pH range of 3.0 to 5.3. The organism was found to have $D_{87.8°C}$ = 11 min; $D_{91.1°C}$ = 3.8 min; $D_{95°C}$ = 1.0 min *(7)*.

CHARACTERIZATION STUDY

The objective of NFPA's research study was to characterize isolates from acid products.

Experimental protocol

Source of microorganisms

Eleven isolates of acidophilic sporeformers were obtained from industry sources and Dr. Don Splittstoesser, Cornell University. Isolates were obtained as vegetative cells on slants or were isolated from product in our laboratories. Isolates were obtained from spoiled canned diced tomatoes (NFPA #N-1089), spoiled apple-grape-raspberry juice (N-1090), spoiled apple juice (N-1107), normal apple-cranberry juice (N-1108), normal apple juice concentrate (N-1098, N-1100, N-1101, N-1102, N-1103), and apple pear juice blend (N-1104 and N-1105). Strains were isolated from products using K medium, pH 3.7; K medium was prepared from 2.5 g yeast extract, 5.0 g peptone, 1.0 g glucose, 1.0 g Tween 80, 15 g agar, 25% malic acid solution filter sterilized and used to adjust pH after autoclaving, and 990 ml deionized water. Isolates on slants were grown in Orange Serum Broth (OSB) (Difco), pH 5.0, at 35°C and stored on Orange Serum Agar (OSA), pH 5.0, (Difco) slants at 4°C or lyophilized.

Isolation media

A preliminary investigation into the suitability of various isolation media was undertaken, using strains N-1089, N-1090, N-1107, N-1108 and N-1098. A loopful of culture from each slant was placed into OSB (pH adjusted with HCl to 3.5, 4.0, 4.5, and 5.0) and incubated at 20, 35 and 55°C for up to 2 weeks (these organisms are known to grow slowly at suboptimal temperature). From each tube showing growth, organisms were streaked onto a variety of growth media: OSA (Difco), Tomato Juice Agar, Special (TJAS) (Difco), and Potato Dextrose Agar (PDA) (Difco), each adjusted to pH 3.5, 4.0, 4.5 and 5.0 using HCl; dextrose tryptone agar (DTA) (Difco) pH 7.4; and K medium, pH 3.7. Plates were incubated at the temperature at which the organisms grew in broth (i.e. if they grew in OSB at 55°C, plates were incubated at 55°C, not at 20°C or 35°C). In further studies, organisms were grown on K medium at 43°C. Growth was evaluated by determining the number of strains that grew on each of the media at each pH and incubation temperature. All samples were plated in duplicate.

Characterization tests

Biochemical characterization tests were based on the identification scheme described by Gordon et al. *(6)*, except that media were adjusted to pH 5.0. The ATCC reference strains for *Alicyclobacillus acidoterrestris*, *A. acidocaldarius,* and *A. cycloheptanicus* were also tested. Organisms were analyzed for macroscopic and microscopic appearance, motility, reaction to catalase test, reaction to Voges-Proskauer test, fermentation of carbohydrates (D-glucose, D-xylose, D-trehalose, L-arabinose, D-mannitol; acid production was measured by noting change in pH), production of indole, production of dihydroxyacetone, utilization of citrate and propionate, starch hydrolysis, phenylalanine deamination, nitrate reduction, growth in azide dextrose broth, resistance to lysozyme, and growth in the presence of 0, 5%, 7% and 10%

TABLE 1. Comparison of unknown strains with *Alicyclobacillus acidocaldarius* ATCC 27009 *A. cycloheptanicus* ATCC 49028 and *A. acidoterrestris* ATCC 49025

Characteristics	27009	49028	49025	N-1089	N-1090	N-1098	N1100	N1101	N1102	N1103	N1104	N1105	N1107	N1108
Gram stain	+	+	+	V	+	V	V	V	V	V	V	+	+	V
Motility	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Catalase	+	-	+(w)	+	+	+	+	-	-	-	+	-	+	+
Anaerobic growth	-	-	-	+	-	-	-	-	-	-	-	-	-	-
Voges-Proskauer	+	-	-	-	-	-	-	-	-	-	-	-	-	-
Acid from														
D-glucose	+	-	+	-	-	+	-	-	-	+	+	+	+	+
L-arabinose	+	-	+	+	+	+	-	+	+	+	-	+	+	+
D-xylose	+	+	+	-	+	+	-	+	+	+	-	+	-	-
D-mannitol	+	+	+	+	+	+	+	+	+	+	+	+	+	+
D-trehalose	+	-	-	-	-	+	-	-	-	-	-	+	-	-
Utilization of														
citrate	+	-	+	+	+	+	+	+	+	+	+	+	+	+
propionate	+	-	-	-	-	-	-	-	-	-	-	-	-	-
Hydrolysis of starch	+	-	-	-	-	-	-	-	-	-	-	-	-	-
Deamination of phenylalanine	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nitrate reduction	+	-	-	-	-	-	-	-	-	-	-	-	-	-
Formation of														
Indole	+	-	-	-	-	-	-	-	-	-	-	-	-	-
Dihydroxyacetone	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Growth in nutrient broth	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Growth in NaCl														
0%	+	+	+	+	+	+	+	+	+	+	+	+	+	+
5%	+	-	-	-	-	-	-	-	-	-	-	-	-	-
7%	+	-	-	-	-	-	-	-	-	-	-	-	-	-
10%	+	-	-	-	-	-	-	-	-	-	-	-	-	-
Growth with 0.001% lysozyme present	+	-	-	-	-	-	-	-	-	-	-	-	-	-
Growth with 0.02% azide present	+	+	+	-	-	+	+	+	+	+	+	-	+	+

+(w) weakly positive

NaCl. Growth in OSB was investigated over a pH range of 2.5 to 5.0 and a temperature range of 20-60°C.

Six of the isolates, N-1089, N-1090, and N-1108, N-1098, N-1104, N-1107 were ribotyped using a Riboprinter (Qualicon) *(9)*. Ribotyping was carried out by Dr. John Webster of Qualicon, and Dr. Guodong Wang, NFPA, a subsidiary of DuPont. Ribotyping is a general method for distinguishing species and types by using electrophoretic patterns of *Eco*RI restriction fragments labeled by hybridization with an rRNA operon from *Escherichia coli*. DNA was extracted from the cells, isolated from chromosomal DNA, and then cut using a restriction enzyme. Fragments were separated by gel electrophoresis on a nylon membrane (Southern Transfer), and then hybridized with an *E. coli* ribosomal RNA operon (*EcoR*1). An alkaline phosphatase conjugate was applied, followed by chemiluminescent substrate, allowing visualization of the fragments that hybridize.

RESULTS AND DISCUSSION

Studies on isolation media

Because strains grew slowly on most isolation media, plates were routinely incubated for up to 5 days. All isolates grew on OSB, pH 5.0, and on K medium, pH 3.7, incubating at 35°C. Growth was observed more frequently on plates with pH 4.5 and 5.0 than on those with pH 3.5, indicating that the organism preferred these pH values. There appeared to be a relationship between media pH and growth temperature;

at 20°C, all isolates grew on media at pH 5.0 but only 2 grew at pH 3.5, whereas at 55°C, all isolates grew at pH 3.5 but only 2 grew at pH 5.0. The organisms did not grow on DTA, pH 7.4. Growth occurred more rapidly (1 to 2 days) on K medium incubated at 43°C than at 35°C.

Phenotypic characterization tests

In general, the isolates were Gram positive with a tendency towards Gram variability, and were motile rods forming central, subterminal and terminal spores that slightly swelled the sporangium. Colonies were round, creamy white, translucent to opaque, 3 to 5 mm in diameter after 5 days growth on K medium, pH 3.7, incubating at 35°C. Results of characterization tests are shown in Table 1. Of the three reference strains, *A. acidoterrestris* was most similar to the isolates. Isolates were VP negative; 7 were catalase positive and 4 negative; all produced acid from D-mannitol, 6 from D-glucose, 9 from L-arabinose, 6 from D-xylose, and 2 from D-trehalose. All utilized citrate but not propionate, did not hydrolyze starch, were negative for deamination of phenylalanine, and did not reduce nitrate. All strains were indole negative and dihydroxyacetone negative. Strains did not grow in the presence of 0.001% lysozyme, but 8 grew in the presence of 0.02% azide. Strains did not grow in the presence of 5% NaCl. The pH range for growth in OSB was 2.5 to 5.5 for vegetative cells over a temperature range of 20-55°C. The minimum pH for spore germination was 3.24.

Ribotyping

Isolates were represented by a group of patterns corresponding to a species. Ribotyping distinguished the species from approximately 200 other species of bacteria in DuPont's computer database of normalized patterns. The six strains tested, N-1089, N-1090, N-1098, N-1104, N-1107, and N-1108, were identified as *Alicyclobacillus acidoterrestris*.

In previous studies *(3)*, as in our studies, some variability in results of biochemical characterization tests was reported. As more strains are isolated and identified, accurate methods to classify these strains will be of value.

NFPA SURVEY

NFPA undertook a survey of the food industry to determine the extent of spoilage by acidophilic sporeformers. Fifty-seven companies were chosen for the survey, based on membership of NFPA's Microbiology and Food Safety Committee and Juice Products Committee. There were 34 responses to the survey (60%). Of those who responded, 12/34 (35%) had experienced spoilage that would be consistent with growth of acidophilic sporeformers, although this was not always confirmed. Individuals from most companies reported one or two incidents of spoilage in the past 5 years, with the spoilage rate for most companies being about 5% of the lot experiencing the problem. Spoilage occurred in early spring or summer and did not appear to be the result of processing changes. Spoilage was reported most commonly in apple juice but also in other juices and diced canned tomatoes. The pH of products ranged from 3.2 to 4.1. Spoilage was mainly apparent as an off flavor or odor, with or without a sediment. In some spoilage incidents, product was discolored or cloudy. Spoilage organisms were recovered from both product and processing equipment, on a variety of media, with a pH ranging from 3.5 to 5.2, over a temperature range of 25-55°C. Companies often did not recognize that they had a spoilage incident until they received consumer complaints. Often the initial reaction was to assume that the off flavor was due to chemical contamination rather than microbial growth, as no gas was produced and the juice appeared normal.

CONCLUSIONS

Alicyclobacillus can survive a typical heat process given to fruit juices, germinate, grow, and cause spoilage in acid products. Spoilage may be difficult to detect, as product may appear normal or have a light sediment and gas is not produced. Often the only obvious indication of spoilage is an off flavor. Organisms grow slowly on isolation media, so growth may not be detected during routine quality control tests. *Alicyclobacillus* represent a new challenge to the juice industry and potentially to all processors of acid and acidified foods. Studies to characterize the organism further and to find control measures are in progress.

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Isolation and Enumeration of Sporeforming, Thermo-acidophilic, Rod-shaped Bacteria from Citrus Processing Environments

Cornelis A. Wisse and Mickey E. Parish

SUMMARY

Sporeforming thermo-acidophilic rod-shaped (STAR) bacteria were isolated from different sources within and outside citrus processing plants. Strains were found in soil and on surfaces of oranges from citrus groves. Samples collected at several citrus processing facilities showed that STAR bacteria were present on surfaces of unwashed and washed fruit, in condensate water, and in juice concentrate. Strains were also isolated from bulk stored orange concentrate, pear concentrate, single-strength pear juice, and orange juice nectar. Spore concentrations enumerated in condensate water, a by-product of the juice concentration process used for cleaning fruit surfaces, ranged from non-detectable levels to 2.3×10^3 MPN/ml. Total microbial populations in condensate water ranged from non-detectable levels to 7.9×10^5 CFU/ml. Results indicated that complete elimination of these organisms from fruit juices would be difficult; however, improvement of fruit cleaning operations and condensate water systems may reduce the incidence of STAR contamination in fruit juices.

INTRODUCTION

Thermo-acidophilic, sporeforming bacilli (Gram positive and Gram variable) have been isolated from natural sources such as hot springs and soil since the 1960s *(4, 5, 6, 9, 10, 11, 16, 22)*. Early reports identified these strains as species of *Bacillus*; however, further research has resulted in the description of two genera, *Alicyclobacillus* and *Sulfobacillus (10, 24)*.

Until a few years ago, sporeforming bacteria were not expected to spoil citrus juices. Species of *Bacillus* commonly isolated from fruit juices are usually considered saprophytic and of little concern in citrus juices *(12, 25)*. Although spores of these organisms survive thermal pasteurization, they are unable to germinate and outgrow in the low-pH environment of most fruit juices.

Documented reports of low pH spoilage by sporeforming bacteria began to appear in the early 1980s. Cerny et al. described the isolation of thermo-acidophilic sporeformers from spoiled apple juice that was cloudy and had an off flavor *(3)*. Ten years later, Splittstoesser et al. reported the isolation of sporeforming bacilli from spoiling apple juice and from an

applecranberry beverage *(20)*. McIntyre et al. isolated acidophilic bacilli from berry and citrus juices and from ingredient water *(14)*. Strains isolated by Splittstoesser et al. and McIntyre et al. were thermophilic, formed spores that survived pasteurization and produced growth in fruit juice. The isolated strains closely resembled the genus *Alicyclobacillus* in pH range and temperature range for growth *(24)*. Previdi et al. characterized four *Alicyclobacillus* strains isolated from different fruit juices and found them to be comparable to *A. acidoterrestris (19)*. Recently Yamazaki et al. reported the isolation of *A. acidoterrestris* from several spoiled acidic beverages *(27)*.

Articles that describe the isolation of sporeforming, thermo-acidophilic, rod-shaped bacteria from juices often identify the isolated strains as species of *Alicyclobacillus (2, 3, 14, 19, 20, 27)*. Recent information published on other thermo-acidophilic sporeformers that contain ω-alicyclic fatty acids in their cell membranes, such as some species of *Sulfobacillus*, complicates the identification of thermo-acidophiles isolated from fruit juices *(9, 16)*. Until further research confirms that thermo-acidophiles involved in fruit juice spoilage are presumptively *Alicyclobacillus* species and not members of another genus, it is appropriate to designate these microorganisms using nonspecific terminology. Therefore, the organisms of interest in this study are referred to as sporeforming, thermo-acidophilic, rod-shaped (STAR) bacteria.

Spoilage problems in Europe of juice products stored at ambient temperature during the unusually hot summers of 1994 and 1995 increased research interest in STAR bacteria *(2)*. Sources of the organism, routes of contamination, and spore concentrations at different stages in fruit juice processing are poorly understood and are of interest to the fruit juice processing industry. Objectives of this study were to detect and enumerate sporeforming thermo-acidophilic rod-shaped bacteria in citrus processing.

MATERIALS AND METHODS

Samples

Samples tested for presence of STAR bacteria included soil (18 samples) from orange groves, whole oranges, and line samples from 10 citrus processing plants. Soil samples from countries other than the United States were imported in compliance with USDA-APHIS-PPQ regulations. Samples from processing facilities included whole fruit, before and after washing; single-strength orange juice after extraction; concentrated juice from the evaporator; and condensate water from the evaporator and fruit-wash spray nozzles. At one plant, thirty-three orange juice concentrate samples were collected from the evaporator during six consecutive processing days. All samples from processing facilities were collected during the 1995-1996 crop season.

Fifty-nine samples of frozen concentrated orange juice (FCOJ) and other fruit juice purees and concentrates of various geographic origins in bulk storage containers were tested. Two consumer products (a shelf-stable single-strength pear juice and orange juice nectar), both hot-filled in retail packages, were also sampled. The retail package samples were provided by processors that suspected STAR spoilage in the products.

Media

The medium used to isolate and enumerate STAR bacteria was modified from media of Cerny et al. *(3)* and Darland and Brock *(4)*. ALI broth consisted of (mg/ml distilled water): 0.2 $(NH_2)SO_4$, 0.5$MgSO_4 \times H_2O$, 0.25 $CaCl \times H_2O$, 3 KH_2PO_4, 1 glucose, 2 soluble starch and 2 yeast extract. Broth pH was adjusted to 3.5 with 1N H_2SO_4 prior to autoclaving. ALI agar was produced as follows: ALI broth was prepared with twice the concentration of all components and the pH was adjusted as above. An equal volume of 3.5% aqueous agar (Bacto-agar, Difco Laboratories, Detroit, MI) was prepared. The two solutions were autoclaved separately, tempered to 50°C and mixed using aseptic technique. Plates were poured immediately after mixing. Autoclaving did not change the ALI broth pH by more than 0.1 units.

Selected samples were plated on Orange Serum Agar (OSA, Difco) and Plate Count Agar (PCA, Difco).

Plate counts

Total plate counts on PCA, Aciduric counts on OSA, and STAR counts on ALI agar were conducted using either pour or spread plate techniques, depending upon the anticipated population size *(21)*. Plates were counted after two days of incubation at 30°C (OSA), 35°C (PCA) or 45°C (ALI agar). All plating was conducted in duplicate.

Isolation of STAR bacteria

Sample preparation. Randomly selected undamaged oranges were placed in new, clean plastic bags with the use of sterile latex gloves. Sampling points were the fruit receiving areas (unwashed fruit) and a point after brush washing prior to juice extraction (washed fruit). In the laboratory, surfaces of five fruit from each sampling point were swabbed with a sterile sponge aseptically removed from a whirl-pak speci-sponge bag (International Bioproducts, Redmond, WA) that contained 150 ml sterile peptone saline solution (PSS: 8.5 g/l NaCl and 1 g/l bacto-peptone, Difco). After swabbing, the sponge was returned to the sterile bag and kneaded by hand for 30 sec. Fruit surface areas were calculated based upon the formula for area of a sphere, $4\pi r^2$ where r is the fruit radius. A 5-ml sample of the PSS was aseptically transferred to 100 ml ALI broth in a 250 ml flask. Individual condensate water samples (50 ml) were filtered through 0.45μm filters (Gelman Sciences), and the filter was transferred to 100 ml ALI broth. Soil samples (5g) were added directly to 100 ml ALI broth.

Samples (100 ml) of single strength juice, juice nectar, and diluted concentrates or purees were added to a 250 ml sterile flask. Fruit juice concentrates and purees were diluted to 11 to 14° Brix with sterile water. All samples were tempered to ambient before the heat activation step.

Heat activation. To activate spores and eliminate vegetative cells, flasks were placed in a 90°C water

TABLE 1. Detection of STAR bacteria in citrus processing facilities

	Citrus processing plant									
	I	II	III	IV	V	VI	VII	VIII	IX	X
Unwashed fruit surface	+*	+	+	+	+	+	-	+	+	-
Washed fruit surface	NT	+	+	+	+	+	-	-	-	+
Condensate water from spray nozzle	NT	NT	NT	+	+	+	+	-	+	+
Condensate water from evaporator	NT	NT	NT	+	NT	-	NT	-	-	+
Single-strength juice to evaporator	-	-	-	-	-	-	-	-	-	-
Concentrate from evaporate	NT	-	-	-	-	+	-	-	-	-

*"+" signifies the detection of STAR bacteria; "-" signifies no detection of STAR bacteria; NT = Not Tested

TABLE 2. Detection of STAR bacteria in fruit juice samples

Type of sample	Type of container	Number of samples tested	Samples positive for the presence of STAR bacteria
FCOJ*	Tanker trucks	11	4
FCOJ	210-liter drums	12	1
Various fruit concentrates/purees	210-liter drums	36	2 (pear concentrates)
Pear juice	retail package	1	1
OJ nectar	retail package	1	1

*FCOJ = frozen concentrated orange juice. OJ = orange juice

bath for 20 minutes. Water in the bath was at least 3 cm above the contents of the flask. The water bath was covered with aluminum foil to ensure thorough heating. After heat treatment, flasks were rapidly cooled in ice water and incubated at 45°C. When broth or juice became turbid or an off-odor was sensed, isolation streaks were made on ALI agar plates, which were then incubated 24 to 48 h at 45°C.

All samples were spread plated (0.1 ml) on duplicate ALI agar plates after 10 days incubation. Colonies of different morphologies were picked and streaked for isolation on ALI agar plates. Microscopic examination was conducted to confirm that isolates were endosporeforming rod-shaped bacteria. Isolates were stored in ALI broth with 20% glycerol at minus 76°C.

MPN enumeration of spores

A 3-tube most probable number (MPN) technique was used to estimate the number of STAR spores in selected samples *(17)*. Duplicate 10-ml samples of fruit surface PSS rinse, condensate water, single strength juice, and juice nectar were transferred to sterile tubes and heated for 10 minutes at 90°C to activate spores. Samples of concentrates or soil (1 g) were added to tubes containing 9 ml PSS prior to heat activation. After being heated, all tubes were rapidly cooled in an ice bath. Two serial dilutions (10^{-1} and 10^{-2}) from each tube were prepared in PSS. Aliquots (1 ml) of the heat treated samples and corresponding dilutions were inoculated into three tubes of 10 ml ALI broth. Outgrowth (visible turbidity) was checked after eight days of incubation at 45°C. Statistical tables provided the most probable number (MPN) of spores per ml, gram or cm^2 with a 95% confidence interval.

RESULTS

Isolation of STAR bacteria

Strains of STAR bacteria were detected in 7 of 18 soil samples, on surfaces of unwashed fruit at 8 of 10 processing plants, on surfaces of washed fruit at 6 of 9 processing plants, and in condensate water used to wash fruit at 6 of 7 test facilities (Table 1). At two plants, condensate water directly from the evaporator contained STAR bacteria. STAR bacteria were not isolated from single strength juice fed into the evaporator of the ten test plants but were found in concentrate samples from the evaporator of one facility. Thirty-three other concentrate samples collected later at the same plant during six consecutive processing days tested negative for these organisms.

Results for the detection of STAR strains in fruit juices are shown in Table 2. STAR bacteria were detected in FCOJ from bulk tankers and from 210-liter drums used for bulk commerce. Two pear juice concentrates from 210-liter drums, and retail packages of pear juice and orange juice (OJ) nectar, also contained STAR bacteria.

TABLE 3. Microbiological counts in condensate water sampled from evaporators, spray nozzles and a storage tank

Facility	Sampling point	Aciduric Count (OSA) CFU/ml	Total Count (PCA) CFU/ml	STAR Count (ALI broth) MPN/ml
Plant IV	Spray nozzle	315	500	NT*
Plant V	Spray nozzle	2000	2000	NT
Plant VI	Spray nozzle	6300	12600	240
Plant VII	Spray nozzle	630	1300	15
Plant VIII	Spray nozzle	<1 est.	<1 est.	<3
Plant IX	Spray nozzle	20 est.	20 est.	<3
Plant X	Spray nozzle	80	630	240
Plant IV	Storage tank	790000	790000	2300
Plant IV	Evaporator	<1 est.	<1 est.	NT
Plant VI	Evaporator	<1 est.	<1 est.	<3
Plant VIII	Evaporator	<1 est.	<1 est.	<3
Plant IX	Evaporator	<1 est.	<1 est.	<3
Plant X	Evaporator	<1 est.	<1 est.	<0.3

*NT = Not tested

Enumeration of STAR spores

Soil. Although STAR bacteria were isolated from soil samples, growth was not visible in the MPN enumeration experiment after eight days of incubation. Concentrations of spores in the seven samples were estimated as <3 spores/g soil.

Washed and unwashed fruit. MPN experiments to estimate number of spores in samples with positive detection results (see Table 1) were subsequently conducted. The estimated number of spores in all samples of washed and unwashed fruit surfaces were below the lower limit of detection, <90 spores/fruit. Lower serial dilutions used for MPN testing of washed-fruit samples from plant X indicated the presence of 46 spores/fruit.

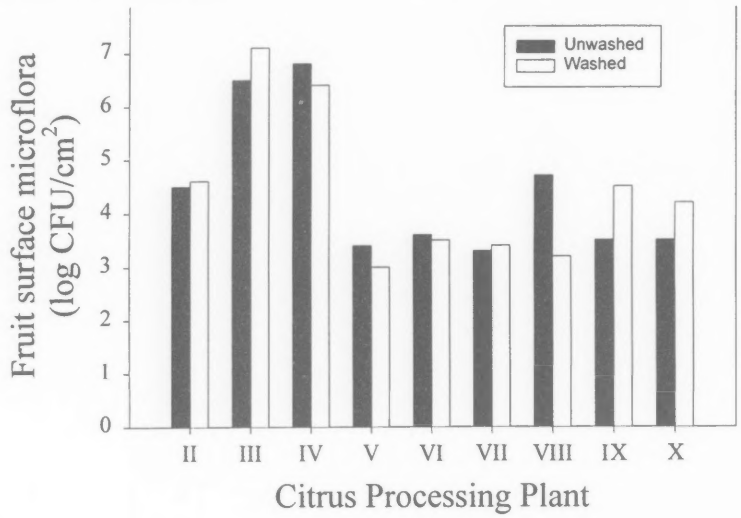
In addition to the MPN testing, results from the detection experiments reported above can be used to estimate the concentration of spores. Five fruits were washed with 150 ml PSS and a 5 ml aliquot was inoculated into 100 ml of ALI broth. A negative result indicated absence of growth and corresponded to <1 spore per 5 ml PSS. Based upon the total amount of PSS and number of fruit tested, this corresponds to <6 spores per fruit. A positive result indicated the theoretical presence of at least 6 spores per fruit.

Water samples. STAR spore counts of condensate water sampled at spray nozzles in the fruit brushwasher ranged from <3 spores/ml to 240 spores/ml (Table 3) at the six facilities that tested positive for the presence of STAR bacteria (Table 1). The spore count for condensate water sampled from a storage tank at one of the facilities was 2300 spores/ml. This water also had the highest total (PCA) and aciduric (OSA) counts of the condensate waters tested (Table 3). Although STAR bacteria were detected in condensate water sampled directly from the evaporator in two of five facilities (Table 1), MPN results, as well as total and aciduric plate count results were below the detectable limit for all evaporator water samples (Table 3).

Concentrate and single strength fruit juice samples. Spore populations (by MPN) in the five bulk-stored FCOJ samples that tested positive for the presence of STAR bacteria were <30, 150, 230 (two samples) and 430 spores/g 65°Brix concentrate. The only positive concentrate sample collected from the evaporator of a Florida processing plant contained 40 spores/g of 65°Brix concentrate.

