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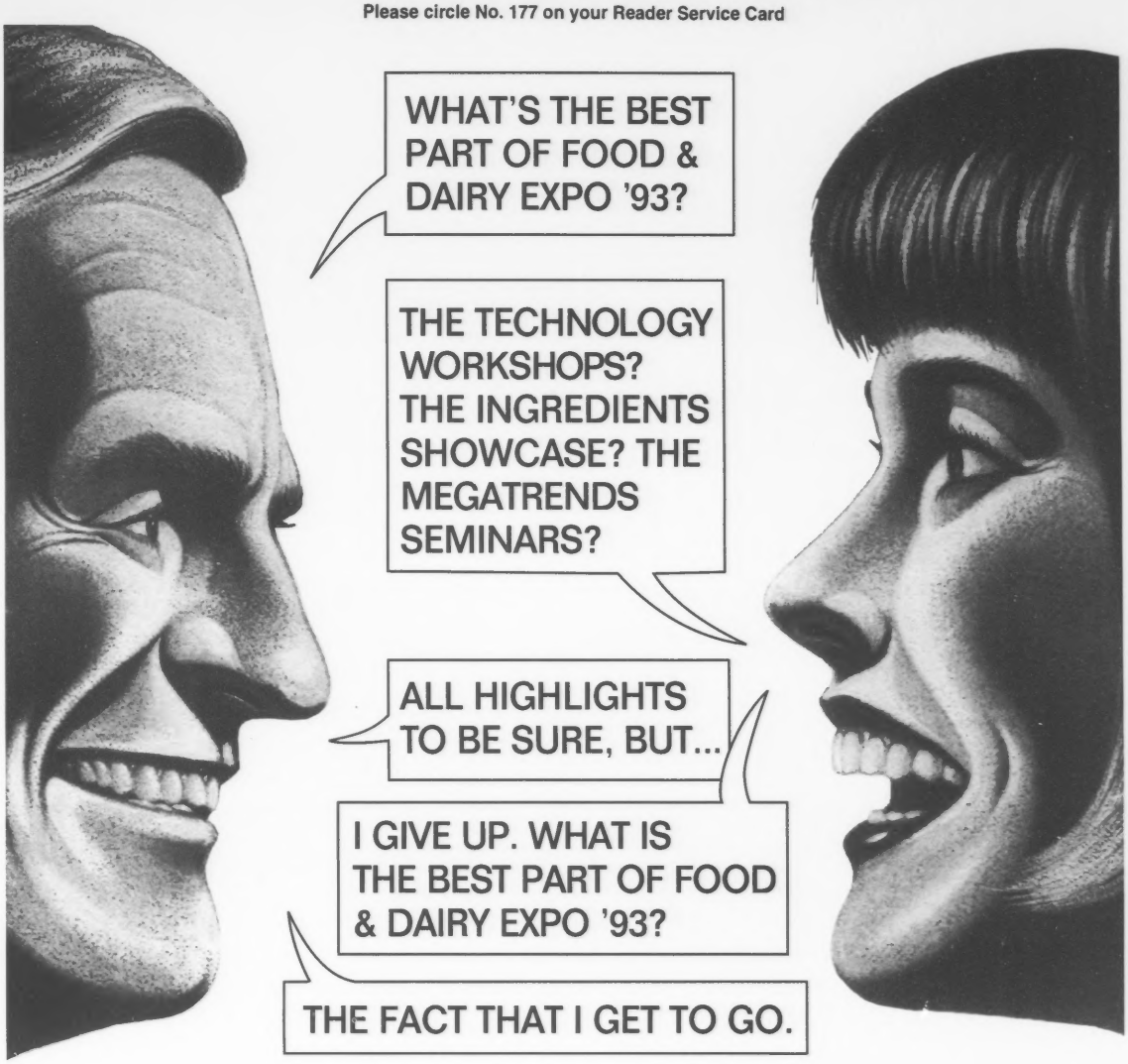

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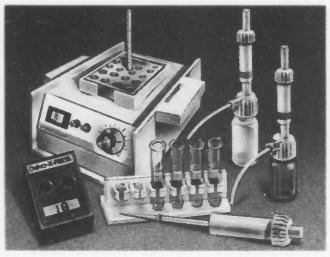

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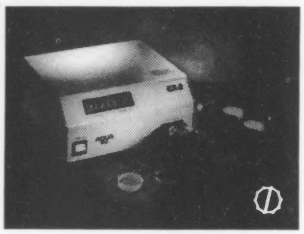

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