A fruit juice nectar (minimum 55% fruit juice content) contained more than 1100 spores/ml by MPN. Plate counts on ALI agar estimated the spore concentration to be 1.7×10^3 CFU/ml. Spore concentrations were estimated by MPN as <30 spores/g for the pear concentrate samples

Figure 1. Aciduric microflora on orange serum agar per square centimeter fruit surface before and after fruit wash operation at nine citrus processing plants.



and <3 spores/ml for the consumer retail package of single strength pear juice.

DISCUSSION

Detection of STAR bacteria

STAR bacteria were isolated from several different sources. Positive detection of these organisms in soil samples was expected, since several publications mention their recovery from different soils in various parts of the world *(4, 7, 8, 11, 16)*. Isolation of STAR bacteria from fruit surfaces was also expected, in as much as cross-contamination with soil or other contaminated fruits during growth, fruit harvesting, and handling practices commonly occurs. Therefore, it is not surprising that STAR bacteria were detected on unwashed fruit surfaces at eight of ten processing plants.

It is most interesting that these organisms were recovered from washed fruit surfaces at six of nine facilities. One explanation is that there were substantial numbers of STAR spores in condensate water used for fruit washing (Table 3). Condensate water evaporates from juice during the thermal process used to produce juice concentrates. It is then condensed and used for a variety of purposes, such as fruit washing. An increase in the total microflora and STAR bacteria spore counts of condensate water between the evaporator and storage tanks or spray nozzles (as shown in Table 3) indicated that heavy microbial contamination and/or growth occurs in the condensate water system. The pH of condensate water from the evaporator was approximately 4.8, whereas the pH of water samples from the spray nozzles was approximately 7. Warm, acidic environments provide necessary conditions for growth of thermo-acidophilic bacilli. The condensate water recovery system is a critical point that needs improvement in some citrus processing plants to ensure that microorganisms are not inadvertently added to the juice processing line.

Another factor that could influence the contamination of washed fruit surfaces involved the efficacy of fruit washing operations. Most of the fruit wash systems studied did not effectively reduce the fruit surface microbial population after washing (Fig. 1). Research has shown that the maximum cleaning efficiency of most fruit wash systems produces a 90 to 99% reduction in the population of microorganisms on a citrus fruit surface under optimum pilot plant situations, whereas less-than optimum-conditions may result in only a 60% reduction of fruit surface microflora *(23)*. Research on effective fruit washing regimes is necessary to ensure that fruit are as clean as possible before juice extraction.

Contamination routes of FCOJ with STAR

STAR bacteria are carried into processing plants on fruit surfaces, soil, and other environmental sources. Because fruit surfaces may be continuously contaminated with spores from the condensate wash water, the extracted juice could very well contain spores and theoretically contaminate the evaporator. An empirical correlation exists between fruit surface and juice microflorae *(15, 26)*. STAR spores were not recovered from tested samples of single-strength juice prior to evaporation (Table 1), which indicates that the level of STAR spores was probably below the test detection limit. This was also reflected in the fact that these spores were recovered from concentrate taken directly from the evaporator in only one of the processing test facilities (Table 1). This lack of STAR spores in the concentrate taken directly from the evaporator could also be because citrus processors in Florida do not use condensate water to wash juice cells during production of concentrates. Proposed rules by the European Union to require condensate water for in-line washing of juice cells will probably result in the contamination of FCOJ by STAR bacteria. Efforts are needed to investigate water treatment protocols for condensate water.

Rinsing clean equipment (extractors, pipelines, evaporator, blending tanks) with condensate water containing STAR spores may contaminate the juice going to the evaporator, or the final FCOJ product. Heat treatment in the evaporator is not sufficient to kill STAR spores, which have reported D-values ranging from 14 to 54 min at 90 or 91°C and z-values between 6 and 10°C *(3, 14, 18, 20)*. It is known that bacterial spores are generally capable of attachment to surfaces of pipelines and equipment *(1)*. Temperatures in latter stages of the evaporator might even support germination and outgrowth. Thermophilic bacteria in milk are reported to attach to pasteurizer surfaces, grow and contaminate pasteurized milk *(13)*. Further research

is needed to determine specific contamination points during citrus juice processing.

CONCLUSION

Isolation of STAR spores from geographically disparate soil and juice samples in this research, coupled with reports of isolation of strains in Europe and Japan, indicates that STAR bacteria are widespread over different climate zones. Although sporeforming bacteria were previously considered to be of little significance in fruit juices, the isolation of STAR bacteria, as described in this and previous reports, significantly changes our understanding of fruit juice microbiology. The widespread presence of STAR spores in soil, on fruit surfaces, in the processing environment, and in juice products suggests that their complete elimination from the final product could be difficult and impractical. However, improvements in cleaning regimes and condensate water systems may substantially reduce contamination of FCOJ by STAR bacteria. Further studies are needed to better characterize spoilage and to develop methods that reduce the incidence of these organisms in fruit juices.

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Protecting Stainless Steel Dairy Equipment from Corrosion

Thomas M. Gilmore,[1] Robert R. Maller,[2] and Vincent Mills[3]

The purpose of this article is to provide guidance on the practices and recommendations related to the installation, passivation, maintenance, cleaning, and bactericidal treatment of stainless steel equipment. Close observance of the recommendations herein will result in longer, corrosion-free service life for stainless equipment and should provide a clean, sanitary surface for milk, milk products, and other comestibles. There are ten recommended practices to extend the corrosion resistance of stainless steel.

Nickel, chromium, and molybdenum bearing stainless steel of the American Iron and Steel Institute (AISI) 300 Series is resistant to corrosion by milk and other dairy products; that is, under normal operation the milk and other dairy products that come in contact with the stainless steel will not cause corrosion. Stainless steel derives its corrosion resistance from a thin, durable layer of chromium oxide that forms at the metal's surface and gives stainless steel its characteristic "stainless quality" *(6)*. The passive film on a stainless steel surface consists of a mix of iron, chromium, and, if present in the bulk steel, molybdenum oxides. The chromium oxide film can form in air instantaneously if the stainless steel surface is clean and dry. However, since the advent of circulation cleaning and clean-in-place (CIP) procedures, corrosion problems in dairy plants have been aggravated. Stainless steel is the best material known to dairy equipment manufacturers for the construction of dairy equipment, but the following procedures must be followed to ensure preservation of the surfaces of stainless steel equipment.

INSTALLATION AND MAINTENANCE OF STAINLESS STEEL DAIRY EQUIPMENT

1. The use of dissimilar metals should be minimized in the fabrication of the product contact surfaces, especially if the equipment is to be placed in a CIP-type installation. Wherever possible, only AISI 300 Series stainless steel should be used. "White metal," a copper-nickel alloy, should not be used in fabricating product contact surfaces. If possible, AISI 400 Series stainless steel should not be used with AISI 300 Series in fabricating a product contact surface, especially if the equipment is to be used in a CIP-type installation. The use of dissimilar metals, even two different series stainless steels, or "white metal" for product contact surfaces in the same system may result in discoloration, pitting, or etching.
2. Stainless steel tubing should be isolated from metal pipe hangers with nonabsorbent insulation. Failure to insulate may result in galvanic or other types of electrolytic corrosion, with serious damage to the piping. Absorbent insulation may accumulate moisture and aid in the corrosion of the piping.
3. Gaskets should be nonabsorbent materials that are free from iron oxide or other corrosive substances. Chemically active gasketing material may induce corrosion. Absorbent gaskets may permit a build-up of highly concentrated cleaning and bactericidal compounds that can produce pitting.
4. Leaky gaskets and joints should be promptly replaced or repaired. The use of different types of fittings in making pipe connections should be avoided where possible. Properly designed and installed pipe and equipment supports and mountings are necessary to prevent undue mechanical strains and stresses on joints. Product and cleaning material leaking through joints may promote corrosion if the corrosive material is allowed to remain in the joint area. CIP installations, where lines are not normally dismantled, are especially susceptible to corrosion in the joint area if leaks occur.
5. Welding and polishing should be performed by competent individuals using approved methods and materials. The use of low welding temperatures, appropriate grades of welding rod and parent metal, and iron-free polishing wheels and

compound is encouraged. Excessive grinding and polishing may also leave the surface in a weakened condition. The corrosion resistance of even the highest grades of stainless steel may be reduced considerably by the use of excessive welding heat, by the presence of oxygen during welding, by the use of low grade welding rod or parent metal, by the incorporation of iron particles during polishing, or from failure to remove weld spatter or fluxing agents.

If any question exists as to the quality of the finished weld and polish, appropriate quality checks such as X-ray or dye-check should be used. Pits or voids remaining in the polished weld area should be completely removed, since they form natural areas for corrosion to start.

6. When new equipment, and particularly CIP systems are installed, all electrical equipment in the area of the installation should be checked for proper connections, grounding, worn or damaged insulation, or other factors that might lead to stray electrical currents. Periodic preventive maintenance checks should be made to ensure that this condition does not occur. A pitting form of corrosion may result if stray electrical currents come in contact with moist stainless steel. Local electric power companies or electricians should be consulted with regard to detection of such a condition.
7. When installation is complete, and prior to use, the equipment and piping should be thoroughly cleaned, drained, passivated, and, if possible, allowed to air dry. It should then be subjected to an approved bactericidal treatment just before product is to be processed. Thorough cleaning and air drying permits the formation of a protective chromium oxide film, which is the key to placing the system in its most corrosion-resistant (passive) condition.

The chromium oxide film can form in air instantaneously if the stainless steel is clean and dry. Further exposure to air does not yield additional corrosion protection. Complete passivation cannot be achieved if product contact surfaces are not clean or contain surface defects. It should be noted that the interaction between the different oxides and the passivation/corrosion characteristics of stainless steel is very complicated and is not yet fully understood.

The passivation process will enhance the chromium fraction in the passive film, as established by a number of authors, e.g., Olsson and Hornstrom *(5)* or Olefjord and Wegrelius *(4)*. The main mechanism for this process is selective dissolution, predominantly of iron *(3)*.

An increased chromium fraction in the passive film is one important parameter that influences the corrosion resistance of steel; however, it has less influence on the steel's ability to repassivate spreading pit corrosion. On the other hand, a properly performed passivation process will use up a number of possible initiation sites for pitting by dissolving surface sulphides. This type of mechanism adds value to the effects of surface passivation.

FABRICATION CAUTIONS

1. Hygienic fabrication techniques must be used to eliminate the use of ferrous-containing grinding and polishing materials and thus to prevent iron particles from being imbedded in the surface. In addition, the finished surface should be free of oil (machine lubricants) and shop dirt.
2. At times, the interior surface of equipment (especially vessels) delivered from equipment manufacturers can be covered with oil (mineral, organic, silicone). Product contact surfaces can also contain high carbon tramp steel, grease, dust, and other manufacturing dust that, if not removed, can lead to pitting, rusting, and crack and crevice corrosion.
3. Treatment of stainless steel with nitric, phosphoric or an organic acid is useful after machining to enhance the protective nature of the chromium oxide. These acids are normally used after cleaning with an alkaline dairy cleaner. Nitric acid enhances the level of chromium in the protective film on stainless steels. ASTM A 380 describes eight nitric acid-based cleaning/passivation treatments and four cleaning treatments using other chemicals *(1)*.

CORROSION POTENTIALS CREATED DURING FABRICATION *(6)*

Defects and contaminants that can lead to corrosion are caused during the manufacturing process. Surfaces must be cleaned of the following potential sources of corrosion:

1. Embedded iron particles, picked up from forming rollers, carbon steel wire brushes, layout and cutting tables, and grinding.
2. Heat tint, resulting when welding heats the base metal, causing heavy oxide films (scale) to develop in the area of applied heat. The oxide films range in color from straw yellow to black; the color variation in the base metal is also dependent on the amount of oxygen gas present during the welding process. Heat tint will result in lower corrosion resistance of the stainless steel.
3. Weld flux, produced by welding with covered electrodes and forming along the sides of the weld bead. Weld flux is difficult to remove, requiring brushing with stainless steel wire brushes, abrasive disc and flapper wheel grinding, methods which may leave small flux particles at the side of the bead head. The flux particles are excellent crevice formers.

4. Arc strikes and spatter, which produce small pinpoint surface defects that become areas of corrosion in the protective film.
5. Scratches and paint, which can initiate corrosion, as can crayon marks and other instruction markings if they are not removed.

OTHER SURFACE TREATMENTS *(6)*

1. Passivation treatments are not designed to remove heat tint, embedded iron particles, heat treating scale, and other surface defects produced during fabrication, because nitric acid does not corrode or remove the surface layers having embedded defects. Elimination of these defects requires removal of the normal protective oxide layers in addition to 25 to 40µm of the substrate metal via pickling of the surface in a nitric-hydrofluoric acid bath.
2. Electrocleaning and electropolishing techniques are useful alternatives to the pickling treatment just mentioned. Electrocleaning can be used to remove imperfections from the surface of stainless steel after fabrication. Electrocleaning removes embedded iron particles; however, unlike pickling, it makes the substrate surface smoother.
3. Electropolishing is the same process as electrocleaning but is generally performed for longer periods of time.
4. Pickling, electrocleaning, and electropolishing surface treatments are beyond the scope of this document.

COMPLETE PASSIVATION PROCESS

The complete passivation process consists of inspection, mechanical cleaning, degreasing, immersion, and rinsing:

1. Mechanical cleaning *(6)*

Many mechanical methods can be used to clean welds, such as chipping, brushing, grinding, and blasting. However, many of these methods may do more harm than good if not performed properly.

Grit blasting can be extremely detrimental because it is difficult to keep grit from becoming embedded in the surface being blasted. Grit blasting also roughens the surface, creating small cracks and crevices that set the stage for localized crevice corrosion.

Shot-peening with clean stainless steel shot produces compressed stresses and reduces the risk of stress cracking; however, it does not eliminate crevice corrosion because of the roughened surface.

Sand blasting should be avoided unless it is the only cleaning method available. If sand blasting is used, only new, uncontaminated sand should be used, and then only once.

Glass bead blasting is an effective method for local and large area cleaning.

Grinding with clean silicon carbide discs or clean aluminum oxide flapper wheels can remove heat tint and other weld-related defects. However, even light grinding leaves a cold worked smeared surface that may contain microcracks, laps, seams and other defects that can initiate crevice corrosion.

During heavy grinding, when grinding wheels overheat the surface of stainless steel, the excess heat will degrade the stainless steel's corrosion resistance to depths greater than 25 to 50µm. Grinding should be used only when removal of the weld crown is critical to optimizing corrosion resistance.

Chipping is normally used between weld passes to remove weld slag and subsequent weld passes to eliminate any damaging effects created during the welding process. This is not an acceptable final surface finishing technique for product contact surfaces.

2. Inspection procedures

The water-break test, described in ASTM A 380 *(1)*, is easy to perform and is effective in detecting residual organic matter that may not have been removed in the degreasing operation. A sheet of water directed over the surface will break (bead up) around oil, grease, and other organic contaminants on the surface. A surface that exhibits good sheeting is said to be oil free.

Water can be useful for detecting iron contamination: if contamination is present, rust streaks and spots will form on wetted surfaces over a period of several hours. The copper sulfate and ferroxyl tests, which are much more sensitive than the water test, are specified when the surface must be entirely free of iron *(6)*. Although these tests are easy to use, test solutions do not have a long shelf life.

3. Cleaning/degreasing:

Passivation cannot form or enhance the protective film when grease, oil, fingerprints, or other organic contamination are present on product contact surfaces. In fact, when polishing stainless steel to meet hygienic standards, some mills use an oil that contains an extreme pressure (EP) additive. The use of the EP additive yields an aesthetically pleasing finish; however, it is difficult to remove. All manufacturing oils, EP addi-

tive, and mineral oil must be completely removed prior to passivating to prevent stains, streaks, and future corrosion. An oily or soiled surface cannot be passivated, because oil and soil block the acid and oxygen from reaching the metal surface.

Degreasing and general cleaning may be accomplished by immersion in, swabbing with, or spraying with alkaline cleaner, solvent, detergent cleaners, or a combination of these; by vapor degreasing; by ultrasonics, using various alkaline cleaners; by steam, with or without cleaner; or by high-pressure water-jetting.

4. Immersion/spraying *(2)*

The part to be passivated is immersed or sprayed (depending on the size of the piece, e.g., large vessels are usually sprayed) in a solution selected from ASTM A 380 *(1)*. In addition to the standard nitric acid solution, there are a number of solution variations that contain a combination of other oxidizing acids successfully used to treat large vessels and that are appropriate for all grades of stainless steel, including 200, 300, and 400 series, with specific precipitation hardening and free-machining alloys in various heat treatment conditions and surface finishes.

CLEANING AND BACTERICIDAL TREATMENT

1. Only products supplied by reputable and responsible chemical manufacturers, who are familiar with dairy processing equipment processes and limitations and who are able and willing to make specific recommendations for cleaning practices should be used. Responsible chemical manufacturers continuously check the results obtained with their products on dairy processing equipment and maintain technically qualified staffs of service personnel.
2. The manufacturer's products must be used in the precise manner in which they are recommended, but only with the concurrence of the equipment manufacturer. Misuse of normally acceptable cleaning and bactericidal products, in excessive concentration, temperatures, or exposure times, may cause permanent damage to processing equipment.
3. A suitable water conditioner should be used if the water supply is contaminated with foreign matter that may cause discoloration of the metallic surfaces or undesirable deposits. Deposits or discoloration from a contaminated water supply may counteract the best cleaning practices and may cause corrosion of the best quality stainless steel equipment.
4. When product processing has been completed, the equipment should be immediately rinsed with warm water until the rinse water is clear and complete circulation or manual cleaning should follow as soon as possible. Product deposits are most easily removed while still moist, and considerable amounts of soil can be removed by the initial rinse following processing. Particles of moist soil left on the stainless surfaces may cause pitting at a point beneath the particle.
5. When manual cleaning is indicated, only soft nonmetallic brushes, sponges, or pads should be used. An extended period of soaking in the cleaning solution will facilitate removal of stubbornly adhering residues. Extreme care is required with manually brushing to avoid scratching the surface of stainless steel equipment. Metal brushes or sponges will scratch the surface of stainless steel equipment and may promote corrosion over an extended period of time. If improperly used, even nonmetallic brushes may scratch the surface. Metallic particles from sponges, if allowed to remain on equipment or in pipelines, may cause corrosion.
6. If both alkaline and acid cleaners are used alternately in circulation cleaning, one must be completely rinsed out before the other is introduced into the system. After chemical circulation has been completed, the system must be thoroughly rinsed with warm water, and then with cool water before it is shut down. Wherever possible, the system should be completely drained and opened to allow the metallic surfaces to air dry so that the corrosion-resisting passive film (oxide) may form. If alkaline cleaning solutions and milk residues are not completely removed, a milkstone buildup may occur. If acid solutions are not completely removed, a highly corrosive atmosphere that can cause discoloration or pitting may form. In addition, most chemical bactericides are considerably more corrosive if they are introduced into an acidic medium. A thorough final rinse is very important in preventing corrosion.
7. Bactericidal treatment with live steam is often only partially effective and may cause considerable damage to processing equipment if not designed for high temperature use and sanitizing. It is recommended only if the system is designed to be self-draining, contains no dead air pockets or no cold spots, and is balanced to prevent physical damage. Concentrated heat may cause buckling, erosion, or discoloration of the stainless steel and may reduce corrosion resistance in localized areas. Hot water circulation is the preferred method if heat sanitizing is desired. Water at 180°F (82°C) circulated for five minutes is a typical procedure.
8. When chemical bactericides are used, extreme caution must be exercised to use them only as prescribed by the chemical manufacturer, in con-

currence with local health authorities and the equipment manufacturer. Specific concentrations, temperatures, and exposure times must be followed as recommended. In addition, the chemical bactericide should be applied just before the equipment is to be used, and in no case should the exposure time exceed twenty minutes. Excessive concentrations, exposure times, or temperatures employed during bactericidal treatment with chemicals may cause serious corrosion of the metal surface and premature aging of the sanitary rubber parts in the system. It should be noted that an increase of even a few degrees in the temperature at which the chemical bactericide is applied will greatly increase its chemical activity and thus the corrosive effect upon the metallic surfaces and the aging effect upon the rubber surfaces. Therefore, minimum temperature should be employed when applying chemical bactericides.

9. If it is impossible to replace "white metal" and AISI 400 Series stainless steel components from processing systems that are to be circulation (CIP) cleaned, these parts should be removed from the system during the cleaning cycle and manually cleaned. "White metal" and AISI 400 Series stainless steels are considerably less resistant to chemical attack than the AISI 300 Series stainless steels, and they are readily corroded when cleaned by circulation methods. Note that 3-A Standards do not provide for the use of "white metal."

RECOMMENDED PRACTICES TO EXTEND THE CORROSION RESISTANCE OF STAINLESS STEEL

1. Use only soft fiber brushes, pads, or sponges for manual cleaning.
2. Use a water conditioner if water is high in undesirable foreign materials.
3. Remove weld spatter, fillings, fittings, wrenches, and rubber parts from wet stainless steel surfaces.
4. Remove all milk residues from stainless steel surfaces.
5. Use chemical cleaners only as directed by the manufacturer, and thoroughly rinse all alkaline and acid cleaners from stainless steel surfaces with clear water.
6. Apply chemical bactericides immediately prior to processing and only as directed by the manufacturer. In no case should exposure be longer than twenty minutes.
7. Whenever possible, open equipment and allow to air dry after the final clear water rinse.
8. Install equipment and piping so that all parts are aligned and well supported to prevent undue stress or strain on any component.
9. Use only stainless steel of similar series in systems that are to be cleaned by circulation (CIP) methods.
10. Allow only qualified personnel, using approved techniques and materials, to weld and polish stainless steel equipment.

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Call for Nominations
1998 IAMFES Secretary

Nominations are now being accepted by the Nominating Committee for the office of IAMFES Secretary. A representative from the regulatory sector will be elected in the spring of 1999 to begin serving at the conclusion of the 1999 IAMFES Annual Meeting for the year 1999-2000.

Letters of nomination, including a photograph and biographical sketch are to be submitted to the Committee Chairperson **no later than November 1, 1998.** After the close of nominations, the Committee will review the nominees and select two (or more) persons to be presented to the Membership for voting.

The Secretary-Elect is determined by a majority of votes cast through a mail vote taken in the spring of 1999. Official Secretary duties begin at the conclusion of the 1999 IAMFES Annual Meeting. The elected Secretary serves as a Member of the Executive Board of IAMFES for a total of five years succeeding to President, then serving as Past President. Board meetings are scheduled at least three times a year and other commitments may be necessary.

For more information regarding duties and requirements of the position, please contact David Tharp, Executive Director at 800.369.6337 or 515.276.3344; Fax: 515.276.8655; E-mail: dtharp@iamfes.org.

Send a letter of nomination for Secretary of IAMFES, along with a photograph and biographical sketch of nominee, to the Nominations Chairperson:

F. Ann Draughon
University of Tennessee
Food Tech Department
P.O. Box 1071
Knoxville, Tennessee 37901-1071
Phone: 423.974.7425; Fax: 423.974.7450
E-mail: draughon@utk.edu

Nomination deadline is November 1, 1998.

New Members

AUSTRALIA

Steven M. Thugesen
Foodpartners
Booval, Queensland

CANADA

Pierre Theriault
Health & Community Services
Edmundston, New Brunswick

Amanda E. Whitfield
University of Guelph
Guelph, Ontario

Lain Wright
Kitchener, Ontario

CHINA

Dennis Christian
Christian Consulting Services
Shanghai

EGYPT

Salem Abd-El-Ghani
National Research Centre
Dokki, Cairo

INDONESIA

Sri Raharjo
Gadjah Mada University, Yogyakarta

MEXICO

Olivia F. Esqueda
U.A.S.I.P., San Luis Potosi

Aurelio Lopez-Malo
Universidad de Las Americas-Puebla,
Cholula, Puebla

OMAN

Usama M. Abdul-Rauof
Faculty of Education, Salalah

SAUDI ARABIA

Yasser B. Jad
Saudia Catering, Jeddah

SOUTH AFRICA

Tracey-Lee Pattison
Wits University, Wits

SPAIN

Joaquin Clemente
Badajoz, Badajoz

UNITED ARAB EMIRATES

Belinda Lee
Dubai

UNITED STATES

ARKANSAS

Marlene Janes
University of Arkansas, Fayetteville

Hong H. Y. Yang
University of Arkansas, Fayetteville

CALIFORNIA

Donald R. Beck
Chaos Solutions, Palm Dessert

William B. Hitchcock
Zep Manufacturing Co., Elk Grove

Lee H. Jensen
California Dept. of Food
& Agriculture, Sacramento

Frances F. Pabrua
California Strawberry Commission
Watsonville

Anna Rys-Rodriguez
Primus Laboratories, Santa Maria

COLORADO

James A. Carver
GTC-Nutrition, Johnstown

CONNECTICUT

Timothy C. Jackson
Nestle R & D Center
New Milford

FLORIDA

Dongjin Shin
University of Florida, Gainesville

GEORGIA

Gary Ades
Technical Food Information
Spectrum, Atlanta

Lynda G. Collins Kelley
USDA, Bogart

Suzana Tkalcic
University of Georgia, Athens

IDAHO

Shawn D. Delaney
Kraft Foods, Rupert

ILLINOIS

Bharat N. Bhatt
Nevin Association, South Beloit

John P. Hartman
M & M/Mars Inc., Burr Ridge

Gerald Murawski
Food Service Professionals, Chicago

Debora D. Ruffie
Kraft Foods, Glenview

INDIANA

Bob MacDonald
SRC, Columbia City

KANSAS

Aaron Truax
Kansas State University, Manhattan

KENTUCKY

Judith I. True
Cabinet for Public Health
Frankfort

MAINE

Lisa D. Colson
Health & Environmental Testing
Laboratory, Augusta

MICHIGAN

Phillip R. Allen
Dow Corning Corporation
Midland

Dur Efaw
Meijer Inc., East Lansing

Hui Peng
Wayne State University, Detroit

Robert G. Taylor
Michigan Dept. of Agriculture,
Food and Dairy Division
Lansing

MISSOURI

Keith Nunes
Meat & Poultry, Kansas City

Cathy R. Sullivan
Saline Co. Health Office
Marshall

NEW JERSEY

Gary Dainton
Chemstar Corporation, Sewell

NEW YORK

Greg Chiarella
Kraft Foods, Tarrytown

Althea A. Jones
Joseph E. Seagram & Sons
White Plains

Ibrahim Naderi
Jamaica

NORTH CAROLINA

Jeffrey E. Hawley
Harris Teeter, Inc., Matthews

OHIO

Samuel R. Scopelliti, Jr.
Steris Corporation, Mentor

OKLAHOMA

Brian Shofran
Oklahoma State University
Stillwater

Neeraj Khanna
Bio-Cide International, Norman

PENNSYLVANIA

William F. Fett
U.S. Dept. of Agriculture
Wyndmoor

William M. Keck
Turkey Hill Dairy, Conestoga

Mark A. Matrozza
Microbac Laboratories, Inc.
Pittsburgh

SOUTH CAROLINA

Deborah L. Hoyt
Cryovac, Duncan

SOUTH DAKOTA

Dorothy Franklin
Sioux Falls Health Dept.
Sioux Falls

TENNESSEE

Roslyn E. Malone
Cargill Inc., Memphis

TEXAS

Paul G. Belase
Alamo Water Refiners, Inc.
San Antonio

Stephen C. Braithwaite
Dreyer's Ice Cream, Houston

Martha Hudak-Roos
T.F.S., League City

Gary Schweitzer
Borden Inc., Garland

VIRGINIA

Larry E. Seamans, Sr.
Maryland & Virginia Milk Producers
Coop., Chase City

WISCONSIN

Michael F. Ely
Wisconsin Dept. of Agriculture
Madison

Jean A. Fuchs
SYSCO, Fond du Lac

Gregory J. Leyer
SC Johnson Professionals
Sturtevant

Julie A. Parsons
J. J. Kelber & Assoc., Neenah

New IAMFES Sustaining Members

Chris K. Dwyer
Raven Biological Labs
Omaha, NE

Deneen W. Rief
Medallion Labs
Minneapolis, MN

UpDates

Bock Elected IAFIS Chairman — Lefevre, Chairman-Elect

Bill C. Bock, Vice President and General Manager of Interbake Dairy Ingredients, was named Chairman of the Board of the International Association of Food Industry Suppliers (IAFIS), at the Association's Annual Conference. As Chairman, Bock will preside over the 19 member Board of Directors.

In addition to his tenure on the Board of Directors, Bock has served on the following IAFIS Committees: Executive Committee, Marketing Committee, Show Committee, Industrial Marketing Training Subcommittee, and Annual Conference Committee, as a member and Chairman.

Also elected at the Conference was IAFIS' new Chairman-Elect, Steve Lefevre, President of King Engineering Corporation, Ann Arbor, Michigan. Lefevre, actively involved on IAFIS committees for more than seventeen years, has served on the Association's Board of Directors, the Annual Conference Committee, the IDFA/IAFIS Joint Executive Show Committee, and the IAFIS Strategy Planning Committee.

In addition, the membership elected four At-Large Directors. Each of the following Directors will serve a 3-year term, expiring in 2001: John S. Barsanti, Walker Stainless Equipment Company, Inc., New Lisbon, WI; Robert J. Daley, Jr., Sparta Brush Company Inc., Sparta, WI; Camilla Nielsen, Nielsen-Massey Vanillas, Waukegan, IL; and Steve Schlegel, Hixson Architects/Engineers, Cincinnati, OH.

Also serving 3-year terms are Distribution & Transportation Director Robert H. Sprinkman, W.M. Sprinkman Corporation, Franksville, WI, and Processing Commodity Director Larry Hanson, Sani-Matic Systems, Madison, WI, who was re-elected to the position.

The Educational Foundation of the National Restaurant Association Announces John Metz, FMP, as 1998-99 Chairman

The Educational Foundation of the National Restaurant Association announces John C. Metz, FMP, President and CEO of Metz Enterprises, Inc., Dallas, PA, as the new Chairman of its Board of Trustees for 1998-99.

Metz has a lengthy and esteemed background in the restaurant/hospitality industry, beginning in 1967 when he founded Custom Management Corporation.

In addition to his professional experience, Metz is affiliated with numerous industry organizations and has received many awards for his accomplishments.

The other 1998-99 officers of the Foundation's Board of Trustees are: Ralph Brennan, FMP, Owner, Bacco/Red Fish Grill/Mr. B's, New Orleans, as Vice Chairman; Michael Hurst, FMP, President, 15th Street Fisheries, Ft. Lauderdale, FL, as Secretary; and Wallace Doolin, President and CEO, Friday's Hospitality Worldwide, Dallas, as Treasurer.

New board members named for the 1998-2001 term are Michael J. Licata, President, International Foodservice Manufacturer's Association, Chicago; Denise Fugo, FMP, President, Sammy's, Cleveland; and Regynald Washington, FMP, General Manager, Epcot Food and Beverage, Walt Disney World Co., Lake Buena Vista, FL.

In addition, John Farquharson, FMP, President, International Food Safety Council, has been named The Educational Foundation's first-ever honorary trustee. He received the recognition for his many years of dedication and service to the Foundation's board of trustees.

Serac, Inc., Promotes Manuel Montero to Regional Sales Manager for Latin America

Serac, Inc. announces the promotion of Manuel Montero to Regional Sales Manager. In his newly appointed position, Montero will assume all communication responsibilities with current and potential customers in Latin America. During the past years, Montero has served Serac in the engineering department and, most recently, as Sales Engineer. Montero's in-depth knowledge of Serac filling capabilities and services will be of great benefit as he works directly with customers and manufacturer's representatives.

Montero obtained his Bachelor of Science degrees in civil and mechanical engineering from tile Illinois Institute of Technology in Chicago. Additional post-graduate studies have been continued at IIT. Montero's extensive knowledge of the packaging industry will enhance the Serac commitment to solve customer problems.

Etherton to Head Penn State Dairy & Animal Science Department

Dr. Terry D. Etherton, Distinguished Professor of animal nutrition in Penn State's College of Agricultural Sciences, will assume duties as head of the Department of Dairy and Animal Science.

"Animal agriculture is the largest component of Pennsylvania's broad and diverse food system, reflecting a multi-billion dollar segment of the state's economy," says Robert Steele, Dean of the college. "Dr. Etherton's broad background in agriculture, spanning the farm to the laboratory bench through his teaching, research and outreach activities, makes him a superb choice for this position."

Etherton led the department's development of an internationally recognized research program focusing on endocrine regulation of animal growth. He is most noted for pioneering studies on the effects of treating pigs with recombinantly-derived porcine growth hormone (pGH), and on the use of hypothalamic peptide growth hormone-releasing factor (GRF) in pigs. In addition, Etherton has taught courses in animal growth and development, integrated animal biology, and regulation of nutrient metabolism.

Etherton is recognized worldwide for his expertise and leadership in the area of endocrine regulation of animal growth, and is a leading authority on the safety and usefulness of agricultural biotechnology. He has received numerous scientific awards, including the Hoffman-LaRoche Animal Growth and Development Award from the American Society of Animal Science in 1990, Penn State's University Faculty Scholar Medal in Life and Health Sciences in 1991, and the Alex and Jessie C. Black Award for Excellence in Research from Penn State's College of Agricultural Sciences in 1993. He was awarded the title of Distinguished Professor by Penn State in 1996.

The Department of Dairy and Animal Science provides undergraduate and graduate education in animal agriculture; conducts basic and applied research to improve the efficiency of animal production and enhance the quality of animal products; and facilitates the application of relevant information to solve problems through its cooperative extension and outreach programs.

Walker Stainless Hires New Plant Manager

Walker Stainless Equipment Company, Inc. recently announced the hiring of Ken Short as Plant Manager of their Tavares, FL manufacturing facility. Walker's Tavares facility produces the company's full line of Welded Ring transport trailers as well as their exclusive aluminum frame and cradle transport trailers.

According to Denny Tenhoff, Vice President and General Manager of the Transportation Products group, "Through lean design manufacturing and our customer driven product delivery system, we have dramatically improved our operating efficiency and delivery time while reducing our customers' costs. One of Ken's primary goals will be to implement strategies that further this effort while increasing our plant's overall manufacturing capacity and productivity. I am confident that Ken will be an excellent addition to the Walker team."

Short has nearly thirty years of domestic and international experience involving design, engineering, fabrication, quality assurance, marketing and manufacturing management. He is a graduate of the University of Tampa with a degree in Industrial Management.

Dr. Bahram Grami to Become Analytical Services Manager

Effective June 29, 1998, Dr. Bahram Grami will become Analytical Services Manager for the American Association of Cereal Chemists (AACC) and for the American Society of Brewing Chemists (ASBC). The recently created position, currently held on an interim basis by Dr. Elwood F. Caldwell, provides staff support for AACC's Approved Methods and Technical committees, as well as management for its International Check Sample and Proficiency Rating programs. Dr. Caldwell, whose distinguished tenure at AACC headquarters has included positions as Director of Scientific Services as well as Analytical Services Manager, will retain his original schedule during a month-long transition period.

With a Ph.D. in agronomy from the University of Manitoba, Dr. Grami brings a strong background in analytical methodology to his new position. Most recently, he has been involved in research projects in Dr. Harold Corke's University of Hong Kong food science laboratory. Prior to that, he managed the departmental cereal laboratory at the University of California-Davis for eight years.

William L. Bennet Joins AIB International

William L. Bennet has joined AIB International as Manager, Quality Systems, and will be actively involved in consulting and education to the food industry relating food quality, food safety, and HACCP.

Bennet has had a significant and varied career in the food industry since he graduated from Pennsylvania State University with a BS in food technology. He started with the Pillsbury Company in Minneapolis, MN, in 1969 and directed quality operations at several Pillsbury subsidiaries until moving to SAF Products in 1985. From 1987 to the present, Bennet operated his own consulting business, WorldView Food Products, Inc., in Minneapolis where he was involved in sales, technical problem solving and prevention programs for small to midsize companies, served as a Consultant to large companies on flour and grain technology, helped develop strategic plans for Roman Meal Milling, Integrity Mills, and small oat, buckwheat, and Amaranth processors.

Additionally, Bennet formulated a TVP-based lunch line for Nutri-Systems that included individual, microwavable portion pouches for sloppy joes, chili, and tacos. He developed custom-roasted grains and blends for Nabisco, Pillsbury, and General Mills. With Leon Levine, he co-authored a patent for a microwavable snack product using Amaranth grain. Bennet also has an extensive background in the health benefits of food and nutrition. He also contributed to a University of Minnesota study of grains and the immune system.

Bennet has post-graduate courses from the University of St. Thomas, Minneapolis, and Temple University as extensive continuing education courses in a variety of business, computer, and food-related topics. He is a member of IFT and the AACC and has been a member of the National Restaurant Association, Public Health Professionals, Bakery Engineers, and the National Nutritional Foods Association.

World Dryer Promotes Bruce Bohner

David Ring, Vice President, Sales & Service for World Dryer Corporation, has announced the promotion of Bruce P. Bohner to National Sales Manager. Based in Atlanta, GA, Mr. Bohner was previously Southern Regional Sales Manager for World Dryer.

Bruce's new position encompasses sales activities for the complete World Dryer and Electric-Aire product lines, including hand sanitation equipment. Bohner's duties include managing manufacturers' multi-line representatives, handling national accounts, creation of product demand, conducting sales meetings, rolling out new products, and promotions to World Dryer reps and distributors.

Bohner earned a degree in economics and psychology from Wabash College. Before joining World Dryer two years ago, he was employed by Arby's Franchise Association in Atlanta as a Franchise Director of Field Marketing. During his 22 year career, Bruce has held positions with the Taco Bell Corporation, Long John Silver's, Cole & Weber Advertising in Seattle and Leo Burnett USA in Chicago.

Hopkinson Elected 3-A Symbol Council Officer

Mr. Reginald C. Hopkinson, Pittsford, NY was elected Vice-Chairman of the Board of Trustees of the 3-A Sanitary Standards Symbol Administrative Council at the June 5 meeting of the Symbol Council. Hopkinson has served as a Trustee of the Symbol Council since 1992, representing the International Association of Food Industry Suppliers.

The objectives and purposes of the Board of Trustees, governing body of the 3-A Symbol Council, are: to promote the public health; to minimize confusion and conflict in the field of standards relating to the sanitary performance of food equipment, and, to encourage the use of food equipment of sanitary design by administering and supervising the proper use of the "3-A Symbol," emblematic of compliance with standards of sanitary design developed and promulgated as 3-A Sanitary Standards.

Other officers of the 3-A Symbol Council are Dr. Warren S. Clark, Jr., Chairman and Mr. Earl O. Wright, Secretary-Treasurer.

Major Gaps in Research on Antibiotic Resistance Need Filling; WHO Meeting on Quinolone Use in Food Animals and Potential Impact on Human Health

Fluoroquinolones are important members of the quinolone group of antibiotics licensed to treat diseases in humans and animals. However, their use in livestock animals can contribute to increased resistance in foodborne bacteria (such as *Campylobacter* and *Salmonella*) which may infect humans. Fluoroquinolones are important for the treatment of invasive *Salmonella* and *Campylobacter* infections in humans and an increase in the resistance in these bacteria is therefore of concern. "To date, there has been little documented impact on human health of fluoroquinolone use in livestock, but there is concern over the potential human health consequences if resistance were to increase and spread. Further research and data gathering are thus essential," said Dr. David Heymann, Director of the World Health Organization's (WHO) Division of Emerging and other Communicable Diseases Surveillance and Control (EMC). Consequently, WHO convened a meeting on the medical impact of quinolone use in food animals at WHO headquarters in Geneva from 2 to 5 June. The meeting, in which over 60 experts from both the human and animal health fields participated, agreed that that major emphases of future research should include: determining the full extent of quinolone usage outside human medicine; improving epidemiological evidence on how resistance in both animals and humans develops, persists and spreads between animal species and humans; developing surveillance techniques specifically designed to capture the above data; determining the mechanisms and levels of resistance in important zoonotic pathogens to quinolones and how important these resistance levels are in terms of human health risk; developing strategies for prudent use in animals to maximize therapeutic benefit while minimizing development of resistance; developing alternatives, such as Following the introduction of fluoroquinolones in several countries, *Salmonella* with reduced susceptibility to fluoroquinolones have emerged in food animals; resistant *Campylobacter* have also emerged. Although no human cases have been documented, the experts expressed concern that there could be treatment failures in humans infected with *Salmonella* with reduced susceptibility. The experts also noted that, with the use of fluoroquinolones in humans, human pathogens have begun to develop resistant strains and there are now several circumstances in which resistance has limited the therapeutic use of this class of antibiotic for important diseases such as for gonorrhoea and typhoid. While fluoroquinolones are not used as growth promoters, they are currently used for treatment of animal disease in many countries of the world and, in some regions, they are also used for disease prevention in animals.

However, the data available so far on their usage are scarce and are often the proprietary information of the drugs' manufacturers. Consequently, correlations between quinolone usage and the emergence of resistance are hard to make. WHO and the meeting's participants welcomed the initiative by COMISA (World Federation of the Animal Health Industry) at the 2-5 June meeting that provided sales and volume data for the major fluoroquinolones in more than 30 countries.

The experts, from 18 countries, requested that WHO, in conjunction with the Food and Agriculture Organization of the United Nations (FAO) and the International Office of Epizootics (OIE), work together to gather data, standardize testing methods and develop a code of practice for the prudent use of antimicrobials in food animals. WHO should also, the participants agreed, ensure that public health safeguards are given prominence in such a code of practice.

Nine Northeast Dairy Producers Charged with Milk Adulteration, Conspiracy

A federal grand jury in Burlington, VT, returned a 28-count indictment April 30 against nine Northeast dairy producers and three truck drivers who were charged with violating federal laws relating to conspiracy, food adulteration, stolen property, using false documents and witness tampering and retaliation.

At their arraignment in early May, all 12 pled not guilty. No trial date had been set at press time.

According to the indictment, the defendant dairy producers shipped their milk to Fairdale Farms, a fluid milk processing plant in Bennington, VT. Between 1993 and August 1996, the indictment alleges, the producers, acting in collusion with the truck drivers, conspired to defraud Fairdale

Farms by falsely inflating the amount of milk they produced and shipped.

Some farmers allegedly added a salt-water mix to their milk to throw off the cryoscope test, which measures the milk's freezing point. They then kicked back a portion of their milk check to the drivers. Other producers simply paid the drivers to falsely increase pounds of milk shipped to the plant without adding water to the milk. USDA officials estimate that illegally added water to milk costs the dairy industry $1 billion a year.

Dairy producers named in the indictment are: Thomas Curtis and Marc Vadnais, Argyle, NY; Guy Clark III, Cambridge, NY; Edward Hart Jr., Hudson Falls, NY; Kenneth Thomas III, Middle Granville, NY; Briar Barbur, Greenwich, NY; Richard Hulett, West Pawlet, VT; Keith Bruso, Buskirk, NY: Milt Tyler, Fort Ann, NY. The three indicted truck drivers are Terry Abrahamson, Okeechobee, FL; Dennis Bates, Greenwich, NY; and Reggie Matte, Hoosick Falls, NY.

In February, Curtis was arrested and indicted on charges that he threatened a witness who was cooperating with the grand jury investigation. The April indictment restated those witness-tampering and retaliation charges, to which Curtis already pleaded not guilty.

Fairdale Farms' receiving plant employees first detected irregularities with milk shipments and began exhaustive testing to pinpoint problems. At one point, the company ran chloride tests and found elevated chloride levels in the milk. The chloride content was up due allegedly to the added salt.

When plain water is added to milk, the adulterated milk will freeze at a higher temperature. The cryoscope test detects this. Adding salt to water makes a solution that mirrors the specific gravity of milk. When added to milk, it doesn't raise milk's freezing point. Milk freezes at 31°F; water, 32°F. Most receiving plants check for added water on every tanker; individual bulk tanks may be checked once or twice a month.

After noticing abnormalities, Fairdale notified state regulatory authorities, traced back the questionable milk to allegedly offending producers and independent drivers, and cut them off from supplying milk, says Gary Warren, Fairdale's general manager.

The federal government became involved in the investigation in 1996 and followed it through to the indictment process. Investigations into this case and others across the U.S. continue.

Defendants in the Northeast face up to 10 years in prison and federal fines up to $250,000. Civil penalties could also be sought by Fairdale Farms.

Reprinted from: Dairy Today, June/July 1998

AHI Action Plan to Address Concerns Surrounding Antibiotic Use in Food Animals

The Animal Health Institute, a U.S. trade association representing manufacturers of animal health products, has announced an action plan to address the complex issue of antibiotic use in animals.

AHI's approach is based on working in concert with government agencies, the Food and Drug Administration and United States Department of Agriculture, who have oversight for the regulation of animal health care products and monitor resistance. AHI's plan to reduce the potential for resistance in humans and assure the availability of animal antibiotics combines several elements, including: an independent assessment to examine benefits and relative risk to people of treating animals with antibiotics; development of guidelines for the prudent use of antibiotics in farm animals; and support for improved surveillance and monitoring of how animal antibiotics are used.

Mathews stated that the approach demonstrates that the animal health industry shares the concern of public health officials that the inappropriate use of antibiotics whether on the farm, in hospitals or by physicians can contribute to the increase of antibiotic resistant bacteria.

The kit can be obtained at: www.ahi.org/info/general/antibiotics. htm; or send a fax request to 703.684.0125 to receive a mailed copy.

U.S. Poultry & Egg Association Back, Food Safety Campaign

The U.S. Poultry & Egg Association will extend its financial support for the Partnership for Food Safety Education's public awareness campaign through 1998. Fight BAC!™ is a multi-pronged effort to teach people of all ages how they can reduce the spread of foodborne illness. The two-year-old campaign is funded by the contributions of U.S. Poultry and eight other industry trade associations. Technical assistance and in-kind support is provided by government agencies and consumer organizations.

"The safety of food is a matter of concern for consumers and food producers alike," said U.S. Poultry & Egg Association President Don Dalton. "We are proud to participate in this grassroots effort to educate consumers about the steps they can take to minimize their risk of foodborne illness."

The Partnership for Food Safety Education was formed in response to a 1996 independent panel report that called for a public-private partnership to educate the public about safe food handling and preparation.

The multi-year campaign utilizes public service announcements, point-of-purchase materials, and school and community outreach efforts to bring Americans face-to-face with the problem of foodborne illness and to motivate them to take action. Additional information is also available via the Partnership's Web site: www.fightbac.org.

The group accomplishes its mission by mobilizing a national network of public health, nutrition, food science, education, and special constituency groups to support the campaign and extend its reach.

U.S. Poultry is the largest and most active organization of its kind in the world. As part of its overall mission, U.S. Poultry provides training and consultation programs that help ensure that the nation's poultry and egg supply is safe and wholesome. The association sponsors microbial testing programs for food safety, monitors federal food regulatory programs, conducts Hazard Analysis and Critical Control Points systems training, and represents the industry in food safety issues.

IAFIS Offers Online Food Industry Information Center

The International Association of Food Industry Suppliers (IAFIS) has announced the launch of the online version of its Food Industry Information Center (FIIC), it can be found at: www.iafis.org/fiic. The Food Industry Information Center is the only free on-line source to specialize in current food manufacturing standards, legislation, trade, commerce, safety, and other issues key to the global food industry.

FIIC On-line Center emphasizes electronic information resources rather than books. The collection of approximately fifty reference volumes and CD-ROM products is non-circulating, and continuously updated. The Center has access to 1200 Commercial Databases providing efficient and timely access to information. FIIC Online is available 24-hours-a-day, seven-days-a-week, and can be accessed directly through www.iafis.org, or at the URL www.iafis.org/fiic.

Joe Hall to Relinquish 3-A Symbol Council Administrative Officer Position

Mr. Joe W. Hall, Jr. submitted his request to the 3-A Symbol Council to relinquish his position as its Chief Administrative Officer. The request was submitted to the Council at its June meeting. Mr. Hall, who has held the position since July 1, 1994, indicated his duties with the Coburg Dairy require commitments that prevent him from continuing Symbol Council activities. He asked that his resignation become effective on December 31, 1998, but indicated his willingness to extend beyond that date, if necessary, to ensure that a smooth transitition of the office can be made.

Persons interested in serving as Chief Administrative Officer of the 3-A Symbol Council should contact either Dr. Warren S. Clark, Jr., Chairman of the Symbol Council Board of Trustees at Phone: 312.782.4888; Fax: 312.782.5299; or Mr. Earl O. Wright, Secretary-Treasurer of the Council at 501.855.9408.

U.S. Filter Acquires Gardiner Equipment Co., Inc.

U.S. Filter/Stranco has announced that it has acquired Houston-based Gardiner Equipment Co., Inc. maker of the Water Champ® chemical induction system.

"This merger gives us resources for growth that were unavailable to us as a single product company," said Jack Gardiner, founder and inventor of the Water Champ.

"While we have strong representation in municipal markets, U.S. Filter/Stranco brings us additional industrial distribution. We both have highly customer-focused company cultures. This is a good fit for our customers and our reps."

While Gardiner will remain in Texas in a new role as Vice President of Stranco, U.S. Filter is relocating Water Champ's product experts to Bradley, IL.

Researchers Use Sentinels to Detect Infectious Disease of Young Turkeys

Recently completed research funded by the U.S. Poultry & Egg Association dealt with the use of sentinels to detect infectious disease of young turkeys. The project is part of the association's extensive industry research program encompassing all segments of broiler, turkey, and commercial egg operations.

A brief overview of the completed project is shown below. A complete report is available from the researchers or from U.S. Poultry, 770.493.9401.

Project No. 174; Drs. H. John Barnes[A] and James S. Guy[B], Department of Food Animal and Equine Medicine, Department of Microbiology, Pathology and Parasitology, College of Veterinary Medicine, North Carolina State University, Raleigh, NC 27606.

Sentinels as a Research Tool for Spiking Mortality of Turkeys

Spiking mortality of turkeys (SMT) is a newly recognized infectious transmissible disease that causes

high mortality, severe stunting, and increased susceptibility to other diseases because of damage to the immune system in young turkeys. The cause of SMT is unknown and there is no specific way to diagnose the disease except to reproduce it in susceptible poults. In this study, young turkeys (sentinels) were placed into 55 flocks to determine if they were infected with the SMT agent. Studies were done on the sentinels to better understand the disease and identify its cause.

The objectives of this study were to: (1) experimentally reproduce SMT through use of sentinels exposed to clinically affected flocks, (2) examine samples from poults prior to exposure and at intervals after exposure for possible causative agents, (3) determine if clinically normal or recovered flocks could be potential sources of the microorganisms that can cause SMT, (4) determine if microorganisms that cause SMT can survive cleaning and disinfection procedures, and (5) determine if any relationships exist between agents causing SMT and those causing other enteric (intestinal) diseases of turkeys. In addition, an evaluation of the sentinel method was done.

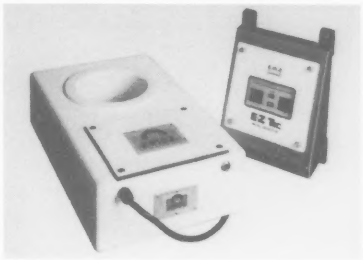
SMT was readily reproduced in the sentinels after placement into affected flocks. The suspected existence of a milder form of SMT (Excess Mortality ofTurkeys [EMT]) was confirmed, which led to the disease being renamed Poult Enteritis Mortality Syndrome (PEMS). From the results of the sentinel studies, SMT, EMT, and PEMS were defined based on clinical mortality patterns. Having at least a clinical definition made it possible to identify positive, negative, and suspect farms. Sentinels discriminated among different types of enteric diseases. Those placed into flocks that had milder forms of intestinal diseases (often referred to as "poult enteritis complex") did not develop SMT, although they did experience severe stunting.These findings indicate SMT is a specific disease and not a severe form of poult enteritis complex. Stunting, whether the result of SMT or poult enteritis complex, was virtually universal as it developed in 54 of 55 sentinel groups. No evidence was found to indicate vertical transmission or the existence of an extended carrier state in recovered flocks. No indication of a potential food safety problem was found. The SMT agent appears to be highly susceptible to environmental conditions and does not survive long outside of the turkey. These findings are most consistent with a reservoir for the agent and a vector to introduce it into the flocks. The cause of SMT was not discovered, however, several potential agents were excluded. Based on these studies, turkey coronavirus was not found to be the cause of SMT. Information on the occurrence, nature, and cause of SMT gained in these studies has practical application in the development of effective prevention and control programs.

Thompson to Manage CVM Antimicrobial Resistance Efforts

Dr. Sharon R. Thompson, a Veterinary Medical Officer in FDA's Center for Veterinary Medicine (CVM), has been appointed to the newly created position of Associate Director for Veterinary Medical and International Affairs. In this capacity, Dr. Thompson will be responsible for managing and coordinating national and international activities on antimicrobial resistance related to drug therapy in food animals. She will lead CVM's efforts to develop an overall strategy to define scientifically-based standards for the regulation of antimicrobial products. She will also lead the Center's initiative to promote the prudent use of antimicrobials in food animals. Dr. Thompson will continue to provide direction to the Center's international activities. Dr. Thompson currently serves as FDA's representative to the Veterinary International Cooperation on Harmonization (VICH) Steering Committee.

Since 1992, Dr. Thompson has been a Special Assistant to the Center Director, concentrating in the area of international affairs. In her new role, she will work with experts, both within and outside the Agency, to address issues involving antimicrobial products for animals. She will serve as FDA's spokesperson and authoritative source of information and advice on matters related to this issue. Dr. Thompson will also serve as the official liaison to other government agencies and foreign and domestic organizations working in this area.

CVM is concerned that the use of antimicrobial drugs in food animals will create antimicrobial drug resistance that could contribute to drug-resistant human pathogens. However, CVM believes that there is legitimate need for older as well as newer antimicrobial drugs in animal agriculture. CVM views developing criteria or standards for regulating these products to address the emerging concerns about antimicrobial resistance as the Center's top priority. CVM expects that these efforts will help create a stable regulatory environment for these products.



Eriez Magnetics

New Metal Detector for Vertical Form, Fill, & Seal Equipment Detects Ferrous Contaminants Before Packaging

The new E-Z Tec® VFS Metal Detector from Eriez, detects minute pieces of ferrous contamination in gravity fed material flow ensuring product purity before material is bagged and sealed. Ideal for snack foods that are packaged in foil or plastic, and other granular or powdered material that is gravity fed.

The low profile design of the VFS allows it to fit between the checkweigher and the vertical form, fill, and seal machine detecting contamination just prior to packaging. When contamination is detected, a timing device marks the contaminated bag so it can be removed from the batch. Just the contaminated package is discarded, not the entire batch, thus reducing waste.

The VFS is available in either analog or microprocessor-based electronics. The Eriez' E-Z Tec® MPC (Micro Processor Control) has a digital screen with alpha-numeric displays of all preset functions or reject occurrences as they take place, and also records the date and time of any changes to the preset settings. Standard size apertures for 4-, 6- and 8 inch (102, 152, and 203mm) pipe are available.

Eriez Magnetics, Erie, PA

Reader Service No. 312

New Improved Simplate™ Device

The SimPlate™ family of tests from IDEXX have been improved, making them even easier to perform. The SimPlate™ device's patented plate design has been modified to include a super-absorbent sponge which soaks up excess liquid, eliminating the previously required "pour-off" step.

The SimPlate™ product family is a group of easy-to-perform, easy-to-read tests for coliforms and *E. coli*, yeast and mold, and total plate count. These tests eliminate media preparation and other time-consuming steps involved with current pour plate methods, cutting time to results in half. SimPlate™ assays are performed by placing a sample and preprepared media onto a Simplate™ device and incubating for 24 or 48 hours, depending on the media being used. After incubation, results are read by counting the number of positive wells and referring to the MPN chart to determine total counts. Tedious counting is not required.

IDEXX Food Safety Net Services, Inc., Westbrook, ME

Reader Service No. 313

A Cleaning Validation System Accessible to the Food Industry

BioControl Systems Inc., developer and manufacturer of rapid food safety diagnostic tests recently launched an innovative new product. AssureSwab™ visual swab test is a self-contained, rapid cleaning validation kit for all types of food processing and production environments.

Traditionally, hygiene monitoring has been conducted through total plate count methods which yield results in 24 or more hours. More recently Adenosine Triphosphate Bioluminescence (ATP)-based systems provided the only rapid testing available for cleaning validation, but the significant investment required in equipment and trained personnel have placed ATP systems out of reach for many food businesses.

AssureSwab has eliminated the need for expensive equipment, thereby making rapid cleaning validation available to the entire food industry. The AssureSwab kit contains everything needed to conduct cleaning validation. Test results are easy to read as the test is based on a color change, and can therefore be used by a wide range of personnel without extensive training.

AssureSwab uses a proprietary technology that detects invisible protein residues on surfaces that have come into contact with food products. Protein should not be present if the cleaning procedure is effective, as protein is a nutrient source for harmful bacteria. The AssureSwab kit is highly sensitive and can detect micrograms of protein that are invisible to the eye.

BioControl Systems, Inc., Bellevue, WA

Reader Service No. 314

Rapid Results with Culture Confirmation

Dynabead® anti-Salmonella is designed for rapid, immunomagnetic selective enrichment (IMS) of *Salmonella* directly from pre-enrichment broths. The rapid and simple protocol (less than 30 minutes) saves 24 hours of valuable testing time compared to standard culture methods because Dynabeads® anti-Salmonella simply replaces the use of selenite or tetrathionate selective enrichment broths. Isolated *Salmonella* colonies (or negative results) are achieved in 48 hours from receipt of sample.

Dynabeads® anti-Salmonella are uniform, superparamagnetic microspheres (2.8 microns in diameter) with affinity purified antibodies on their surface. When incubated with a sample, Dynabeads® will bind their target bacterium forming a bacterium: magnetic bead complex. This complex is separated from the heterogeneous sample by performing the test in a magnetic test tube rack (Dynal MPC®-M). The isolated and concentrated bacterium: bead complex can then be cultured on any selective culture medium.

This highly sensitive system will detect as few as 100 organisms/ml of pre-enriched sample. Complete detection is achieved: over 200 serotypes (1400 strains) of *Salmonella* have been tested. The concentration and purification of the sample by immunomagnetic separation (IMS) improves bacterial isolation and thus is useful for cultural confirmation of other presumptive methods. The protocol is simple and reagents are shelf stable. The versatility provided by this methodology will allow testing of many different sample types while enhancing the efficiency of existing manual and automated detection methods.

Dynal, Lake Success, NY

Reader Service No. 315

IR Measures Surface Temperature Fast, Without Contact

Cooper Instrument Corporation is introducing a new infrared thermometer for monitoring temperatures in the food processing and foodservice industries. The IR thermometer allows the operator to simply point, shoot, and read to efficiently monitor food processing and holding areas, refrigeration and freezer equipment, and to verify safe food temperatures. This handheld gun style thermometer features a FDA Class II laser (also available without laser) allowing the operator to get a visual confirmation of where the gun is aimed. These are easy-to-use thermometers that read surface temperatures without contact, which means no cross contamination or damage to food products.

The IR thermometer by Cooper is a simple and durable design to provide accurate readings, even after a 3-foot drop onto concrete. With a temperature range of -250° to 750°F (-320° to 400°C), ambient temperature range of 32° to 120°F (0° to 50°C), accuracy at 77°F (25°C) or above is, ±1 % of reading or ±2°F whichever is greater and 8:1 optics, the infrared can be used in a variety of applications.

Temperature readings are displayed in tenths on the backlit LCD screen up to 200°F, any higher then 200°F the readings are measured in whole numbers.

Powered by only a 9-volt Alkaline or Nicad battery the IR has a battery life of 50 hours when the backlight and laser are turned off, and 16 hours when the backlight is used 50% and the laser is used 50% of the time. With a compact design that measures 5.4" × 1.6" × 7.7" and weight of only 9.5 ounces this unit can be handled all day without the operator feeling fatigued and it can be stored just about anywhere in conditions with a temperature range of -13°F to 158°F (without the battery). Cooper's model 410 thermometer comes standard with a hard black case, a clip which allows you to clip it to your belt, and a battery. Another option is model 400, a more economical unit without the laser or case set. All IR thermometers can be calibrated and certified to NIST standards, if required.

Cooper Instrument Corporation, Middlefield, CT

Reader Service No. 316

Insul-Stor® for Liquids

H & R Industries proudly introduces an innovative all-plastic, insulated transport and storage container for temperature sensitive liquids. Urethane insula-

tion in a double wall design protects product quality, maintains temperatures, and allows product transfer in conventional trailers or storage in standard warehouses. Front sloping, cone-bottom design with fitted bag liner and attached dispensing valve facilitates complete discharge of even semi-viscous liquids. Tapered sides permit empty containers to nest, which lowers return freight costs and reduces storage space requirements. Stacking cover with corner tie-down straps seal container for sanitary road transfer or warehouse storage. Site ports indicate liquid level. INSUL-STOR® FOR LIQUIDS is the convenient and economical returnable packaging alternative for drums or bulk deliveries of both food or nonhazardous chemicals.

H & R Industries, Inc., Beecher, IL

Reader Service No. 317

Copesan Services Releases Pest Management Training Videos for Food Processing

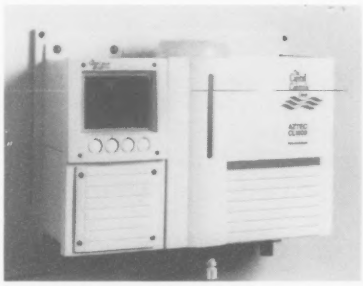
Copesan Services is raising the educational training level for all food industry employees by providing interactive video training modules. Copesan's Signature Care™ training videos feature visual demonstrations and real-life examples in a user-friendly, modular series.

The two Signature Care™ training modules currently available feature Integrated Pest Management (IPM) and Key Pests of the Food Industry. The IPM module details the twelve interdependent components of the IPM puzzle. The Key Pest module, through outstanding cinematography, covers the basic identification, biology, habits and control options of rodents, insects and birds.

Each interactive video module is conveniently packaged in a three-ring binder and contains a 28 minute VHS videotape, tips for effective training, an outline for trainee note taking, a copy of the audio script for reference, a post-test for assessing participants' comprehension and a list of suggested reference materials.

Copesan Services, Inc. Brookfield, WI

Reader Service No. 318



Capital Controls Company, Inc.

Capital Controls Introduces New Residual Analyzer

Capital Controls Company, Inc. introduces a new residual analyzer. Advanced microprocessor-based electronics and a 3-electrode measuring cell arrangement make the AZTEC® CL1000 Residual Analyzer the best instrument on the market for continuous, accurate, precise measurement of chlorine residual levels in drinking water, wastewater, cooling water, poultry processing and other process water applications.

The unique 3-electrode measuring cell arrangement provides the analyzer with the capability of measuring in the parts per billion (ppb) residual range, as well as high residual ranges to 60 mg/l. Residual indication is provided on a 3" × 4" display in either a one inch digital format or, in a graphical format with up to 28 days of data at a glance. On-screen instructions, self-diagnostics, six adjustable relays, and dual 4-20 mAdc output signals are standard.

The flow to the analyzer is monitored by an infrared flow detection system. A pH electrode is used to control reagent addition with a solenoid valve in order to optimize reagent consumption while maintaining the best PH for precise residual measurement. Sample temperature variations are compensated with a 100 ohm RTD.

The AZTEC® Series CL1000 Residual Analyzers are constructed of corrosion-resistant materials and are modular in design for serviceability. Universal power recognition is incorporated into the unit.

Capital Controls Company, Inc., Colmar, PA

Reader Service No. 319

Read the Temperatures of Up to Four Areas or Three Products at Once

New radio-transmission technology saves wiring costs and fits any budget. A central-panel thermometer with up to three remotely-located thermometers can transmit temperature readings up to 100' without wires. Signal transmission is on license-free 433 MHz which has been thoroughly tested and penetrates most walls and radio interference.

The central panel has an internal sensor and displays local air temperature, while each of the three remote thermometers take local air temperature, or when used with an optional probe, take internal temperatures. Local air temperature is continuously displayed on the central panel and a simple channel change displays remote thermometer readings on the second half of the central panel.

Min/max temperatures are displayed and the central panel has hi/lo audible and visual alarms

when readings are over or under pre-set points. The unit measures from -58.0° to 158.0°F in 0.1° increments and is F/C switchable. The central panel and each remote thermometer is economically priced at $30.00 each. Probes are extra.

All Quality Assurance Products, Inc., Gainesville, FL

Reader Service No. 320

Power and High Filtration Makes the Nilfisk GB 1133 Ideal for Cleanroom Central Cleaning Systems

The Nilfisk GB 1133 vacuum cleaner is ideal for use in central vacuum cleaning systems because it supplies an airflow of 757 cfm and 145 inches of waterlift, which is the strongest suction power available in a Nilfisk vacuum cleaner. The vacuum cleaner may service multiple cleanrooms in the same facility via a series of strategically placed drops with inlets. These inlets enable the operator to bring nothing more than a hose and nozzle into the cleanroom environment. In addition, a totally enclosed, fan-cooled, 3-phase induction motor with regenerative blower allows for continuous operation.

The first stage of the GB 1133 vacuum cleaner's filtration system is an 18-gallon container that captures the bulk of collected debris. A separator system can be added for increased collection capacity. The second stage includes seventy-two GORE-TEX® main filter tubes. These tubes combine to ensure that a steady, even airflow moves through the vacuum cleaner which extends filter life and eliminates premature clogging. Shaking the external filter agitator handle keeps the main filter tubes free of dust and prevents the operator from exposure to the dust. The standard manometer measures pressure differentials within the vacuum and alerts the operator when to shake the filter. The final stage of filtration features four HEPA (High Efficiency Particulate Air) filters that retain 99.97% of all particles down to and including 0.3 microns in size.

The GB 1133 vacuum cleaner's 100mm orifice can accommodate a single hose up to 100mm, a double hose up to 70mm or a triple hose up to 50mm. A multi-hose attachment maintains the same level of powerful suction achieved by a single hose, while increasing productivity.

Nilfisk-Advance America, Inc., Malvern, PA

Reader Service No. 321

BusinessExchange

Services/Products

BusinessExchange

Services/Products

ADVERTISING INDEX

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Holders of 3-A Symbol Council Authorization as of August 1998

Questions or statements concerning any of the holders' authorizations listed below, model numbers or the equipment fabricated should be addressed to: Administrative Officer, 3-A Symbol Council, 3020 Bluff Rd., Columbia, SC 29209; Phone 803.783.9258; Fax 803.783.9265

01-07 Storage Tanks for Milk and Milk Products

2 APV Americas-Lake Mills (5/1/56)
100 South CP Avenue
Lake Mills, Wisconsin 53551

117 DCI, Inc. (10/28/59)
P.O. Box 1227, 600 No. 54th Avenue
St. Cloud, Minnesota 56301

127 Paul Mueller Co. (6/29/60)
P.O. Box 828
Springfield, Missouri 65801

440 Scherping Systems (2/28/85)
801 Kingsley Street
Winsted, Minnesota 55395

31 Walker Stainless Equipment Co., Inc. (10/4/56)
902 - 2nd Main Street
Elroy, Wisconsin 53929-0126

02-09 Pumps for Milk and Milk Products

63R APV Americas-Lake Mills (4/29/57)
100 South CP Avenue
Lake Mills, Wisconsin 53551

946 APV Fluid Handling-America (11/25/97)
100 South CP Avenue
Lake Mills, Wisconsin 53551-1799
(Mfg. by: APV Fluid Handling
Howard Pumps Ltd.
Eastbourne, East Sussex
U.K.)

636 Abel Pumps Corporation (7/10/91)
79 North Industrial Park
511 North Avenue
Sewickley, Pennsylvania 15143-2339
(Mfg: Abel Pumps
Buchen, Germany)

568 Allweiler AG, Werk Bottrop (5/15/89)
Kirchhellener Ring 77-79
D-46244 Bottrop
Germany
(U.S. Rep.: Shanley Pump and Equipment, Inc.
2525 South Clearbrook Drive
Arlington Heights, IL 60005)

793 Ampco Pumps Co. (9/14/94)
4000 W. Burnham Street
Milwaukee, Wisconsin 53215

212R Babson Brothers Company (2/20/70)
Dairy Systems Division
20903 West Gale Avenue
Galesville, Wisconsin 54630-0659

923 Bombas Bornemann S.R.L. (5/16/97)
Armenia 2898 (1605)
Munro, Argentina
(U.S. Rep.: Bornemann Pumps, Inc.
P.O. Box 1769
Matthews, North Carolina 28105)

205R Boumatic (5/22/69)
1919 S. Stoughton Road
P.O. Box 8050
Madison, Wisconsin 53716

739 CSF Inox S.P.A. (6/25/93)
Strada per Bibbiano
7 - Montecchio E. (RE)
Italy
(U.S. Rep.: Sanchelima Intl.
1781-83 N.W. 93rd Avenue
Miami, Florida 33172)

709 Conexiones Inoxidables (1/18/93)
de Puebla S.A. de C.V.
Vicente Guerrero No. 211
Xicotepec de Juarez
Edo, Puebla, Mexico
(U.S. Rep.: Ben Dolphin Consulting
4735 Lansing Drive
North Olmsted, Ohio 44070)

820 Drum Industries, Inc. (3/17/95)
2501 Constant Comment Place
Louisville, Kentucky 40299
(Mfg. by: Alfa Laval Pumps, LTD
Easbourne East Sussex
England BN 23 6PQ)

671 Flowtech Inc., - Teknoflow, Inc. (4/1/92)
1701 Spinks Drive
Marietta, Georgia 30067

466 Fluid Metering, Inc. (1/10/86)
5 Aerial Way, Suite 500
Syosset, New York 11791

828 Flux Pumps Corp. (4/13/95)
4430 Commerce Circle
Atlanta, Georgia 30336
(Mfg. by: Flux Geraete GmbH
Talweg 12
D75433 Maulbronn
Germany)

306 Fristam Pumps, Inc. (5/2/78)
2410 Parview Road
Middleton, Wisconsin 53562

65R Alfa Laval/G & H Products Corp. (5/22/57)
P.O. Box 909
Pleasant Prairie, WI 53158-0909

325 Johnson Pumps (U.K.) Ltd. (12/19/79)
Highfield Industrial Estate
Edison Road, Eastbourne
East Sussex, England BN23 6PT
(U.S. Rep.: Viking Pump, Inc.
406 State Street, P.O. Box 8
Cedar Falls, Iowa 50613)

145R ITT Jabsco Products (11/20/63)
1485 Dale Way
Costa Mesa, California 92626
(Mfg. by: ITT Jabsco, England)

502 Inoxpa, s.a. (4/28/87)
Carrer Dels Telers, 54
17820 Banyoles
Spain
(U.S. Rep.: Jensen Fittings Corp.
107-111 Goundry Street
North Tonawanda, NY 14120)

314 Len E. Ivarson, Inc. (12/22/78)
3100 W. Green Tree Road
Milwaukee, Wisconsin 53209

603 Johnson Pumps (U.K.) Ltd. (8/16/90)
Highfield Industrial Estate
Edison Road, Eastbourne
East Sussex, England BN23 6PT
(U.S. Rep.: Viking Pump, Inc.
406 State Street, P.O. Box 8
Cedar Falls, Iowa 50613)

604 Johnson Pumps (U.K.), Ltd. (8/16/90)
Highfield Industrial Estate
Edison Road, Eastbourne
East Sussex, England BN23 6PT
(U.S. Rep.: Viking Pump, Inc.
406 State Street, P.O. Box 8
Cedar Falls, Iowa 50613)

841 Johnson Pumps (U.K.), Ltd. (8/18/95)
Highfield Industrial Estate
Edison Road, Eastbourne
East Sussex, England BN23 6PT
(U.S. Rep.: Viking Pump, Inc.
406 State Street, P.O. Box 8
Cedar Falls, Iowa 50613)

673 Alfa Laval Pumps, Inc. (4/16/92)
9201 Wilmot Road
Kenosha, Wisconsin 53141-1426

654 Mono Pumps Ltd., Dresser Pump Div. (10/22/91)
Martin Street
Audenshaw, Manchester
England M34 5DQ
(U.S. Rep.: MonoFlo, Dresser Pump Division
Dresser Industries
821 Live Oak Drive
Chesapeake, Virginia 23320-2601)

400 Netzsch Incorporated (8/15/84)
119 Pickering Way
Exton, Pennsylvania 19341-1393

827 PACKO Diksmuide NV (4/14/95)
Cardijnlaan 10
B8600 Diksmuide, Belgium
(Not available in the U.S.A.)

701 Pierre Guerin SA (10/27/92)
BP. 12 - 79210
Mauze-Sur-Le-Mignon
France
(U.S. Rep.: Alfa Technical Group, Inc.
601 Thompson Road N.
Syracuse, New York)

241 Puriti, S.A. de C.V. (9/12/72)
Alfredo Nobel 39
Industrial Puente de Vigas
Tlalnepantla, Mexico
(U.S. Rep.: Waukesha Cherry-Burrell
611 Sugar Creek Road
Delavan, WI 53115)

148R Moyno Industrial Products (4/22/64)
A Division of Robbins & Myers, Inc.
P.O. Box 960
Springfield, Ohio 45501-0960

910 O.M.A.C. SRL Pompe (1/2/95)
Via G. Falcone 8, I-42948
Rubiera (RE) Italy
(U.S. Rep.: Sanchelima International, Inc.
1781-83 N.W. 93rd Avenue
Miami, Florida 33172)

684 PCM Pompes (7/9/92)
17, rue Ernest Laval
92170 Vanves
France
(U.S. Rep.: Alfa Laval Pump, Inc.
9201 Wilmot Road, P.O. Box 1426
Kenosha, WI 53141-1426)

934 Platdot Ein Harold (8/6/97)
Kibbutz Ein Harod Meuhad
18965
Israel
(U.S. Rep.: Norix-International L.T.D.
35 Monhegan Street
Clifton, New Jersey 07013)

888 Seeberger GmbH + Co. (8/30/96)
Scharnholzstrasse 344
D-46240
Bottop, Germany
(U.S. Rep.: seepex, Inc.
511 Speedway Drive
Enon, Ohio 45323)

595 seepex, Inc. (3/16/91)
511 Speedway Drive
Enon, Ohio 45323
(Mfg. by: Seeberger GmbH + Co.
Scharnholzstrasse 344
D-46240 Bottrop
Germany)

678 Shanley Pump & Equipment, Inc. (5/11/92)
2525 S. Clearbrook Drive
Arlington Heights, Illinois 60005
(Mfg. by: Phillip Hilge GmbH, Germany)

911 Sigma Equipment Corp. (3/20/97)
39 Westmoreland Avenue
White Plains, New York 10606

507 Sine Pump (7/21/87)
c/o Sundstrand Fluid Handling
14845 West 64th Street
Arvada, Colorado, 80004

567 Stainless Products, Inc. (4/4/89)
1649-72nd Avenue
P.O. Box 169
Somers, Wisconsin 53171

860 Sudmo North America, Inc. (11/28/95)
4786 Colt Road
Rockford, Illinois 61109
(Mfg. by: Sudmo Schleicher AG
Industiestr. 7
D-73469, Reisburg
Germany)

72R L.C. Thomsen Inc. (8/14/57)
1303-43rd Street
Kenosha, Wisconsin 53140

26R Tri-Clover, Inc. (9/29/56)
9201 Wilmot Road
Kenosha, Wisconsin 53141

609 Tuthill Corp. (12/12/90)
Tuthill Pump Division
12500 S. Pulaski Road
Alsip, Illinois 60658

899 Und Maschinenfabrik (12/31/96)
Lederle GmbH Pumpen
GewerbestraBe 53 D-79194
Gundelfingen, Germany
(U.S. Rep.: Alto Systems Inc.
P.O. Box 60667
Houston, Texas 77205)

52R Viking Pump, Inc. (12/31/56)
A Unit of IDEXX Corporation
406 State Street, P.O. Box 8
Cedar Falls, Iowa 50613
(Mfg. by: Johnson Pump
Highfield Ind. Estate, Edison Road
Eastbourne, E. Sussex
UK BN 23 6PT)

29R Waukesha Cherry-Burrell (10/3/56)
611 Sugar Creek Road
Delavan, Wisconsin 53115

04-04 Homogenizers and Reciprocating Pumps

75 APV Homogenizer Group (9/26/57)
500 Research Drive
Wilmington, Massachusetts 01887

390 American Lewa, Inc. (6/9/83)
132 Hopping Brook Road
Holliston, Massachusetts 01760
(Mfg. by: Lewa, Germany)

247 Bran & Luebbe, Inc. (4/14/73)
1025 Busch Parkway
Buffalo Grove, Illinois 60015

657 Microfluidics International, Corp. (11/4/91)
P.O. Box 9101
30 Ossipee Road
Newton, Massachusetts 02164-9101

558 Niro Soavi S.p.A. (1/3/89)
43100 Parma (Italy)
VIA M. Da Erba Edoari, 29/A
(Distributed in the U.S. by:
Niro Hudson, Inc.
1600 Country Road F
Hudson, Wisconsin 54016)

770 Tetra Pak Inc. (6/13/94)
8400 Lakeview Parkway, Ste. 500
Pleasant Prairie, Wisconsin 53158
(Mfg. by: Tetra Pak-Stainless Equipment AB
Lund, Sweden)

87 Waukesha Cherry-Burrell (12/29/57)
(Fluid Handling Division)
611 Sugar Creek Road
Delavan, Wisconsin 53115

05-14 Stainless Steel Automotive Milk Transportation Tanks for Bulk Delivery and/or Farm Pick-up Service

379 Brenner Tank Mauston, Inc. (3/15/83)
N. 3760 Hwy. 12 & 16
Mauston, Wisconsin 53948

756 Beall Trailers of California (2/21/94)
1301 South Avenue
Turlock, California 95380-5108

70R Brenner Tank, Inc. (8/5/57)
450 Arlington Avenue, P.O. Box 670
Fond du Lac, Wisconsin 54936

40 Hills Stainless Steel & Equipment Co., Inc. (10/20/56)
505 W. Koehn Street
Luverne, Minnesota 56156

513 Nova Fabricating, Inc. (8/24/87)
404 City Road
P.O. Box 231
Avon, Minnesota 56310

85 Polar Tank Trailer, Inc. (12/20/57)
Holdingford, Minnesota 56340

653 Tremcar (10/10/91)
1, Tougas Street
Iberville, Quebec, Canada J2X 2P7
(U.S. Rep.: Bay State Tr. & Tr.
527 Winthrop
Rehobeth, Massachusetts 02769)

25 Walker Stainless Equip. Co., Inc. (9/28/56)
625 State Street
New Lisbon, Wisconsin 53950

623 Walker Stainless Eq. Co., Inc. (3/28/91)
560 E. Burleigh Boulevard
P.O. Box 358
Tavares, Florida 32778

437 West-Mark (11/30/84)
2704 Railroad Avenue, P.O. Box 100
Ceres, California 95307

10-03 Milk and Milk Products Filters Using Disposable Filter Media

593 Filtration Systems (3/2/90)
Div. of Mechanical Mfg. Corp.
10304 N.W. 50th Street
Sunrise, Florida 33351

435 Sermia International (11/27/84)
771 Boul. Industriel
Blainville, Quebec
Canada J7C 3V3
(U.S. Rep.: Edward W. Fox, Jr.
1200 Rolling Ridge Way, #403
Bloomington, Indiana 47403)

296 L. C. Thomsen, Inc. (8/25/77)
1303 43rd Street
Kenosha, Wisconsin 53140

35 Tri-Clover, Inc. (10/15/56)
9201 Wilmot Road
Kenosha, Wisconsin 53141

11-05 Plate-type Heat Exchangers for Milk and Milk Products

880 AGC Engineering (6/7/96)
8869 SE 58th St. Avenue
Portland, Oregon 97206

365 APV Heat Exchanger AS (9/8/82)
Platinvej, 8
P.O. Box 329
DK-6000 Kolding
Denmark
(Not available in the U.S.A.)

20 APV Heat Transfer Technologies (9/4/56)
395 Fillmore Avenue
Tonawonda, New York 14150

120 Alfa-Laval, Agri, Inc. (12/3/59)
11100 No. Congress Avenue
Kansas City, Missouri 64153

17 Tetra Pak Engineering (8/30/56)
8400 Lake View Parkway
Pleasant Prairie, Wisconsin 53158
(Mfg. by: Alfa Laval Thermal
Lund, Sweden)

718 Babson Bros. Co. (3/8/93)
Dairy Systems Div.
1400 West Gale Avenue
Galesville, Wisconsin 54630

30 Waukesha Cherry-Burrell (10/2/56)
Process Equipment Division
P.O. Box 35600
Louisville, Kentucky 40232-5600

14 Chester-Jensen Co., Inc. (8/15/52)
5th & Tilghman Sts., P.O. Box 908
Chester, Pennsylvania 19016

791 The Coburn Co., Inc. (9/14/94)
834 E. Milwaukee Street, Box 147
Whitewater, Wisconsin 53190
(Mfg. by: Elmega S./L.
Apartado De Cerros, 1
Camino Vrejo De Mourelle, S/N
15840 [Santa Comba] La Coruna
Spain)

468 GEA Ecoflex North America, Inc. (2/2/86)
7150 Distribution Drive
Louisville, Kentucky 40258-2528
(Mfg. by: GEA Ahlborn GmbH Co.
P.O. Box 1180
Voss-Strasse 11/13
D-3203 Sarsted
Germany)

622 ITT Standard (2/25/91)
175 Standard Parkway
Cheektowaga, New York 14227

360 Laffranchi Wholesale Co. (7/12/82)
P.O. Box 338
Ferndale, California 95536

414 Paul Mueller Co. (12/13/83)
P.O. Box 828
Springfield, Missouri 65801

912 Pladot Ein Harod (4/3/97)
Kibbutz Ein Harod Meuhad
18965 Israel
(Mfg. by: A.P.V. Company, Ltd.
P.O. Box 4
Crawley-West Sussex RH 102QB
England)
(U.S. Rep.: Norix-International L.T.D.
35 Monhegan Street
Clifton, New Jersey 07013)

279 The Schlueter Company (8/30/76)
3410 Bell Street, P.O. Box 548
Janesville, Wisconsin 53547-0548
(Mfg. by: Samuel Parker, New Zealand)

650 API Schmidt-Bretten, Inc. (10/3/91)
380 E. Central Avenue
Bohemia, New York 11716

670 Flomax International, Ltd. (4/1/92)
2 Robert Street
P.O. Box 14537
Panmurie, Auckland
New Zealand
(U.S. Rep.: Masport, Inc.
6140 McCormick Drive
Lincoln, Nebraska 68507)

658 Thermaline (11/15/91)
180-37th Street
Auburn, Washington 98001

885 Tranter, Inc. Texas Division (7/11/96)
1900 Old Burk Highway
Wichita Falls, Texas 76304

610 Universal Dairy Equipment (12/13/90)
11100 N. Congress Avenue
Kansas City, Missouri 64153
(Mfg. by: Alfa Laval Agri, Inc.
Kansas City, Missouri 64153-1296)

12-05 Tubular Heat Exchangers for Milk and Milk Products

886 API Ketema Heat Transfer Technology (7/16/96)
2300 W. Marshall Drive
Grand Prairie, Texas 75051

438 APV Heat Transfer Tech. (12/10/84)
395 Fillmore Avenue
Tonawanda, New York 14150

248 Allegheny Bradford Corp. (4/16/73)
P.O. Box 200, Route 219 South
Bradford, Pennsylvania 16701

243 Babson Brothers Company (10/31/72)
Dairy Systems Division
20903 West Gale Avenue
Galesville, Wisconsin 54630-0659

605 Waukesha Cherry-Burrell (8/30/90)
Process Equipment Division
P.O. Box 35600
Louisville, Kentucky 40232-5600

103 Chester-Jensen Co., Inc. (6/6/58)
5th & Tilghman Sts., P.O. Box 908
Chester, Pennsylvania 19016

824 DASI Industries, Inc. (3/17/95)
214 Sherlake Lane
Knoxville, Tennessee 37922
(Mfg. by: Sacome Incapsa
30001 Murcia Spain)

712 Enerquip, Inc. (2/24/93)
611 North Road
P.O. Box 467
Medford, Wisconsin 54451

889 FMC Corporation-FranRica Systems (9/5/96)
P.O. Box 30127
Stockton, California 95213-0127

298 Feldmeier Equipment, Inc. (1/28/85)
6800 Town Line Road
P.O. Box 474
Syracuse, New York 13211

217 Girton Manufacturing Co. (1/31/71)
P.O. Box 900
Millville, Pennsylvania 17846

616 ITT Standard (1/4/91)
175 Standard Parkway
Cheektowaga, New York 14227

711 Kusel Equipment Co. (2/24/93)
820 West Street
Watertown, Wisconsin 53094

238 Paul Mueller Co. (6/28/72)
P.O. Box 828
Springfield, Missouri 65801

96 C. E. Rogers Co. (3/31/64)
1895 Frontage Road, P.O. Box 118
Mora, Minnesota 55051

532 Scherping Systems (6/8/88)
801 Kingsley Street
Winsted, Minnesota 55395

614 Tetra Pak Processing Systems (5/2/91)
P.O. Box 179
8400 Lake View Parkway, Suite 500
Pleasant Prairie, Wisconsin 53158
(Mfg. by: Tetra Pak Stainless Equipment AB
P.O. Box 64
Bruggaregatan 23, S-221 00
Lund, Sweden)

951 Thermaline, Inc. (1/30/98)
180 - 37th Street N.W.
Auburn, Washington 98001

632 Yula Corporation (6/4/91)
330 Bryant Avenue
Bronx, New York 10474

13-09 Farm Milk Cooling and Holding Tanks

802 Refinox S.A. DE C.V. (11/10/94)
Ind. Torreon, Coah, Mexico
(U.S. Rep.: James Read
M. E. Stainless
601 High Plain Drive
Bel Air, Maryland 21014)

49R Alfa Laval Agri, Inc. (12/5/56)
11100 North Congress Avenue
Kansas City, Missouri 64153

240 Babson Brothers Company (9/6/72)
Dairy Systems Division
P.O. Box 659
Galesville, Wisconsin 54630
(Mfg. by: Paul Mueller Co.
1600 West Phelps Street
Springfield, Missouri 65801)

4R Dairy Equipment Co. (6/15/56)
1919 S. Stoughton Road
Madison, Wisconsin 53708-8050

12R Paul Mueller Co. (7/31/56)
1600 W. Phelps, P.O. Box 828
Springfield, Missouri 65801

611 Universal Dairy Equipment (12/13/90)
11100 N. Congress Avenue
Kansas City, Missouri 64153
(Mfg. by: Alfa Laval Agri Inc.
Kansas City, Missouri 64153-1296)

16-05 Evaporators and Vacuum Pans for Milk and Milk Products

132 APV Anhydro (10/26/60)
182 Wales Avenue
Tonawanda, New York 14150

277 Contherm, Inc. (8/19/76)
P.O. Box 352, 111 Parker Street
Newburyport, Massachusetts 01950

500 Dedert Corporation (4/9/87)
20000 Governors Drive
Olympia Fields, Illinois 60461

186R Marriott Walker Corp. (9/6/66)
925 E. Maple Road
Birmingham, Michigan 48011

273 Niro, Inc. (5/20/76)
Evaporator Division
9165 Rumsey Road
Columbia, Maryland 21045

639 Niro-Sterner, Inc. (7/10/91)
421-6th Street South
Winsted, Minnesota 55395

107R C.E. Rogers Co. (7/31/58)
P.O. Box 118
1895 Frontage Road
Mora, Minnesota 55051

17-09 Formers, Fillers and Sealers of Single Service Containers for Fluid Milk and Fluid Milk Products

939 BWI KP Aerofill (10/16/97)
807 West Kimberly Road
Davenport, Iowa 52808-3848

382 SIG Combibloc, Inc. (4/15/83)
4800 Roberts Road
Columbus, Ohio 43228
(Mfg. by: PKL Verpackungsystems, Germany)

192 Evergreen Packaging (1/3/67)
2400-6th Street S.W., P.O. Box 3000
Cedar Rapids, Iowa 52406

488 BWI Fords Holmatic, Inc. (12/22/86)
1750 Corporate Drive, Suite 700
Norcross, Georgia 30093

619 Hassia Verpackungsmaschinen GmbH (2/22/91)
Heerweg 19
D-63691 Ranstadt
Germany
(U.S. Rep.: Hassia USA, Inc.
1210 Campus Drive West
Morganville, New Jersey 07751)

473 International Paper Company (6/12/86)
Liquid Pkg. Division
6238 Tri Ridge Boulevard
Loveland, Ohio 45140

735 Kvalitetsproduktion AB (6/11/93)
S-693 29 Degerfors, Sweden
(U.S. Rep.: Flowtech, Inc.
1900 Lake Park Drive, Suite 345
Smyrna, Georgia 30080)

330 Milliken Packaging (8/26/80)
P.O. Box 736
White Stone, South Carolina 29353
(Mfg. by: Chubukkikai, Japan)

442 Milliken Packaging (3/21/85)
P.O. Box 736
White Stone, South Carolina 29386

137 Elopak, Inc. (10/17/62)
30000 South Hill Road
New Hudson, Michigan 48165

941 Oden Corporation (10/28/97)
255 Great Arrow Avenue
Buffalo, New York 14207-3024

281 Purity Packaging Corp. (11/8/77)
800 Kaderly Road
Columbus, Ohio 43228
(Mfg. by: Purity Packaging Corp.
25 Aylmer Street
Peterborough, Ontario, Canada K9J 6Y8)

967 RAPAK (6/18/98)
20939 Cabot Boulevard
Hayward, California 94545

924 Robert Bosch GmbH (6/4/97)
P.O. Box 1127
D-71301
Waiblingen, Germany
(U.S. Rep.: Robert Bosch Corporation
9890 Red Arrow Highway
Bridgman, Michigan 49106)

482 Serac, Inc. (8/25/86)
300 Westgate Drive
Carol Stream, Illinois 60188

681 Shikoku Kakoki Co., Ltd. (6/8/92)
No. 10-01 Nishinokawa
Tarohachisu, Kitajima-Cho
Itanogun, Tokushima, Japan
(U.S. Rep.: Elopak, Inc.
30000 South Hill Road
New Hudson, Michigan 48165)

220 Tetra Rex Packaging Systems (4/24/71)
451 East Industrial Boulevard
Minneapolis, Minnesota 55413

351 Tetra Pak, Inc. (1/6/83)
1287 Barclay Blvd.
Buffalo Grove, IL 60089
(Mfg. by: A.B. Tetra
Italy)

694 IPFO International, Inc. (9/23/92)
100 Kings Point Drive
Century Towers, Suite 706
Miami, Florida 33160
(Mfg. by: Time Pack
GmbH, Weissensburg, Germany)

19-04 A1 Batch and Continuous Freezers for Ice Cream, Ices, and Similarly Frozen Dairy Foods, as Amended

141 Waukesha Cherry-Burrell (4/15/63)
P.O. Box 35600
Louisville, Kentucky 40232-5600

146 Waukesha Cherry-Burrell Corp. (12/10/63)
P.O. Box 35600
Louisville, Kentucky 40232-5600

286 Tetra Laval Food Hoyer, Inc. (12/8/76)
7711 95th Street, P.O. Box 0902
Pleasant Prairie, Wisconsin 53158-0902
(Mfg. by: Tetra Pak Hoyer APS
Denmark)

355 Emery Thompson Machine & Supply Co. (3/9/82)
1349 Inwood Avenue
Bronx, New York 10452

22-07 Silo-type Storage Tanks for Milk and Milk Products

154 APV Americas-Lake Mills (2/10/65)
100 South CP Avenue
Lake Mills, Wisconsin 53551

168 Waukesha Cherry-Burrell (6/16/65)
575 E. Mill Street
Little Falls, New York 13365

160 DCI, Inc. (4/5/65)
P.O. Box 1227, 600 No. 54th Avenue
St. Cloud, Minnesota 56301

312 Feldmeier Equipment, Inc. (9/15/78)
6800 Town Line Road
P.O. Box 474
Syracuse, New York 13211

439 JV Northwest, Inc. (1/22/85)
390 S. Redwood Street
Canby, Oregon 97013

155 Paul Mueller Co. (2/10/65)
1600 W. Phelps, P.O. Box 828
Springfield, Missouri 65801

503 Ripley Stainless, Ltd. (5/1/87)
RR #3, Suite 41
Summerland, British Columbia V0H 1Z0
(Not available in the U.S.A.)

479 Scherping Systems (8/3/86)
801 Kingsley Street
Winsted, Minnesota 55395

675 Stainless Fabrication, Inc. (4/22/92)
4455 W. Kearney
Springfield, Missouri 65803

920 Technova, Inc. (4/24/97)
1450 Hebert Street
Drummondville, Quebec
Canada J2C 2A1
(U.S. Rep.: Bay State Truck & Trailer
527 Wintrop
Rehobeth, Massachusetts 02769)

165 Walker Stainless Equipment Co., Inc. (4/26/65)
625 State Street
New Lisbon, Wisconsin 53950

23-02 Equipment for Packaging Viscous Dairy Products

174 APV Crepaco (9/28/65)
A Division of APV North America, Inc.
100 South CP Avenue
Lake Mills, Wisconsin 53551-1799

902 A.T.S. Engineering, Inc. (1/10/97)
7270 Torbram Road, Unit 23
Mississauga, Ontario
Canada L4T 3Y7
(U.S. Rep.: L and A Package Sales
356 Millstone Road
Clarksburg, New Jersey 08510
and Packaging Specialist
4500 Greenville Avenue
Dallas, Texas 75206)

366 AUTOPPROD, Inc. (9/15/83)
5355 - 115th Avenue N
Clearwater, Florida 33760

965 BENHIL-GASTI Verpack (5/27/98)
ungsmaschinen GmbH
JagenbergstraBe 1
D-41468 Neuss
Germany
(U.S. Rep.: Autoprod, Inc.
5355 - 155th Avenue N
Clearwater, Florida 34620)

868 Cryovac Division (3/5/97)
W.R. Grace & Co-Conn
P.O. Box 464
Duncan, South Carolina 29223-0464

853 Elmar Industries (10/11/95)
200 Gould Avenue, P.O. Box 245
Buffalo, New York 14043-0245

674 Hayssen Manufacturing (4/20/92)
225 Spartangreen Boulevard
Duncan, South Carolina 29334

447 GEI International, Inc. (7/22/85)
700 Pennsylvania Drive
Exton, Pennsylvania 19341-0439

942 Oden Corporation (10/28/97)
255 Great Arrow Avenue
Buffalo, New York 14207-3024

870 Phoenix Engineering & Design Co. (3/22/96)
4634 Case Drive, P.O. Box 1467
Janesville, Wisconsin 53546

343 Tetra Pak Hoyer, Inc. (7/6/81)
7711 - 95th Street
Pleasant Prairie, Wisconsin 53158
(Mfg. by: Alfa Hoyer, Denmark)

679 Consolidated Biscuit Co. (6/1/92)
312 Rader Road
McComb, Ohio 45858

635 Interbake Dairy Ingredients Div. (7/10/91)
2821 Emerywood Parkway, Suite 210
Richmond, Virginia 23294

760 Jordan Manufacturing, Inc. (2/23/94)
1688 County Road 192
Crossville, Alabama 35962

537 Osgood Industries, Inc. (7/19/88)
601 Burbank Road
Oldszmar, Florida 34677

666 RapidPak (3/5/92)
2530 West Everett Street
Appleton, Wisconsin 54914-4958

740 Raque Food Systems, Inc. (6/25/93)
11002 Decimal Drive
Louisville, Kentucky 40299

222 Sweetheart Packaging (11/15/71)
10100 Reistertown Road
Owing Mills, Maryland 21117

891 World Cup Packaging Corporation (9/20/96)
777 Progressive Lane
South Beloit, Illinois 61080

24-02 Non-coil Type Batch Pasteurizers

158 APV Americas-Lake Mills (3/24/65)
100 South CP Avenue
Lake Mills, Wisconsin 53551-1799

161 Waukesha Cherry-Burrell (4/5/65)
575 E. Mill Street
Little Falls, New York 13365

187 DCI, Inc. (9/26/66)
P.O. Box 1227, 600 No. 54th Avenue
St. Cloud, Minnesota 56302

166 Paul Mueller Co. (4/26/65)
P.O. Box 828
Springfield, Missouri 65801

878 Walker Stainless Equipment (5/14/96)
625 State Street
New Lisbon, Wisconsin 53950

25-02 Non-coil Type Batch Processors for Milk and Milk Products

159 APV Americas-Lake Mills (3/24/65)
100 South CP Avenue
Lake Mills, Wisconsin 53551-1799

162 Waukesha Cherry-Burrell (4/5/65)
575 E. Mill Street
Little Falls, New York 13365

188 DCI, Inc. (9/26/66)
P.O. Box 1227, 600 No. 54th Avenue
St. Cloud, Minnesota 56301

725 Inox-Tech, Inc. (4/14/93)
6705 Route 132
Ville Ste-Catherine
Quebec, Canada J0L 1E0
(U.S. Rep.: Michael Ripka, Pres.
Bionex
12615 E. Meridian Avenue
Payallup, Washington 98373)

710 Lee Industries, Inc. (2/10/93)
P.O. Box 687
514 West Pine Street
Phillipsburg, Pennsylvania 16866

167 Paul Mueller Co. (4/26/65)
P.O. Box 828
Springfield, Missouri 65801

687 SANIFAB (8/3/92)
528 North Street
Stratford, Wisconsin 54484

448 Scherping Systems (8/1/85)
801 Kingsley Street
Winsted, Minnesota 55395

520 Stainless Fabrication, Inc. (12/8/87)
4455 W. Kearney
Springfield, Missouri 65803

837 Viatec Process Incorporated (7/10/95)
500 Reed Street
Belding Michigan 48809

202 Walker Stainless Equip. Co., Inc. (9/24/68)
625 State Street, P.O. Box 202
New Lisbon, Wisconsin 53950-0202

26-03 Sifters for Dry Milk and Dry Milk Products

752 Andritz Sprout-Bauer (1/28/94)
35 Sherman Street
Muncy, Pennsylvania 17756

363 Kason Corp. (7/28/82)
67-71 East Willow Street
Millburn, New Jersey 07041

430 Midwestern Industries, Inc. (10/11/84)
915 Oberlin Road, P.O. Box 810
Massillon, Ohio 44648-0810

185 Rotex, Inc. (8/10/66)
1230 Knowlton Street
Cincinnati, Ohio 45223

656 Separator Engineering, Ltd. (11/4/91)
810 Ellingham Street
Pointe Clair, Quebec, Canada H9R 3S4
(U.S. Rep.: Kason Corp.
1301 E. Linden Avenue
Linden, New Jersey 07036)

172 Sweco, Inc. (9/1/65)
(Division of Emerson Electric Company)
7120 Buffington Road
Florence, Kentucky 41042

27-03 Equipment for Packaging Dry Milk and Dry Milk Products

353 All-Fill, Inc. (3/2/82)
418 Creamery Way
Exton, Pennsylvania 19341

935 Bossar S.A. (8/8/97)
Poligono Industrial Roca
C/. San Marti s/n.
08100 Martorelles
(Barcelona)
Spain
(U.S. Rep.: Hayssen Manufacturing Co.
225 Spartangreen Blvd.
Duncan, South Carolina 29334)

831 Custom Equipment Design (5/9/95)
1057 Highway 80 East, P.O. Box 4807
Monroe, Louisiana 71203

618 Hayssen Manufacturing Company (2/18/91)
225 Spartangreen Boulevard
Duncan, South Carolina 29334
(Mfg. by: Yamato Scale Co.
Akasi, 673, Japan)

625 Ishida Company, Ltd. (4/2/91)
44, Sanno-Cho, Shogoin
Sakyo-Ku, Kyoto, Japan
(U.S. Rep.: Heat & Control
21121 Cabot Blvd.
Hayward, California 94545-1132)

922 Ishida Co., Ltd. (5/9/97)
44 Sanno-Cho, Shogoin
Sakyo-Ku
Kyoto, Japan
(U.S. Rep.: Heat & Control, Inc.
21121 Cabot Boulevard
Hayward, California 94545-1132)

409 GEI Mateer-Burt Co. (10/31/83)
434 Devon Park Drive
Wayne, Pennsylvania 19087

905 Pacmac, Inc. (2/13/97)
1161 Armstrong Avenue
P.O. Box 360
Fayetteville, Arkansas 72702-0360

895 Spiroflow-Orthos Systems, Inc. (11/27/96)
2806 Gray Fox Road
Monroe, North Carolina 28110

497 Triangle Package Machinery Co. (2/26/87)
6655 West Diversey Avenue
Chicago, Illinois 60635

28-03 Flow Meters for Milk and Milk Products

270 ABB Instrumentation, Inc. (2/9/76)
P.O. Box 20550
Rochester, New York 14602-0550

272 Accurate Metering Systems, Inc. (4/2/76)
1651 Wilkening Court
Schaumburg, Illinois 60173

253 Badger Meter, Inc. (1/2/74)
4545 W. Brown Deer Road
P.O. Box 23099
Milwaukee, Wisconsin 53223

884 Bailey-Fischer & Porter GmbH (7/12/96)
Dransfeld Strasse, Gottingen 37079
Germany
(U.S. Rep.: Bailey-Fischer & Porter
125 E. County Line Road
Warminster, Pennsylvania 18974)

956 Blancett Fluid Flow Meters (3/19/98)
100 E. Felix Street South, Suite 190
Fort Worth, Texas 76115-3548

359 Brooks Instrument Division (6/11/82)
407 West Vine Street
Hatfield, Pennsylvania 19440
(Mfg. by: Fisher-Rosemount Technologies de Flujo S.A. de C.V.
Avenida Miguel de Cervantes 111
Complejo Industrial Chikuahua
Chihuahua, Chihuahua
31109 Mexico)

660 Danfoss A/S (11/20/91)
DK-6430
Nordborg, Denmark
(U.S. Rep.: Danfoss Electronics
2995 Eastrock Drive
Rockford, Illinois 61109)

950 Delta M Corp. (1/19/98)
1003 Larsen Drive
Oak Ridge, Tennessee 37830

692 Endress & Hauser Flowtec AG (9/14/92)
Kägenstrasse 7
CH - 4153 Reinach, Switzerland
(U.S. Rep.: Endress & Hauser, Inc.
2350 Endress Place
Greenwood, Indiana 46143)

226 Bailey Fischer & Porter Co. (12/9/71)
125 E. County Line Road
Warminster, Pennsylvania 18974

477 Flowdata, Inc. (7/31/86)
1817 Firman Drive
Richardson, Texas 75081-1826

506 FTI (6/17/87)
4250 East Broadway Road
Phoenix, Arizona 85040

224 The Foxboro Company (11/16/71)
33 Commercial Street
Foxboro, Massachusetts 02035

717 Gemu Valves, Inc. (3/4/93)
3800 Camp Creek Parkway
Ste. 102, Bldg. 2400
Atlanta, Georgia 30331

649 Geo Technology Corporation (10/2/91)
12312 E. 60th Street
Tulsa, Oklahoma 74146

661 G/H Products Corp. (11/21/91)
P.O. Box 909
Pleasant Prairie, Wisconsin 53158-0909

630 Halliburton Services (5/28/91)
Drawer 1431
Duncan, Oklahoma 73536-0346

574 Hersey Measurement Co., Inc. (10/12/89)
150 Venture Boulevard
P.O. Box 4585
Spartanburg, South Carolina 29305

512 Hoffer Flow Controls, Inc. (8/17/87)
107 Kitty Hawk Lane
Elizabeth City, North Carolina 27909

744 Honeywell IAC (11/16/93)
1100 Virgina Drive
Fort Washington, Pennsylvania 19034
(Mfg. by: Endress & Hauser Flowtec AG
Kagenstrasse 7
CH-4153 Reinach
Switzerland)

733 Honeywell, Inc. (5/18/93)
16404 Black Canyon Highway
Phoenix, Arizona 85023-3095
(Mfg. by: Endress & Hauser Flowtec AG
CH-4153 Reinach
Switzerland)

265 Flow Automation (3/10/75)
9303 Sam Houston Parkway South
Houston, Texas 77099-5298

535 FMC Invalco, Inc. (7/12/88)
(An FMC Corporation Subsidiary)
P.O. Box 1183
Hutchinson, Kansas 67504

764 Yokogawa Industrial Automation America Inc. (4/22/94)
4 Dart Road
Newnan, Georgia 30265-1040
(Mfg. by: Yokogawa Electric Corp.
2-9-32 Nakacho
Musashino-shi, Tokyo, 180 Japan)

840 KOBOLD Instr. Inc. (7/17/95)
1801 Parkway View Drive
Pittsburgh, Pennsylvania 15205
(Mfg. by: KOBOLD Messring GmbH
Frankfort HRB 29376
Germany)

871 KOBOLD Instr. Inc. (3/28/96)
1801 Parkway View Drive
Pittsburgh, Pennsylvania 15205
(Mfg. by: Flowdata, Inc.
1817 Firman Drive
Richardson, Texas 75081-1826)

529 KROHNE, Inc. (5/18/88)
7 Dearborn Road
Peabody, Massachusetts 01960
(Mfg. by: Altometer, Holland)

755 Liquid Controls LLC (2/21/94)
105 Albrecht Drive
Lake Bluff, Illinois 60044
(Mfg. by: Processautomatic
Box 117
61070 Vagnharad, Sweden)

778 Magnetrol Intl., Inc. (7/27/94)
5300 Belmont Road
Downers Grove, Illinois 60515

378 Micro Motion, Inc. (2/16/83)
7070 Winchester Circle
Boulder, Colorado 80301

932 Nitto Seiko Co., Ltd. (7/31/97)
623 Japan, 30
Nobu-Cho
Ayabe Kyoto
(Mfg. by: Endress & Hauser Flowtec AG
CH-4153 Reinach
Kagenstrasse 7
Switzerland)
(U.S. Rep.: Endress & Hauser Flowtec AG
Division USA
2350 Endress Place
P.O. Box 246-1
Greenwood, Indiana 46142)

938 norax, L.L.C. (10/16/97)
8809 Industrial Drive
Franksville, Illinois 53126

729 Peek Measurement, Ltd. (4/14/93)
Kings Worthy, Winchester
Hampshire, England S023 7QA
(U.S. Rep.: Peek Measurement
10335 Landsbury, Ste. 300
Houston, Texas 77099-3407)

490 Rosemount, Inc. (1/8/87)
12001 Technology Drive
Eden Prairie, Minnesota 55344
(Mfg. by: Fisher-Rosemount
Technological de Flujo
S. A. de C. V.
Chihua, Chihuahua
31109 Mexico

585 Solartron (12/7/89)
11321 Richmond Avenue
Houston, Texas 77082-2615
(Mfg. by: Solartron, England)

587 Schlumberger Ind., Measurement Div. (12/18/89)
1310 Emerald Road
Greenwood, South Carolina 29646
(Mfg. by: Schlumberger, France)

550 Sparling Instruments Co., Inc. (10/26/88)
4097 N. Temple City Boulevard
P.O. Box 5988
El Monte, California 91731

715 Thermal Instrument Co. (2/25/93)
217 Sterner Mill Road
Trevose, Pennsylvania 19053

803 Turck, Inc. (11/18/94)
3000 Campus Drive
Plymouth, Minnesota 55441-2656

(Mfg. by: EGE - Eletronik
Ravensberg 34
D-24214 Gehorf
Germany)

29-01 Air Eliminators for Milk and Fluid Milk Products

340 Accurate Metering Systems, Inc. (6/2/81)
1651 Wilkening Court
Schaumburg, Illinois 60173

662 G/H Products Corp. (11/21/91)
P.O. Box 909
Pleasant Prairie, Wisconsin 53158-0909

436 Scherping Systems (11/27/84)
801 Kingsley Street
Winsted, Minnesota 55395

30-01 Farm Milk Storage Tanks

421 Paul Mueller Co. (4/17/84)
P.O. Box 828
Springfield, Missouri 65801

31-02 Scraped Surface Heat Exchangers

290 APV Americas-Lake Mills (6/15/77)
100 South CP Avenue
Lake Mills, Wisconsin 53551

323 Waukesha Cherry-Burrell (7/26/79)
Process Equipment Division
P.O. Box 35600
Louisville, Kentucky 40232-5600

274 Contherm, Inc. (6/25/76)
111 Parker Street
Newburyport, Massachusetts 01950

496 FMC Corp.
Fran Rica Systems (2/23/87)
P.O. Box 30127
Stockton, California 95213-0127

361 N.V. Terlet (7/12/82)
P.O. Box 62
7200 AB Zutphen
Netherlands
(U.S. Agent Manning & Lewis-NJ)

964 Schroder GmbH & Co. KG (5/27/98)
Falkenstr. 51-57
D-23564, Lubeck
Germany
(U.S. Rep.: Schroder N.A. Corp.
12780 Westlinks Drive
Fort Myers, Florida 33913)

32-02 Uninsulated Tanks for Milk and Milk Products

397 APV Americas-Lake Mills (6/21/83)
100 South CP Avenue
Lake Mills, Wisconsin 53551

268 DCI, Inc. (11/21/75)
600 No. 54th Avenue, P.O. Box 1227
St. Cloud, Minnesota 56301

708 Lee Industries, Inc. (1/12/93)
P.O. Box 688
Phillipsburg, Pennsylvania 16866

844 Paul Mueller Co. (8/24/95)
1600 West Phelps Street
Springfield, Missouri 65801

354 C.E. Rogers Co. (3/3/82)
1895 Frontage Road, P.O. Box 118
Mora, Minnesota 55051

683 SANIFAB (7/9/92)
A Division of A&B Process Systems Corp.
P.O. Box 86
Stratford, Wisconsin 54484

441 Scherping Systems (3/1/85)
801 Kingsley Street
Winsted, Minnesota 55395

852 Viatec, Inc. (10/18/95)
500 Reed Street
Belding, Michigan 48809

339 Walker Stainless Equip. Co., Inc. (6/2/81)
625 State Street
New Lisbon, Wisconsin 53950

33-01 Polished Metal Tubing for Dairy Products

310 Allegheny Bradford Corp. (7/19/78)
P.O. Box 200 Route 219 South
Bradford, Pennsylvania 16701

812 A.T.I. s.r.l. (1/26/95)
Viale Resegone 7
22036 Erba (Como)
Italy
(U.S. Rep.: Norca Corporation
185 Great Neck Road
Great Neck, New York 11022)

413 Azco, Inc. (12/8/83)
P.O. Box 567
Appleton, Wisconsin 54912

736 Kvalitetsproduktion AB (6/11/93)
S-693 29 Degerfors, Sweden
(U.S. Rep.: Flowtech, Inc.
1900 Lake Park Drive, Ste. 345
Smyrna, Georgia 30080)

308 Rath Manufacturing Co., Inc. (6/20/78)
2505 Foster Avenue
Janesville, Wisconsin 53545

368 Rodger Industries Inc. (10/7/82)
P.O. Box 186, R.R. 1
Blenheim, Ontario
Canada N0P 1A0
(Not available in the U.S.A.)

776 TGPRO (7/18/94)
Bangkok, Thailand
(U.S. Rep.: Kurt Orban Partners
Kurt Orban
450 Kings Road
Brisbane, California 94005)

775 Trent Tube (7/18/94)
P.O. Box 77
East Troy, Wisconsin 53120

289 Tri-Clover, Inc. (1/21/77)
9201 Wilmot Road
Kenosha, Wisconsin 53141

331 United Industries, Inc. (10/23/80)
1546 Henry Avenue
Beloit, Wisconsin 53511

34-02 Portable Bins

916 Custom Metalcraft, Inc. (4/17/97)
2332 East Division
P.O. Box 10587 GS
Springfield, Missouri 65808

647 Thomas Conveyor Company (9/18/91)
Tote System Division
P.O. Box 2916
Fort Worth, Texas 76113-2916

35-00 Continuous Blenders

869 ADMIX, Inc. (3/14/96)
234 Abby Road
Manchester, New Hampshire 03103-3332

527 Arde Barinco, Inc. (3/15/88)
500 Walnut Street
Norwood, New Jersey 07648

590 Chemineer, Inc. (1/23/90)
125 Flagship Drive
North Andover, Massachusetts 01845

417 Waukesha Cherry-Burrell (2/7/84)
Process Equipment Division
P.O. Box 35600
Louisville, Kentucky 40232-5600

825 GEI International, Inc. (3/30/95)
700 Pennsylvania Drive
Exton, Pennsylvania 19341
(Mfg. by: Machines Collette N.V.
Keerbaan 70
B-2160 Wommelgem
Belgium)

914 International Mixing Tech. s.a.r.l. (4/9/97)
469 Avenue Louis Herbeaux
F-59240 Dunkerque
France
(U.S. Rep.: I.M.T. USA
6946 Paseo Laredo
San Diego, California 92037)

642 Mondomix Howden B.V. (8/7/91)
Reeweg 13
P.O. Box 98
1394 ZH Nederhorst den Berg
The Netherlands
(U.S. Rep.: Mondomix Howden
1 West Illinois Street, Suite 300
St. Charles, Illinois 60174)

680 Quadro Engineering, Inc. (6/3/92)
613 Colby Drive
Waterloo, Ontario
Canada N2V 1A1
(U.S. Rep.: Quadro, Inc.
55 Bleeker Street
Milburn, New Jersey 07041-1414)

766 Semi-Bulk Systems (4/28/94)
159 Cassens Court
Fenton, Missouri 63026-2543

724 Silverson Machines, Inc. (4/14/93)
P.O. Box 589
355 Chestnut Street
East Longmeadow, Massachusetts 01028
(Mfg. by: Silverson Machines
Chesham, England)

36-00 Colloid Mills

808 Boston Shearpump, Inc. (12/16/94)
170 Linden Street
Wellesley, Massachusetts 02181-7919

846 IKA Works, Inc. (9/7/95)
2635 North Chase Parkway, S.E.
Wilmington, North Carolina 28405-7499

915 IKA Works, Inc. (4/17/97)
2635 North Chase Parkway, S.E.
Wilmington, North Carolina 28405-7499

608 Kinematica, Inc. (10/17/90)
19 Normandy Road
Newton, Massachusetts 02166
(Mfg. by: Kinematica AG
CH-6014 Littau/Lucerne, Switzerland)

293 Waukesha Cherry-Burrell (8/25/77)
611 Sugar Creek Road
Delavan, Wisconsin 53115

38-00 Cottage Cheese Vats

541 Kusel Equipment Company (9/16/88)
820 West Street
Watertown, Wisconsin 53094

385 Stoelting, Inc. (5/5/83)
502 Highway 67
Kiel, Wisconsin 53042-1600

40-01 Bag Collectors for Dry Milk and Dry Milk Products

381 Marriott Walker Corp. (4/12/83)
925 E. Maple Road
Birmingham, Michigan 48809

456 C. E. Rogers Company (9/25/85)
P.O. Box 118
Mora, Minnesota 55051

41-01 Mechanical Conveyors

631 Flexicon Corporation (5/28/91)
1375 Stryker's Road
Phillipsburg, New Jersey 08865

894 Spiroflow-Orthos Systems, Inc. (11/5/96)
2806 Gray Fox Road
Monroe, North Carolina 28110

42-01 In-Line Strainers

855 Flowtech Inc. (10/30/95)
1701 Spinks Drive S.E.
Marietta, Georgia 30067-8925

655 Tri-Clover, Inc. (10/23/91)
9201 Wilmot Road
Kenosha, Wisconsin 53141

606 Waukesha Cherry-Burrell (9/18/90)
611 Sugar Creek Road
Delavan, Wisconsin 53115

44-02 Air Driven Diaphragm Pumps

958 American LEWA, Inc. (4/15/98)
132 Hopping Brook Road
Holliston, Massachusetts 01746-1499
(Mfg. by: LEWA-Herbert Ott GmbH & Co.
P.O. Box 1563
Ulmer Strasse 10
D-71229, Leonburg
Germany)

959 American LEWA, Inc. (4/15/98)
132 Hopping Brook Road
Holliston, Massachusetts 01746-1499
(Mfg. by: LEWA-Herbert Ott GmbH & Co.
P.O. Box 1563
Ulmer Strasse 10
D-71229, Leonburg
Germany)

937 Versa-Matic Pump Company (9/18/97)
6017 Enterprise Drive
Export, Pennsylvania 15632-8969

713 Warren Rupp, Inc., A Unit of IDEXX Corp. (2/5/93)
800 North Main Street
P.O. Box 1568
Mansfield, Ohio 44905

833 Wilden Pump & Engr. Co. (6/22/95)
22069 Van Buren Street
Grand Terrace, California 92313-5651

805 Tri-Clover (11/18/94)
9201 Wilmont Road
Kenosha, Wisconsin 53141
(Mfg. by: KWW
Dusseldorf, Germany)

927 Yamada America, Inc. (6/18/97)
1575 High Point Drive
Elgin, Illinois 60123

45-00 Cross Flow Membrane Modules

807 CeraMem Separations (11/30/94)
20 Clematis Avenue
Waltham, Massachusetts 02154

786 North Carolina SRT, Inc. (9/24/94)
221 James Jackson Avenue
Cary, North Carolina 27513
(Mfg. by: Tohshin Seiko Co., Ltd.
42-2 Aza Shinmei Tazawa Ohkuma
Watari-Cho, Watari-Gun
Miyagi 889-23 Japan)

46-01 Refractometers and Optical Sensors

785 Bran & Lubbe, Inc. (9/2/94)
1025 Busch Parkway
Buffalo Grove, Illinois 60089
(Mfg. by: Bran & Lubbe
Norderstdt
GMbH [Germany])

955 Brimrose Corp. of America (3/17/98)
5020 Campbell Boulevard
Baltimore, Maryland 21236-4968

859 The Electron Machine Corp. (11/4/95)
15820 CR 450 West
P.O. Box 2345
Umatilla, Florida 32784

800 Epsilon Industrial Inc. (10/24/94)
2215 Grand Avenue Parkway
Austin, Texas 78728

783 James C. Camp (9/2/94)
dba Advantec Process Systems
95 Wyngate Drive
Newnan, Georgia 30265
(Mfg. by: BTG Inc.
2364 Park Central Boulevard
Decatur, Georgia 30035-3987)

940 K-Patents OY (10/23/97)
P.O. Box 77
Fin-01511
Vantaa, Finland
(U.S. Rep.: K-Patents, Inc.
253 W. Joe Orr Road
Chicago Heights, Illinois 60411)

737 MSC Moisture Systems (6/17/93)
117 South Street
Hopkinton, Massachusetts 01748-2273

697 Liquid Solids Control, Inc. (10/21/92)
P.O. Box 259
Farm Street
Upton, Massachusetts 01568

751 Maselli Misure S.p.A. (1/20/94)
Via Baganza, 4/3
43100 Parma, Italy
(U.S. Rep.: Maselli Measurements, Inc.
P.O. Box 7571
7746 Lorraine Avenue
Stockton, California 95267)

921 optek-Danulat Inc. (4/30/97)
279 South 17th Avenue, Suite 10
West Bend, Wisconsin 53095
(Mfg. by: optek-Danulat, Inc.
HaedenkampstraBe 18
D-45143 Essen
Germany)

767 Foss NIR Systems, Inc. (6/6/94)
12101 Tech Road
Silver Spring, Maryland 20904

750 PT Papertech, Inc. (1/20/94)
#301 - 2609 Westview Drive
North Vancouver
B. C. Canada V7N 4M2
(U.S. Rep.: BD Services Corporation
300 North Commercial Street
Bellingham, Washington 98227)

919 Foss NIR Systems, Inc. (4/24/97)
12101 Tech Road
Silver Spring, Maryland 20904

742 Reflectronics, Inc. (9/15/93)
3009 Montavesta Road
Lexington, Kentucky 40502

47-00 Pumps for Cleaning & Sanitizing Solutions

897 Ampco Pumps Company (12/10/96)
4000 West Burnham Street
Milwaukee, Wisconsin 53215

50-00 Level Sensing Devices

705 Bindicator Company (12/29/92)
1915 Dove Street
Port Huron, Michigan 48060

51-00 (Formerly 08-17R) Plug-Type Valves

787 Cipriani, Inc. (8/27/91)
Tassalini S.P.A.
23195 LaCadena Drive, Suite 103
Laguna Hills, California 92653

772 Alfa Laval/G & H Products Corp. (6/10/57)
P.O. Box 909
Pleasant Prairie, Wisconsin 53158-0909

780 L. C. Thomsen, Inc. (8/31/57)
1303 - 43rd Street
Kenosha, Wisconsin 53140

239 LUMACO (6/3/72)
9-11 East Broadway
Hackensack, New Jersey 07601

788 Puriti, S.A. De C. V. (9/12/72)
Alfredo Nobel No. 39
Fracc. Ind. Pte. de Vigas
Tlalnepantha, Mexico
(U.S. Rep.: Waukesha Cherry-Burrell
611 Sugar Creek Road
Delavan, Wisconsin 53115)

781 Robert James Sales, Inc. (8/31/94)
699 Hertel Avenue, Suite 260
Buffalo, New York 14207

357 Tanaco Products (4/15/82)
3860 Loomis Trail Road
Blaine, Washington 98230

777 Tech Control Ent. (8/2/85)
3725 N. Murray Road
Otis Orchard, Washington 99027
(Mfg. by: Tech Control, Taipei, Taiwan)

790 Tri-Clover, Inc. (10/15/56)
9201 Wilmont Road
Kenosha, Wisconsin 53141-1413

759 VNE Corporation (3/16/78)
1149 Barberry Drive
Janesville, Wisconsin 53545

761 Waukesha Cherry-Burrell (12/17/57)
611 Sugar Creek Road
Delavan, Wisconsin 53115

52-01 (Formerly 08-17H) Thermoplastic Plug Type Valves

907 L"A"UFER International AG (2/25/97)
Finkenweg 2
D-88709
Meersburg, Germany
(U.S. Rep.: M. G. Newell Corporation
115 N. 20th Street
Tampa, Florida 33605)

577 Ralet-Defay (11/2/89)
66, Boulevard Poincare
1070 Brussels, Belgium
(U.S. Agent GENICANAM, Chazy, New York)

53-00 (Formerly 08-17A) Compression Type Valves

484 APV Fluid Handling-America (10/22/86)
100 South CP Avenue
Lake Mills, Wisconsin 53551-1799

952 APV Fluid Handling-America (1/30/98)
100 South CP Avenue
Lake Mills, Wisconsin 53551-1799
(Mfg. by: APV Fluid Handling Horsens A/S
Temevej 61-63
DK-8700 Horsens
Denmark)

730 APV Americas-Lake Mills (4/21/93)
100 South CP Avenue
Lake Mills, Wisconsin 53551-1799

552 APV Fluid Handling-America, Inc. (11/23/57)
100 South CP Avenue
Lake Mills, Wisconsin 53551-1799

245 Babson Brothers Company (2/12/73)
Dairy System Division
P.O. Box 659
20903 West Gale Avenue
Galesville, Wisconsin 54630
(Mfg. by: Superior Stainless, Inc.
611 Sugar Creek Road
Delavan, Wisconsin 53115)

443 Badger Meter, Inc. (4/30/85)
6116 East 15th Street
Tulsa, Oklahoma 74112

686 Bardiani Valvole S.R.L. (8/3/92)
Via G. Vittorio, 30/B
43045 Fornovo (PR) Italy
(U.S. Rep.: Sanchelima Int.
1763 Northwest 93rd Avenue
Miami, Florida 33172)

538 Cipriani, Inc.–Tassalina S.P.A. (7/31/88)
23195 La Cadena Drive, Suite 103
Laguna Hills, California 92653
(Mfg. by: Fratelli Tassalini, Italy)

716 Conexiones Inoxidables (3/4/93)
de Puebla S.A. de C.V.
Vicente Guerrero No. 211
Xicotepec de Juarez
Edo, Puebla Mexico
(U.S. Rep: Ben Dolphin Consulting
4735 Lansing Drive
North Olmsted, Ohio 44070)

376 Defontaine of America, Inc. (1/25/83)
16720 W. Victor Road
New Berlin, Wisconsin 53151
(Mfg. by: Defontaine S.A. - Dept. Definox
3, rue Louis Renault - BP 329
44803 Saint-Herblain Cedex
France)

530 Alfa Laval/G & H Products Corp. (5/31/88)
P.O. Box 909
Pleasant Prairie, Wisconsin 53158-0909
(Mfg. by: Alfa Laval LKM ApS
Albuen 31, Box 802
DK-6000 Kolding, Denmark)

883 Keystone Hygienic Valve Division (7/12/96)
12-14 Kaimiro Street
Pukete Industrial Estate
Hamilton, New Zealand
(U.S. Rep.: Keystone Valve Division
P.O. Box 40010
Houston, Texas)

607 Kammer Valve, Inc. (9/25/90)
510 Parkway View Drive
Pittsburgh, Pennsylvania 15205-1410
(Mfg. by: Kammer Ventile GmbH
Manderscheidtstr. 19
45141 Essen 1, Germany)

570 LUMACO (8/9/89)
9-11 East Broadway
Hackensack, New Jersey 07601

881 MTS Milchtechnik AG (6/14/96)
Saint Galler Strasse 19
CH-9042
Speicher AR
Switzerland
(U.S. Rep.: Mr. James Lucas
Lucas & Associates
642 Alvarado St., #306
San Francisco, California 94114)

483 On-Line Instrumentation, Inc. (10/15/86)
Rt. 376, P.O. Box 541
Hopewell Junction, New York 12533

652 Pierre Guerin SA (10/4/91)
BP.12 - 79210
Mauze-Sur-Le-Mignon
France
(U.S. Rep.: Alfa Technical Group, Inc.
4905 West Brook Hill Drive
Syracuse, New York 13215)

551 Puriti, S.A. de C.V. (9/12/72)
Alfredo Nobel 39
Fracc. Ind. Puente de Vigas
Tlalnepantla, Mexico
(U.S. Rep.: Waukesha Cherry-Burrell
611 Sugar Creek Road
Delavan, Wisconsin 53115)

149R Q-Controls (5/18/64)
Subsidiary of Cesco Magnetics
93 Utility Court
Rohnert Park, California 94928

748 Richards Industries Valve Group (1/11/94)
3170 Wasson Road
Cincinnati, Ohio 45209-2381

762 Stainless Products, Inc. (12/18/80)
1649 - 72nd Avenue
Somers, Wisconsin 53171-0169

806 Steri Technologies, Inc. (11/23/94)
857 Lincoln Avenue
Bohemia, New York 11716
(Mfg. by: Aseptomag AG
Bachweg 3, Postfach 415
CH-3401 Burgdorf
Switzerland)

804 Sudmo North America, Inc. (11/18/94)
4786 Colt Road
Rockford, Illinois 61109
(Mfg. by: Sudmo Schleicher AG
Industriester 7 D-73469
Reisburg, Germany)

823 Sudmo North America, Inc. (3/17/95)
4786 Colt Road
Rockford, Illinois 61109
(Mfg. by: Sudmo Schleicher AG
Industiester 7 D-73469
Riesburg, Germany)

954 Taylor Valve Technology (2/25/98)
8300 S.W. 8th Street
Oklahoma City, Oklahoma 73128

542 L.C. Thomsen, Inc. (8/31/88)
1303-43rd Street
Kenosha, Wisconsin 53140

34A Tri-Clover, Inc. (10/15/56)
9201 Wilmot Road
Kenosha, Wisconsin 53141

467 Tuchenhagen North America, Inc. (1/13/86)
9165 Rumsey Road
Columbia, Maryland 21045
(Mfg. by: Otto Tuchenhagen, West Germany)

561 VACU-PURG, Inc. (1/26/89)
214 West Main Street
P.O. Box 159
Fredericksburg, Iowa 50630

584 Valvinox, Inc.-SGRM Division (11/27/89)
650 1ere Rue.
Iberville-QUE-Canada J2X 3B8
(Not Available in the U.S.A.)

796 VNE Corp. (10/11/94)
1149 Barberry Drive
Janesville, Wisconsin 53547
(Mfg. by: EGMO LTD.
1 Hayotsrim, P.O. 266
Nahariya, Israel)

555 Waukesha Cherry-Burrell (12/11/57)
611 Sugar Creek Road
Delavan, Wisconsin 53115

54-02 (Formerly 08-17B) Diaphragm-Type Valves

565 APV Fluid Handling-Americas (10/22/86)
100 South CP Avenue
Lake Mills, Wisconsin 53551-1799
(Mfg. by: APV Rosista, Inc., W. Germany & Denmark)

877 APV Americas-Lake Mills (5/14/96)
100 South CP Avenue
Lake Mills, Wisconsin 53551-1799

615 AsepCo (1/4/91)
1101 San Antonio Road, #301
Mountain View, California 94043

814 Burkert Contromatic Corporation (2/2/95)
2602 McGaw Avenue
Irvine, California 92714
(Mfg. by: Buerkert Steuer-Und Regeltechnik
Christian-Buerkert-Str 13-17
D-74653 Ingelfinger
Germany)

953 Burkert Contromatic Corporation (2/2/98)
2602 McGaw Avenue
Irvine, California 92614
(Mfg. by: Bukert & Cie
B.P. 21
Triembach au Val
F67220 Ville
France)

745 Cashco, Inc. (12/9/93)
P.O. Box 6, Hwy. 140 West
Ellsworth, Kansas 67439-0006

617 Defontaine of America, Inc. (2/1/91)
16720 W. Victor Road
New Berlin, Wisconsin 53151
(Mfg. by: Defontaine S.A. - Dept. Definox
3, rue Louis Renault - BP 329
44803 Saint-Herblain Cedex
France)

856 Flowtech, Inc. (10/30/95)
1900 Lake Park Drive, No. 345
Smyrna, Georgia 30080

637 Gemu Valves, Inc. (7/10/91)
3800 Camp Creek Parkway
Bldg. 2400, Suite 102
Atlanta, Georgia 30331

514 H. D. Bauman Inc. (8/24/87)
35 Mirona Road
Portsmouth, New Hampshire 03801-5317

203R ITT Engineered Valves (11/27/68)
33 Centerville Road
Lancaster, Pennsylvania 17603-2064

55-01 Boot Seal Valves for Milk & Milk Products

821 Keofitt A/S (3/17/95)
Snaremosvej 27
DK-7000 Fredericia
Denmark
(U.S. Rep.: Keofitt, Inc.
c/o Leman
2920-3000 Wolff Street
Racine, Wisconsin 53404

56-00 (Formerly 08-17E) Inlet and Outlet Leak-Protector Plug Valve

34E Tri-Clover, Inc. (10/15/56)
9201 Wilmot Road
Kenosha, Wisconsin 53141

57-01 (Formerly 08-17F) Tank Outlet Valve

531 Alfa Laval/G & H Products Corp. (5/31/88)
P.O. Box 909
Pleasant Prairie, Wisconsin 53158-0909

534 Lumaco (6/30/72)
9-11 East Broadway
Hackensack, New Jersey 07601

643 Paul Mueller Company (8/22/91)
1600 West Phelps
Springfield, Missouri 65801

58-00 (Formerly 08-17M) Vacuum Breakers and Check Valves

843 APV Americas-Lake Mills (8/24/95)
100 South CP Avenue
Lake Mills, Wisconsin 53551

691 Defontaine of America, Inc. (9/19/92)
16720 W. Victor Road
New Berlin, Wisconsin 53151
(Mfg. by: Defontaine S.A. - Dept. Definox
3, rue Louis Renault - BP 329
44803 Saint-Herblain Cedex
France)

835 Alfa Laval/G & H Products Corp. (6/22/95)
P.O. Box 909
Pleasant Prairie, Wisconsin 53158-0909
(Mfg. by: Alfa Laval LKM ApS
Albuen 31, Box 802
DK-6000 Kolding, Denmark)

834 Stanfos, Inc. (6/22/95)
3908 - 69th Avenue
Edmonton, Alberta
Canada T6B 2V2
(U.S. Rep.: Andron Stainless Corporation
8901 Farrow Road, Suite 101
Columbia, South Carolina 29203)

857 Steel & O'Brien, Mfg. Co. (10/30/95)
12850 Route 39
Sardinia, New York 14134

689 VNE Corporation (8/17/92)
1149 Barberry Drive
Janesville, Wisconsin 53547

908 Waukesha Cherry-Burell (4/25/97)
611 Sugar Creek Road
Delavan, Wisconsin 53115

59-00 (Formerly 08-17D) Automatic Positive Displacement Sampler

291 Accurate Metering Systems Inc. (6/22/77)
(Mfg. by: Diessel, Germany)
1650 Wilkening Court
Schaumburg, Illinois 60173

284 Bristol Equipment Co. (11/18/76)
210 Beaver Street
P.O. Box 696
Yorkville, Illinois 60560-0696

60-00 (Formerly 08-17G) Rupture Discs

407 Continental Disc Corp. (10/14/83)
3160 W. Heartland Drive
Liberty, Missouri 64068

854 Fike Metal Prod. (10/17/95)
Div. Fike Corp.
704 South 10th Street
Blue Springs, Missouri 64015

892 Oklahoma Safety Equipment Company (OSECO) (10/11/96)
1701 West Tacoma
Broken Arrow, Oklahoma 74012

61-00 (Formerly 08-17I) Steam Injected Heaters

728 APV Americas (4/14/93)
Heat Transfer Division
395 Fillmore Avenue
Tonawanda, New York 14150

811 Hydro-Thermal Corporation (1/1/95)
400 Pilot Court
Waukesha, Wisconsin 53188

560 Pick Heaters, Inc. (1/19/89)
P.O. Box 516
West Bend, Wisconsin 53095

874 Q-Jet DSI, Inc. (4/2/96)
704 Powell Lane, P.O. Box 350
Lewiston, New York 14092-0350

62-01 (Formerly 08-17L) Hose Assemblies

795 Able Hose & Rubber, Inc. (9/14/94)
2307 E. Hennepin Avenue
Minneapolis, Minnesota 55413

774 The Briggs Co. (7/18/94)
3 Bellecor Drive
New Castle, Delaware 19720

758 Crouch Supply Co. (2/22/94)
P.O. Box 163829
902 S. Jennings
Ft. Worth, Texas 76161

721 Dixon Valve & Coupling Co. (3/23/93)
800 High Street
Chestertown, Maryland 21620-1196

913 JGB Enterprises, Inc. (4/9/97)
115 Metropolitan Drive
Liverpool, New York 13088

757 Nelson-Jameson, Inc. (2/21/94)
P.O. Box 647
2400 East 5th Street
Marshfield, Wisconsin 54449

727 Pure Fit, Inc. (4/14/93)
924 Marcon Boulevard
Allentown, Pennsylvania 18103

799 Rubber World (10/21/94)
936 Links Avenue
Landisville, Pennsylvania 17538

698 Sanitary Couplers, Inc. (10/23/92)
696-698 Pleasant Valley Drive
Springsboro, Ohio 45066

700 Titan Industries, Inc. (10/23/92)
P.O. Box 1007
11121 Garfield Avenue
South Gate, California 90280-7590

63-01 (Formerly 08-17R) Sanitary Fittings

380 Allegheny Bradford Corp. (3/21/83)
P.O. Box 200 Route 219 South
Bradford, Pennsylvania 16701

79R APV Fluding Handling-America, Inc. (11/23/57)
100 South CP Avenue
Lake Mills, Wisconsin 53551-1799

682 Andron Stainless, Ltd. (6/30/92)
6170 Tomken Road
Mississauga, Ontario
Canada L5T 1X7
(U.S. Rep.: Andron Stainless Corp.
8901 Farrow Road, #101
Columbia, South Carolina 29223)

349 APN, Inc. (12/15/81)
921 Industry Road
Caledonia, Minnesota 55921

900 APV Fluid Handling America (12/31/96)
100 South CP Avenue
Lake Mills, Wisconsin 53551-1799

948 ARMATURENWERK (1/2/98)
HOTENSLEBEN GmbH
SchulstraBe 5-6
39393 Holenslebon
Germany
(U.S. Rep.: VNE Corporation
1149 Barberry Drive
Janesville, Wisconsin 53547)

621 Bradford Castmetals (2/25/91)
P.O. Box 33
Elm Grove, Wisconsin 53122

688 Swagelok (8/4/92)
9760 Shepard Road
Macedonia, Ohio 44056-1199

960 C S E Chiang Sung (4/24/98)
Enterprise Co., Ltd.
No. 6-19 To Lun Road
Ta Tsun Hsiang Chang
Hua Shien, Taiwan
Republic of China
(U.S. Rep.: Kurt Orban Partners
450 Kings Road
Brisbane, California 94005)

949 CANDIGRA y CIA, S.A. (1/2/98)
C/. Telers, 54-Aptdo. 174
17820 Banyoles
Spain
(Not Available in the U.S.A.)

645 Cipriani, Inc. - Tassalini S.P.A. (8/27/91)
23195 LaCadena Drive, Suite #103
Laguna Hills, California 92653

962 CIVACON (4/30/98)
416 E. Alondra Boulevard
Gardena, California 90248

696 Conexiones Inoxidables (10/1/92)
de Puebla S. A. de C. V.
Vicente Guerrero No. 112
Xicotepec de Juarez
Edo. Puebla, Mexico
(U.S. Rep.: Ben Dolphin Consulting
4735 Lansing Drive
North Olmsted, Ohio 44070)

528 Mark IV Industrial
Dayco Industrial Division (3/16/88)
P.O. Box 1004
1 Prestige Place
Dayton, Ohio 45401-1004

677 EXCEL-A-TEC, Inc. (5/8/92)
N93 W14635 Whittaker Way
Menomonee Falls, Wisconsin 53051

947 FLOWMECA (12/22/97)
47 rue du Bois Chaland
LISSES
91029 Evry Cedex
France
(U.S. Rep.: FLOWMECA, Inc.
19400 Stevens Creek Boulevard, Suite 200
Cuppertino, California 95014)

838 Food & Dairy Quality Mgmt. Inc. (QMI) (7/10/95)
245 E. 6th Street, Suite 416
St. Paul, Minnesota 55101

67R Alfa Laval/G & H Products Corp. (6/10/57)
P.O. Box 909
Pleasant Prairie, Wisconsin 53158-0909

925 Hassia Verpackungsmachinen (6/5/97)
GmbH
Heerweg 19
D-63691
Ranstadt, Germany
(U.S. Rep.: Hassia USA, Inc.
1210 Campus Drive West
Morganville, New Jersey 07751)

773 Herrli AG (7/15/94)
3210 Kerzers
Switzerland
(U.S. Rep.: VNE Corp.
P.O. Box 1698
Janesville, Wisconsin 53547)

917 Irving Polishing & Mfg., Co., Inc. (4/17/97)
5704 46th Street
Kenosha, Wisconsin 53144-1899

454 Jensen Fittings Corp. (9/11/85)
107-111 Goundry Street
North Tonawanda, New York 14120-5998

933 King Lai International Co., Ltd. (7/31/97)
No. 10, The 6th Street
Youth Industrial Zone
Tachia, Taichung
Taiwan ROC
(Not available in the U.S.A.)

389 Lee Industries, Inc. (5/31/83)
P.O. Box 688
Philipsburg, Pennsylvania 16866

703 Parker Hannifin Corp. (11/6/92)
UHP Products Division
1005 A Cleaner Way
Huntsville, Alabama 35805

200R Paul Mueller Co. (3/5/68)
1600 W. Phelps Street, Box 828
Springfield, Missouri 65801

726 Nalge Process Technologies Group (4/14/93)
924 Marcon Boulevard
Allentown, Pennsylvania 18103

242 Puriti, S.A. de C.V. (9/12/72)
Alfredo Nobel 39
Industrial Puente de Vigas
Tlalnepantla, Mexico
(U.S. Rep.: Waukesha Cherry-Burrell
611 Sugar Creek Road
Delavan, Wisconsin 53115)

424 Robert-James Sales, Inc. (8/31/84)
699 Hertel Avenue, Suite 260
Buffalo, New York 14207

699 Rodger Industries, Inc. (10/23/92)
P.O. Box 186
Blenheim, Ontario
Canada N0P 1A0
(Not available in the U.S.A)

334 Stainless Products, Inc. (12/18/80)
1649-72nd Avenue, Box 169
Somers, Wisconsin 53171

741 Steel & O'Brien Mfg., Inc. (8/26/93)
12850 Route 39
Sardinia, New York 14134

391 Stork Food Machinery, Inc. (6/9/83)
P.O. Box 1258/Airport Parkway
Gainesville, Georgia 30503
(Mfg. by: Stork Amsterdam, Netherlands)

449 Tech Controls Enterprise Co., Ltd. (8/2/85)
3725 N. Murray Road
Otis Orchard, Washington 99027
(Mfg. by: Tech. Control, Taipei, Taiwan)

73R L.C. Thomsen, Inc. (8/31/57)
1303-43 43rd Road Street
Kenosha, Wisconsin 53140

34R Tri-Clover, Inc. (10/15/56)
9201 Wilmot Road
Kenosha, Wisconsin 53141

707 Valvinox, Inc., SG RM Div. (1/5/93)
650-1st Street
Iberville, Quebec, Canada J2X 3B8
(Mfg. by: SG RM, France
Not available in the U.S.A.)

304 VNE Corporation (3/16/78)
1149 Barberry Drive
Janesville, Wisconsin 53547

82R Waukesha Cherry-Burrell (12/17/57)
611 Sugar Creek Road
Delavan, Wisconsin 53115

64-00 (Formerly 08-17N) Pressure Reducing and Back Pressure Regulating Valve

782 CASHCO, Inc. (8/31/94)
P.O. Box 6
Ellsworth, Kansas 67439-0006

753 G & H Products (2/1/94)
P.O. Box 909
Pleasant Prairie, Wisconsin 53158-0909

769 Richards Industries Valve Group (6/6/94)
3170 Wasson Road
Cincinnati, Ohio 45209-2381

65-00 Sight &/or Light Windows & Sight Indications & Contact with Milk & Milk Products

849 Jacoby TarBox Division of (9/25/95)
Clark Reliance Corp.
16633 Foltz Industrial Parkway
Strongsville, Ohio 44136

867 J. M. Canty, Inc. (2/19/96)
6100 Donner Road
Lockport, New York 14096

929 Darrell A. Beer (7/18/97)
d.b.a. SHAE Industries
P.O. Box 1268
121 W. North Street
Healdsburg, California 95448

845 L. J. Star Inc. (9/7/95)
P.O. Box 1116
2201 Pinnacle Parkway
Twinsburg, Ohio 44807
(Mfg. by: Herberts Industrieglas
GmbH & Co.
KG, Wuppertal
Germany)

890 Moisture Systems (9/14/96)
117 South Street
Hopkinton, Massachusetts 01748

818 Tri-Clover, Inc. (3/10/95)
9201 Wilmot Road
Kenosha, Wisconsin 53141-1413

68-00 Ball-Type Valves

898 Fluid Transfer (12/12/96)
Division of Lee Ind., Inc.
514 W. Pine Street
Philipsburg, Pennsylvania 16866

931 LUMACO (7/18/97)
9-11 East Broadway
Hackensack, New Jersey
(Mfg. by: Dairy Pipe Lines, Ltd.
Shirehill Industrial Estate
Saffron Walden, Essex
England)

73-00 Shear Mixers, Mixers and Agitators

901 Admix, Inc. (1/2/97)
234 Abby Road
Manchester, New Hampshire 03103-3332

957 Admix, Inc. (3/24/98)
234 Abby Road
Manchester, New Hampshire 03103-3332

74-00 Sensors and Sensor Fittings and Connections

32 ABB Instrumentation, Inc. (10/4/56)
P.O. Box 20550
Rochester, New York 14602-0550

738 ABB Instrumentation, Inc. (6/25/93)
1175 John Street
Rochester, New York 14602-0550

747 Alloy Engineering Co., Inc. (1/11/94)
304 Seaview Avenue
Bridgeport, Connecticut 06607

576 Ametek Test and Calibration (10/13/89)
Instruments Division
8600 Somerset Drive
Largo, Florida 34643

822 Ametek/U.S. Gauge Division (3/17/95)
PMT Products
820 Pennsylvania Boulevard
Feasterville, Pennsylvania 19053

318 Anderson Instrument Co., Inc. (4/9/79)
156 Auriesville Road
Fultonville, New York 12072

865 APV Heat Transfer Tec (1/25/96)
395 Fillmore Avenue
Tonawanda, New York 14150
(Mfg. by: Pasilac Electronics
Silkelorg, Denmark)

428 ARI Industries, Inc. (9/12/84)
381 ARI Court
Addison, Illinois 60101

659 Bindicator Company (11/20/91)
1915 Dove Street
Port Huron, Michigan 48060

706 Bindicator Company (12/29/92)
1915 Dove Street
Port Huron, Michigan 48060

926 BOURDON - SEDEME S.A. (6/18/97)
125, rue de la Marre
B.P. 214 41103
Vendome Cedex
France
(U.S. Rep.: Rawson & Co., Inc.
P.O. Box 924288
Houston, Texas 77292-4288)

872 Brookfield Eng. Lab, Inc. (3/28/96)
240 Cushing Street
Stoughton, Massachusetts 02072-2398

315 Burns Engineering, Inc. (2/5/79)
10201 Bren Road, East
Minnetonka, Minnesota 55343

525 Caldwell Systems Corporation (3/4/88)
1200 Diamond Circle, Unit K
Lafayette, Colorado 80026

910 CEMCO Mfg., Inc. (3/7/97)
1120 North Peoria
Tulsa, Oklahoma 74106-4904

850 Chicago Stainless Equip. (9/28/95)
511 Weston Ridge Drive
Naperville, Illinois 60563

672 Computer Instruments Corp. (4/3/92)
1000 Shames Drive
Westbury, New York 11590

829 DCT Instruments/Sensotec, Inc. (4/13/95)
2080 Arlingate Lane
Columbus, Ohio 43228-4112
(Mfg. by: Sensotec Inc.
2080 Arlingate Lane
Columbus, Ohio 43228-4112)

862 Delta Controls Corporation (11/30/95)
585 Fortson Street
Shreveport, Louisiana 71107

586 Diversey Lever Equipment (12/14/89)
151 Harvey West Boulevard
Santa Cruz, California 95060

866 Dovex S.S., Inc. (1/29/96)
770 Tower Drive
Medina, Minnesota 55340

640 Dresser Industries (7/16/91)
Instrument Division
250 East Main Street
Stratford, Connecticut 06497

663 Dresser Industries (12/4/91)
Instrument Division
210 Old Gate Lane
Milford, Connecticut 06460

405 Drexelbrook Engineering Co. (9/27/83)
205 Keith Valley Road
Horsham, Pennsylvania 19044

861 Dwyer Instruments, Inc. (11/28/95)
P.O. Box 373
Michigan City, Indiana 46360
(Mfg. by: Ametek, U.S. Gauge Div.
PMT Products
820 Pennsylvania Boulevard
Feasterville, Pennsylvania 19053)

763 EG & G Berthold Laboritorium Prof. (4/21/94)
Berthold GmbH & Co. KGCalmbacher Str. 22
D-7547 Bad Wildbad 1, Germany
(U.S. Rep.: E G & G Berthold USA
100 Midland Road
Oak Ridge, Tennessee 37830)

936 ENFM-USA, Inc. (8/28/97)
11339 East Distribution Avenue
Jacksonville, Florida 32256
(Mfg. by: Eerste Nederlandse Fabriek
Van Manometers B.V.
Scheidam, Holland)

524 Flow Technology, Inc. (1/14/88)
4250 E. Broadway Road
Phoenix, Arizona 85040

459 Endress + Hauser, Inc. (10/17/85)
2350 Endress Place
Greenwood, Indiana 46142
(Mfg. by: Endress + Hauser GmbH
Hauptstrasse 1
D-79689 Maulburg, Germany)

876 Fisher-Rosemount Singapore Private Limited
1 Pandan Cresent
Singapore 0512
Republic of Singapore
(U.S. Rep.: Rosemount, Inc.
12001 Technology Drive
Eden Prairie, Minnesota 55344) (5/14/96)

598 FMC Invalco, Inc.,
A FMC Corp. Subsidiary
P.O. Box 1183
Hutchinson, Kansas 67504-1183 (3/22/90)

206 The Foxboro Company
33 Commercial Street
Foxboro, Massachusetts 02035 (8/11/69)

963 GLI International, Inc.
9020 West Dean Road
Milwaukee, Wisconsin 53224 (5/4/98)

592 Claud S. Gordon Co.
5710 Kenosha Street
P.O. Box 500
Richmond, Illinois 60071 (2/27/90)

668 GP: 50 New York, Ltd.
2770 Long Road
P.O. Box 1150
Grand Island, New York 14072 (3/30/92)

633 Griffith Industrial Products Company
P.O. Box 111
Putnam, Connecticut 06260 (6/21/91)

749 Haenni Cie & AG
CH-3303
Jegenstorf, Switzerland
(U.S. Rep.: Haenni Instruments, inc.
1107 Wright Avenue
Gretna, Louisiana 70056) (1/17/94)

651 HEINRICH KUBLER AG
CH-6341 Baar
Switzerland
(U.S. Rep.: Granzow, Inc.
2300 Crown Point Executive Drive
Charlotte, North Carolina 28227) (10/3/91)

794 Honeywell, Inc.
1100 Virginia Drive
Fort Washington, Pennsylvania 19034 (9/14/94)

557 Honeywell, Inc.
Industrial Controls Div.
1100 Virginia Drive
Fort Washington, Pennsylvania 19034 (12/21/88)

832 H.O. Trerice Co.
12950 W. Eight Mile Road
Oak Park, Michigan 48237-3288
(Mfg. by: Bourdon-Sedene
125 Rue De La Marre
41 100 Vendome
France) (5/12/95)

629 ISE-Magtech
907 Bay Star
Webster, Texas 77598-1531 (5/20/91)

572 ITT Conoflow
P.O. Box 768, Rt. 78
St. George, South Carolina 29477 (9/25/89)

961 KDG Instruments
Crompton Way
Crawley, W. Sussex
RH102YZ, England
(Not available in the U.S.A.) (4/24/98)

798 Kay-Ray/Sensall, Inc.
1400 Business Center Drive
Mount Prospect, Illinois 60056 (10/14/94)

930 Kamstrup A/S
Process Division
Jacob Knudsens Vej 12
DK-8230 Abyhoj
Denmark
(Not available in the U.S.A.) (7/18/97)

945 Kemotron, Inc.
1090 Northchase Parkway, Suite 200 South
Marietta, Georgia 30067
(Mfg. by: Kemotron a/s
Chr. X Alle' 89
DK-2800 Lyngby
Denmark) (11/25/97)

842 Klay Instruments B.V.
Nijverheidsweg 5
NL 7991 CZ Dwingeloo
The Netherlands
(Not available in the U.S.A.) (8/18/95)

396 King Engineering Corp.
P.O. Box 1228
Ann Arbor, Michigan 48106 (6/13/83)

893 Kistler-Morse Corporation
19021-120th Avenue N.E.
Bothell, Washington 98011-9511 (10/31/96)

285 K Systems Corp. (Tank Mate Division)
4391 Butterfield Road
Hillside, Illinois 60162 (12/7/76)

620 Larad Equipment
213 Airport Drive Extension
Hopedale, Massachusetts 01747 (2/25/91)

501 Lumenite Control Technology Inc.
2331 N. 17th Avenue
Franklin Park, Illinois 60131 (4/27/87)

596 Magnetrol International
5300 Belmont Road
Downers Grove, Illinois 60515 (3/20/90)

768 MTS Systems Corporation
Sensors Division
3001 Sheldon Drive
Cary, North Carolina 27513 (6/6/94)

906 Mettler-Toledo Process Analytical, Inc.
261 Ballardvale Street
Washington, Massachusetts 01887
(Mfg. by: Mettler-Toledo Process AG
ImHackacker 15
8902 URDORF Switzerland) (2/14/97)

627 Milltronics, Inc.
P.O. Box 4225
Peterborough, Ontario
Canada K9J 7B1
(U.S. Rep.: Milltronics, Inc.
709 E. Stadium Drive
Arlington, Texas 76011) (4/12/91)

588 Minco Products, Inc. (12/20/89)
7300 Commerce Lane
Minneapolis, Minnesota 55432

863 Nelson-Jameson (1/11/96)
2400 East 5th Street, P.O. Box 647
Marshfield, Wisconsin 54449
(Mfg. by: Chicago Stainless Equipment
511 Weston Ridge Drive
Naperville, Illinois 60563)

597 NUOVA FIMA S.p.A. (3/20/90)
Via C. Battisti 59
28045 - INVORIO (N0) Italy
(Not available in the U.S.A.)

966 ODEN Corporation (5/27/98)
255 Great Arrow Avenue
Buffalo, New York 14207

909 Ohmart/VEGA (3/4/97)
4241 Allendorf Drive
Cincinnati, Ohio 45209-9961
(Mfg. by: VEGA Grieshaber KG
AM Honenstein 113
D-77761 Schiltach
Germany)

523 Paper Machine Components, Inc. (1/3/88)
Miry Brook Road
Danbury, Connecticut 06810

554 Par Sonics, Inc. (11/30/88)
R.D. #1 - Box 505
Centre Hall, Pennsylvania 16828

563 PI Components Corp. (2/13/89)
1951 Highway 290W
Brenham, Texas 77833

644 Princo Instruments, Inc. (8/22/91)
1020 Industrial Highway
Southampton, Pennsylvania 18966-4095

815 ProMag PM LTD (2/24/95)
11552 Merchant Drive
Baton Rouge, Louisiana 70809

487 Pyromation, Incorporated (12/16/86)
5211 Industrial Road
Fort Wayne, Indiana 46825-5152

367 RDF Corporation (10/2/82)
23 Elm Avenue
Hudson, New Hampshire 03051

495 Rosemount Analytical, Inc. (2/13/87)
Uniloc Division
2400 Barranca Parkway
Irvine, California 92606

328 Rosemount, Inc. (5/22/80)
12001 Technology Drive
Eden Prairie, Minnesota 55344

732 SensorTec, Inc. (5/18/93)
16335-7 Lima Road
Huntertown, Indiana 46748

784 Sensotec, Inc. (9/2/94)
2080 Arlington Lane
Columbus, Ohio 43228-4112

515 Setra Systems, Inc. (9/14/87)
159 Swanson Road
Boxborough, Massachusetts 01719

583 S. J. Controls, Inc. (11/11/89)
2248 Obispo Avenue #203
Long Beach, California 90806

873 Smar Equipamentos (4/2/96)
Industriasis Ltda.
7240 Brittmoore, Suite 118
Houston, Texas 77041
(Mfg. by: Smar Equipamentos Industriasis Ltda.
Av. Dr. Antonio Furian Jr.
Serlhozlnko - SP - 14160.000
Brazil)

875 SOR (4/15/96)
14685 W. 105th Street
Lenexa, Kansas 66215-5964

638 Millipore Corporation (7/10/91)
P.O. Box 860709
Plano, Texas 75086-0709

896 TBI-Bailey Controls Company (12/3/96)
2175 Lockheed Way
Carson City, Nevada 89706

641 Tempress A/S (7/16/91)
P.O. Box 2090, DK-8240
Russkov, Denmark
(Not available in the U.S.A.)

690 Texas Thermowell, Inc. (8/25/92)
P.O. Box 1535
Hwy. 96 North
Silsbee, Texas 77656

765 Tri-Clover, Inc. (4/27/94)
9201 Wilmot Road
Kenosha, Wisconsin 53141

444 Tuchenhagen North America, Inc. (6/17/85)
9160 Red Branch Road
Columbia, Maryland 21045
196 Western Avenue
Fond du Lac, Wisconsin 54936-1458

754 Valmet Automation (7/2/95)
30 Thomas Drive
Westbrook, Maine 04092
(Mfg. by: Valmet-Finland
P.O. Box 237 SF-33101
Tampere, Finland)

410 Viatran Corporation (11/1/83)
300 Industrial Drive
Grand Island, New York 14072

779 Wahl Instruments, Inc. (8/10/94)
234 Weaverville Highway
Asherville, North Carolina 28804

522 Weed Instrument Company, Inc. (12/28/87)
707 Jeffrey Way
Round Rock, Texas 78664

569 WEISS Instruments, Inc. (5/24/89)
85 Bell Street
West Babylon, New York 11704
(Mfg. by: Nuova-Fima, Italy)

600 Weksler Instruments Corporation (4/27/90)
250 E. Main Street
Stratford, Connecticut 06497

646 WIKA Instrument Corp. (9/10/91)
1000 Wiegand Boulevard
Lawrenceville, Georgia 30243
(Mfg. by: WIKA Ind. Corp.
63911 Klingenberg
Germany)

685 Winter's Thermogauges, Ltd. (8/3/92)
2220-3 Midland Avenue
Scarborough, Ontario
Canada M1P 3E6
(U.S. Rep.: Winter's Thermogauges, Inc.
6020/3 N. Bailey Avenue
Buffalo, New York 14226)

879 Zurich Industria E (6/3/96)
Comercio LTDA
R. Serra da Piedade, 183
Sao Paulo - SP - Brazil 03131-080
(Not available in the U.S.A.)

The Following Firms Have not Renewed Their 3-A Symbol Authorization and Effective This Date No Longer are Authorized to Display the 3-A Symbol

01-07 Storage Tanks for Milk and Milk Products

28 Waukesha Cherry-Burrell

05-14 Stainless Steel Automotive Milk Transportation Tanks for Bulk Delivery and/or Farm Pick-up Service

201 Paul Krohnert Manufacturing, Ltd.

10-03 Milk and Milk Products Filters Using Disposable Filter Media, as Amended

720 R-P Products

12-05 Tubular Heat Exchangers for Milk and Milk Products

734 The Diversified-Berdell Group, Inc.

13-09 Farm Milk Cooling and Holding Tanks

179R Heavy Duty Products (Preston) Ltd.

16-05 Evaporators and Vacuum Pans for Milk and Milk Products

299 Stork Food Machinery, Inc.

17-09 Formers, Fillers and Sealers of Single Service Containers for Fluid Milk and Fluid Milk Products

848 Septipak, Inc.

19-04 A1 Batch and Continuous Freezers for Ice Cream, Ices, and Similarly Frozen Dairy Foods, as Amended

903 Coldelite Corporation of America

928 Ross' Frozen Custard Corporation

22-07 Silo-type Storage Tanks for Milk and Milk Products

702 Paul Krohnert Manufacturing, Ltd.

928 Ross' Frozen Custard Corporation

28-03 Flow Meters for Milk and Milk Products

918 Honeywell, Inc.

32-02 Uninsulated Tanks for Milk and Milk Products

264 Waukesha-Cherry Burrell

33-01 Polished Metal Tubing for Dairy Products

809 Damascus-Bishop Tube Company

35-00 Continuous Blenders

526 Hosokawa Bepex Corporation

40-01 Bag Collectors for Dry Milk and Dry Milk Products

453 Hosokawa MikriPul E. Systems

45-00 Cross Flow Membrane Modules

807 Coors Ceramics Company

46-01 Refractometers and Optical Sensors

904 AW Company

882 Optek Danulat, Inc.

817 Technitron Labs, Inc.

51-00 (Formerly 08-17R) Plug-Type Valves

271 The Foxboro Company

53-00 (Formerly 08-17A) Compression-Type Valves

594 Oden Corporation

54-02 (Formerly 08-17B) Diaphragm-Type Valves

494 Alfa Saunders Valve, Inc.

55-01 Boot Seal Valves for Milk & Milk Products

839 G & H Products Corporation

63-01 (Formerly 08-17R) Sanitary Fittings

470 Advance Fittings Corporation

74-00 Sensors and Sensor Fittings and Connections Used on Milk and Milk Products Equipment

836 Valmet Automation

Thoughts on Today's Food Safety, *continued* from page 560

When people hear about the benefits of irradiation, interest in purchasing increases. Currently, consumers have heard about this technology because of media coverage resulting from the FDA approval. Another media blitz may be expected when USDA announces approval. Educational efforts should come from all sectors: the federal government, the health community, universities, and the food industry. A broadly based program is appropriate because consumer knowledge is still limited and benefits are substantial. A nationwide consumer awareness program on irradiation was launched in April by the Grocery Manufacturing of America, the Food Marketing Institution, and the American Farm Bureau Federation.

Consumers expect processors and retailers to provide safe food. A World Health Organization report states, "The unwarranted rejection of irradiated food [by industry] is not only contrary to the public health, but also inconsistent with the rights of consumers to protect themselves and their families by choosing foods processed for safety."

When meat and poultry are irradiated everyone wins: industry will be able to meet increasingly stringent microbiological regulations, consumers will buy a safer product, and public health will benefit. Who will lead in a nationwide promotion of the safest meat and poultry in the nation?

REFERENCES

1. Abt Associates Inc. Food Industry & Agribusiness Consulting Practice. 1996. Trends in the United States, Consumer attitudes and the supermarket. Food Marketing Institute, Washington, D.C.
2. Abt Associates Inc. Food Industry & Agribusiness Consulting Practice. 1997. Trends in the United States, consumer attitudes and the supermarket. Food Marketing Institute, Washington, D.C.
3. American Meat Institute. 1998. Consumer attitudes toward irradiated food. Washington, D.C.
4. Anonymous. 1995. The irradiation option. Food Safety Consortium 5(3):1–5.
5. Fox, J. A., and D. G. Olson. In Press. Market trials of irradiated chicken, Radiation Physics and Chemistry.

ComingEvents

SEPTEMBER

·6-9, **InterMopro 98, International Trade Fair for Dairy Products,** in Düsseldorf, Germany. For further information, contact Dusseldorf Trade Shows, Inc., 150 N. Michigan Ave., Suite 2920, Chicago, IL 60601; Phone: 312.781.5180; Fax: 312.781.5188; Web site: www.dtsusa.com/dts/.

·9-10, **Microbiological Concerns in Food Plant Sanitation & Hygiene,** Chicago, IL. For further information contact Silliker Laboratories, Phone: 800.829.7879; Fax: 708.957.8405.

·13-17, **The National Society for Healthcare Foodservice Management 10th Annual National Training Conference,** at The Homestead, Hot Springs, VA. For additional information, contact Michael Giuffrida or Sheila Crowley at 202.546.7236.

·17-18, **Thermal Processing Deviations Workshop,** presented by The Food Processors Institute, Washington, D.C. These workshops are an excellent follow-up for those who have attended a *Better Process Control School.* This includes: Quality Assurance Managers, Quality Control Managers, Process Engineers, and Specialists in Thermal Processing. Participants working in small problem-solving groups will evaluate typical and atypical deviation samples by applying the principles of deviation analysis. Participants will examine in detail the information necessary to determine when a thermal process deviation has occurred; explore "on the line" preventative and corrective actions when deviations happen; evaluate different types of deviations; and learn the documentation required when deviations occur. For additional information, call Customer Service at 202.639.5954.

·22-24, **New York State Association of Milk & Food Sanitarians 75th Anniversary Annual Conference,** Sheraton University Hotel, Syracuse, NY. For more information, contact Janene S. Lucia, NYSAMFS, 172 Stocking Hall, Ithaca, NY 14853; Phone: 607.255.7619; Fax: 607.255.7619; E-mail: jgg3@cornell.edu.

·23-25, **Microscopy/Photomicrography Workshop,** sponsored by the American Type Culture Collection. For more information, contact ATCC, Workshop Coordinator, 12301 Parklawn Dr., Rockville, MD 20852; Phone: 301.231.5566; 800.359.7370; Fax: 301.816.4364; E-mail: workshops@atcc.org.

·25-29, **China Brew & Beverage '98,** at China International Exhibition Centre, Beijing, China. For details, contact Rebecca Chan or Ling Chan of Business & Industrial Trade Fairs Ltd., Unit 1223, 12/F Hongkong International Trade & Exhibition Centre, 1 Trademark Dr., Kowloon Bay, Hong Kong or Phone: 852.2865.2633; Fax: 852.2866.1770, 2866.2076.

OCTOBER

·5-8, **Better Process Control School,** Texas A & M University, College Station, TX. This school is offered by The Food Processors Institute. For additional information, contact Jennifer Jakubik, Phone: 409.845.7341; Fax: 409.845.8906; E-mail: a-wagner@tamu.edu.

·5-9, **Laboratory Methods in Food Microbiology,** South Holland, IL. For further information contact Silliker Laboratories, Phone: 800.829.7879; Fax: 708.957.8405.

·14-16, **Conference on the National Food Safety Initiative: Implications for Microbial Data Collection, Analysis, and Application,** Doubletree Hotel National Airport, Arlington, VA. This conference is organized by International Life Sciences Institute North America (ILSI, N.A.) and the ILSI, N.A. Technical Committee on Food Microbiology, in collaboration with the Centers for Disease Control and Prevention, Food and Drug Administration, **International Association of Milk, Food and Environmental Sanitarians,** National Institutes of Health, U.S. Dept. of Agriculture, and others concerned with microbial food safety. The meeting will be of interest to food protection, and public health professionals. For program and registration information, contact ILSI NFSI (National Food Safety Initiative) Microbial Data Conference, 6200 Aurora Avenue, Suite 200W, Des Moines, IA 50322-2863; Phone: 800.369.6337 (U.S. and Canada); 515.276.3344 (International); Fax: 515.276.8655; E-mail: nfsi@iamfes.org. Questions concerning the conference should be directed to Ms. Catherine Nnoka, Phone: 202.659.0074; Fax: 202.659.3859; E-mail: cnnoka@ilsi.org.

·18-19, **Selection and Fabrication of Stainless Steel for Sanitary Service,** Hotel Sofitel, Rosemont, IL. The International Association of Food Industry Suppliers (IAFIS) and the Nickel Development Institute (NiDI) are sponsoring a program on the properties and proper use of handling of stainless steel for equipment for the dairy, food, and beverage industries. For further information, contact Dorothy Brady, Conference Coordinator at Phone: 703.761.2600; Fax: 703.761.4334; E-mail: info@iafis.org.

·21-23, **18th Food Microbiology Symposium and Workshop,** University of Wisconsin-River Falls, River Falls, WI. The symposium Current "Concepts in Foodborne Pathogens and Rapid Methods in Food Microbiology" will feature

international speakers to discuss the latest research and developments regarding foodborne pathogens, regulatory and industry trends, HACCP implementation, predictive microbiology, and validation of laboratory methods. The workshop, "Rapid and Automated Methods in Food Microbiology" will involve demonstrations and discussions of various tests, instruments and kits available for detection and characterization of foodborne organisms, for assessment of food quality and shelf life and rapid hygiene monitoring in food processing facilities. For further information, contact Dr. Purnendu C. Vasavada, Animal and Food Science Dept., University of Wisconsin-River Falls River Falls, WI 54022, U.S.A. or Phone: 715.425.3150; Fax: 715.425.3372; E-mail: Purnendu.C.Vasavada@uwrf.edu.

·**22-23, Introduction to Microbiological Criteria and Sampling Plans,** Ft. Worth, TX. For further information contact Silliker Laboratories, Phone: 800.829.7879; Fax: 708.957.8405.

·**26-29, Penn State Foodborne Fungi and Mycotoxins Short Course** at the Berks Campus of the Pennsylvania State University, University Park, PA. For additional information, contact The Pennsylvania State University, 306 Ag Administration Bldg., University Park, PA 16802-2601; Phone: 814.865.8301; Fax: 814.865.7050; E-mail: shortcourse@psu.edu.

NOVEMBER

·**2-6, Aseptic Better Process Control Certification School and Aseptic Symposium,** at North Carolina State University, Raleigh, NC. For further information, contact Lisa Gordon at 919.515.2956; Fax: 919.515.7124; E-mail: lisa_gordon@ncsu.edu.

·**4-6, The Dairy Practices Council® Annual Conference,** Harrisburg East Holiday Inn, Harrisburg, PA. The DPC Annual Conference presents outstanding speakers on issues challenging the dairy industry and afternoon task force sessions are reserved for work on developing new guidelines. Participants have the opportunity to exchange information with dairy personnel from industry, regulatory agencies, and academia. For more information, contact The Dairy Practices Council®, P.O. Box 866, Barre, VT 05641-0866; Phone/Fax: 802.476.3092; E-mail: dairypc@dairypc.org; www.dairypc.org.

·**8-12, 1998 International Exposition for Food Processors,** Chicago, IL. For more information, contact Cheryl Clark at Phone: 703.684.1080; Fax: 703.548.6563; E-mail: fpmsa@clark.net.

·**8-12, Microbial Food Contamination Workshop,** The U.S. Fish and Wildlife National Conservation Training Center, Shepherdstown, WV. The objectives of the workshop is to assemble leading experts in the U.S. and Israel for the exchange of information and the development of future strategies and policies to prevent and eliminate microbial food contamination; access and record the present state of our knowledge on food contamination; and to form collaborations between the U.S. and Israeli scientists and industry to pursue innovative technologies to combat food contamination. For additional information, contact BARD Workshop, Charles L. Wilson, USDA-ARS Appalachian Fruit and Research Station, 45 Wiltshire Road, Kearneysville, WV 25430; Phone: 304.725.3451; Fax: 304.728.2340; E-mail: cwilson@asrr.arsusda.gov.

·**9-11, ASI Food Safety Consultants HACCP Workshop,** held at the Holiday Inn-Downtown Riverfront, St. Louis, MO. For further information, contact ASI Food Safety Consultants, Inc., Vorrie Strong or Christine VerPlank, Phone: 314.725.2555; 800.477.0778; Fax: 314.727.2563.

·**16-17, Membrane Applications in the Agri-Food Industry Seminar,** at the Holiday Inn South, Winnipeg, Manitoba, Canada. This course is jointly organized by the Food Development Centre, Manitoba Hydro, the National Research Council, Manitoba Food Processors Assn., Canadian Council on Electrotechnologies, and Assiniboine Community College. The purpose is to demonstrate the economic and process benefits of membrane systems using technology profiles, case study examples and pilot plant demonstrations of actual systems. For additional information, contact Markus Schmulgen, Food Development Centre, Portage la Prairie, Manitoba; Phone: 204.239.3436; 800.870.1044.

·**16-18, 1st NSF International Conference on Food Safety: HACCP — Science, Art, and Industry,** co-sponsored by IAMFES and other organizations, Hyatt Regency Albuquerque, Albuquerque, NM. For additional information, contact Wendy Raeder at Phone: 734.769.8010, ext. 205; Fax: 734.769.0109; E-mail: raeder@nsf.org.

·**22-26, 5th Latin American Congress on Food Microbiology and Hygiene, (COMBHAL 98)** held in Águas de Lindoia, São Paulo, Brazil. COMBHAL 98 is organized by the Brazilian representatives in the Latin American Subcommission (LAS) of ICMSF (International Commission on Microbiological Specifications for Foods) and is sponsored by the Brazilian Society for Microbiology (SBM), Brazilian Society for Food Science and Technology (SBCTA) and International Life Science Institute (ILSI, Brazil). For further information, contact COMBHAL 98 Secretariat, Av. Prof. Lineu Prestes 580, 05508-900, São Paulo-SP-Brazil; Phone: +55.11.8187991; +55.11.8187999; Fax: +55.11.8154410; E-mail: combhal@edu.usp.br.landgraf@usp.br.

DECEMBER

·**1-2, HACCP for Retail, Food Service & Institutional Sectors Seminar,** Guelph, Ontario. For further information, contact Guelph

Food Technology Centre, 88 McGilvray St., Guelph, Ontario N1G 2W1; Phone: 519.821.1246 ext. 5028; Fax: 519.836.1281.

·**1-3, Technical Symposium & Workshop,** Hyatt Regency Crystal City, Arlington, VA. Sponsored by the Strategic Environmental Research and Development Program (SERDP) and the Environmental Security Technology Certification Program (ESTCP). Learn first hand about groundbreaking environmental research and innovative technologies developed by the Department of Defense (DoD), the Department of Energy, the Environmental Protection Agency, and their many public and private collaborators. For more information call 703.736.4548.

·**3, GMP Distribution and Warehousing Seminar,** Houston, TX. For further information, contact ASI Food Safety Consultants, Inc., Christine VerPlank, or Vorrie Strong, Phone: 800.477.0778; Fax: 314.727.2563.

8-9, 1998 FDA Science Forum – Biotechnology: Advances, Applications, and Regulatory Challenges, at the Washington Convention Center, Washington, D.C. The Science Forum is co-sponsored by the FDA, the American Association of Pharmaceutical Scientists, and the FDA Chapter of Sigma Xi, The Scientific Research Society. The Science Forum will bring FDA research and review scientists together with representatives of industry, academia, government agencies, consumer groups, and the public to discuss the impact of the enormous advances in biotechnology on product development and regulation. For additional information, contact the American Association of Pharmaceutical Scientists at Phone: 703.518.8429 or E-mail: meetings@aaps.org.

·**8-11, Thermal Processing Development Workshop,** presented by The Food Processors Institute, Washington, D.C. These workshops are an excellent follow-up for those who have attended a *Better Process Control School*. This includes: Quality Assurance Managers, Quality Control Managers, Process Engineers, and Specialists in Thermal Processing. Participants will generate heat penetration data in the pilot plant of NFPA's research laboratory. Working teams will examine in detail the design of thermal processes; improve skills and understanding of basic thermal process establishment and evaluation techniques, including heat penetration testing and process calculation; identify critical decision-making steps essential to thermal process establishsment; generate data during the workshop excercises; and learn both the General and Ball Formula methods of calculation. For additional information, call Customer Service at 202.639.5954.

IAMFES Offers the Dairy Practices Council *"Guidelines for the Dairy Industry"*

IAMFES has agreed with the Dairy Practice Council to distribute their *"Guidelines for the Dairy Industry."* DPC is a non-profit organization of education, industry and regulatory personnel concerned with milk quality and sanitation throughout the United States. In addition, its membership and subscriber rosters list individuals and organizations throughout the United States, Canada and other parts of the world.

For the past 28 years, DPC's primary mission has been the development and distribution of educational guidelines directed to proper and improved sanitation practices in the production, processing, and distribution of high quality fluid milk and manufactured dairy products.

The DPC Guidelines are written by professionals who comprise six permanent Task Forces. Prior to distribution, every Guideline is submitted for approval to the State Regulatory Agencies in each of the member states which are now active participants in the DPC process. Should any official have an exception to a section of a proposed guideline, that exception is noted in the final document.

The Guidelines are renown for their common sense and useful approach to proper and improved sanitation practices. We think that they will be a valuable addition to your professional reading library.

The entire set consists of 56 guidelines including:

1 Planning Dairy Freestall Barns
2 Effective Installation, Cleaning and Sanitizing of Milking Systems
3 Selected Personnel in Milk Sanitation
4 Installation, Cleaning, & Sanitizing of Large Parlor Milking Systems
5 Directory of Dairy Farm Building & Milking System Resource People
7 Sampling Fluid Milk
8 Good Manufacturing Practices for Dairy Processing Plants
9 Fundamentals of Cleaning and Sanitizing Farm Milk Handling Equipment
10 Maintaining & Testing Fluid Milk Shelf-Life
11 Sediment Testing and Producing Clean Milk
13 Environmental Air Control & Quality for Dairy Food Plants
14 Clean Room Technology
16 Handling Dairy Products from Processing to Consumption
17 Causes of Added Water in Milk
18 Fieldperson's Guide to Troubleshooting High Somatic Cell Counts
21 Raw Milk Quality Tests
22 Control of Antibacterial Drugs and Growth Inhibitors in Milk and Milk Products
23 Preventing Rancid Flavors in Milk
24 Troubleshooting High Bacteria Counts of Raw Milk
25 Cleaning and Sanitizing Bulk Pickup and Transport Tankers
28 Troubleshooting Residual Films on Dairy Farm Milk Handling Equipment
29 Cleaning and Sanitizing in Fluid Milk Processing Plants
30 Potable Water on Dairy Farms
31 Composition and Nutritive Value of Dairy Products
32 Fat Test Variations in Raw Milk
33 Brucellosis and Some Other Milkborne Diseases
34 Butterfat Determinations of Various Dairy Products
35 Dairy Plant Waste Management
36 Dairy Farm Inspection
37 Planning Dairy Stall Barns
38 Preventing Off-flavors in Milk
39 Grade A Fluid Milk Plant Inspection
40 Controlling Fluid Milk Volume and Fat Losses
41 Milkrooms and Bulk Tank Installation
42 Stray Voltage on Dairy Farms
43 Farm Tank Calibrating and Checking
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49 Postmilking Teat Dips
50 Farm Bulk Milk Collection Procedures
51 Controlling the Accuracy of Electronic Testing Instruments for Milk Components
52 Emergency Action Plan for Outbreak of Milkborne Illness in the Northeast
53 Vitamin Fortification of Fluid Milk Products
54 Selection and Construction of Herringbone Milking Parlors
55 Hazard Analysis Critical Control Point System
56 Dairy Product Safety (Relating to Pathogenic Bacteria)
57 Dairy Plant Sanitation
58 Sizing Dairy Farm Water Heater Systems
59 Production and Regulation of Quality Dairy Goat Milk
60 Trouble Shooting Microbial Defects: Product Line Sampling & Hygiene Monitoring
63 Controlling the Quality & Use of Dairy Product Rework
64 Control Points for Good Management Practices on Dairy Farms
65 Installing & Operating Milk Precoolers Properly on Dairy Farms
66 Planning a Dairy Complex – "100 + Questions to Ask"

If purchased individually, the entire set would cost $225. We are offering the set, packaged in three loose leaf binders for $125 plus $9 shipping and handling (outside the U.S., $21 for shipping and handling).

Information on how to receive new and updated Guidelines will be included with your order.

To purchase this important source of information, complete the order form below and mail or Fax (515) 276-8655 to IAMFES.

Please enclose $125 plus $9 shipping and handling for each set of Guidelines. Shipments outside the U.S. are $125 plus $21 shipping and handling. Payment in U.S. $ drawn on a U.S. Bank or by credit card.

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THOUGHTS on Today's Food Safety...

Food Irradiation: Will Consumers Make The Choice?

Christine M. Bruhn, Director, Center for Consumer Research, University of California-Davis, Davis, CA

U.S. Food and Drug Administration's (FDA) approval of irradiation for fresh and frozen red meat in December, 1997 paves the way for another option to enhance the safety of the food supply. Although meat irradiation must await USDA approval, plans to utilize this technology by the food industry are slowly advancing.

Endorsement by the health community was widely recorded in the press. Dr. Sherwood Gorbach, Tuffs University School of Medicine and American Gastroenterology Association Committee on Food Safety noted that all safety concerns have been answered. Michael Osterholm, Minnesota Department of Health compared irradiation to pasteurization of milk and chlorination of water, Donald Thayer, USDA food safety laboratory noted that irradiation could save lives, and Morris Potter, Center for Disease Control and Prevention, said, "Irradiation pasteurization is long overdue."

At the proposed dose, irradiation destroys pathogenic bacteria such as *Salmonella*, *Campylobacter*, and *Escherichia coli* O157:H7. The latter is estimated to cause illness in 7,000 to 20,000 Americans and cost $46 million to $174 million annually.

Consumers recognize that foodborne bacteria are a potential hazard. When asked in 1997 about several potential safety areas, 82% of consumers classified contamination by germs or bacteria as a serious hazard *(2)*. This is more than pesticide residues, 66%, product tampering, 65%, or any other food safety area.

Consumers value the use of irradiation to destroy microorganism which cause foodborne illness. A nationwide study conducted in March 1998 found almost 80% said they would buy products labeled, "irradiated to destroy harmful bacteria" *(3)*. This compares to the 1996 response rate of 69% among those who had heard of irradiation *(1)*.

Although the regulatory approval for red meat generated significant publicity, more of the pubic seems to be concerned about poultry safety. Sixty-seven percent of consumers said it was "appropriate" to irradiate poultry, with pork and ground beef seen as "appropriate" by slightly fewer consumers *(3)*. Over 60% felt irradiation was appropriate at a fast food restaurant with almost 50% considering it appropriate at the grocery store deli or sit-down restaurant.

Consumers see that irradiation's main advantage is the destruction of harmful bacteria with almost 80% indicating that as a reason to buy irradiated products. No one expects irradiation to replace safe food handling. In the 1998 survey, 91% of consumers responded that safe food handling is still important *(3)*.

While almost half of consumers interviewed accepted the term, irradiation, cold pasteurization was preferred by 55%. This is consistent with focus group studies completed in early 1998 in which consumers indicated they were familiar with pasteurization and could understand the benefits of the irradiation process better if the term cold pasteurization was used.

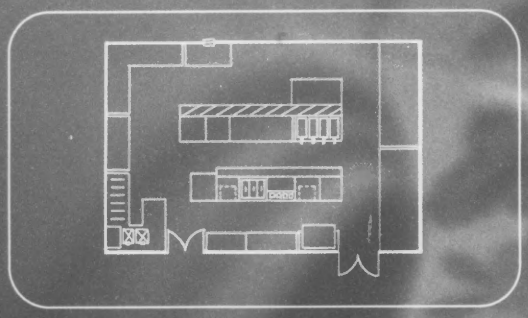
Marketing experiences are consistent with these attitude studies. Numerous irradiated produce items have been marketed in the Chicago area since 1992. Tropical fruit from Hawaii has been sold in Midwest and West Coast markets in collaboration with a study to determine quarantine treatment. Since 1995, 250 thousand pounds of fruit including papaya, atemoya, rambutan, lychee, starfruit, banana, Chinese taro, and oranges were irradiated near Chicago and sold in several markets.

Marketing tests in Kansas showed people also buy irradiated poultry. When the irradiated product was priced 10% less than the store brand, irradiated poultry captured 60% of the market share in 1995 and 63% in 1996 *(4)*. When irradiated and non-irradiated poultry was priced equally, irradiated poultry captured 39% of the market in 1996, 47% in 1997, and about 80% in 1997 when people read background information about irradiation before making a selection *(5)*.

Industry barriers include constructing or leasing an irradiation facility or the transportation and processing at a contract irradiator. Contract facilities currently are available in California (e-beam and cobalt), Colorado (e-beam), Florida, Illinois, Massachusetts, New Jersey, New York, North Carolina, Ohio, South Carolina, Texas, and Utah. Several are currently processing food for market tests. In-plant gamma facilities can be constructed in a little over a year and an e-beam facility in 3 months. Alternatively, a drop in self-contained unit using cesium may be ready for lease in about 2 years.

Industry should position an irradiated product to highlight its advantages. Consumers have responded positively to the statements, "irradiated to destroy harmful bacteria." A statement "*Salmonella* Free" or "*E. coli* O157:H7 Free," if approved by USDA, would likely be well received by the public.

Continued on page 552



Proper dining etiquette includes forks on the left, knives on the right and UL Marks on all the food equipment.

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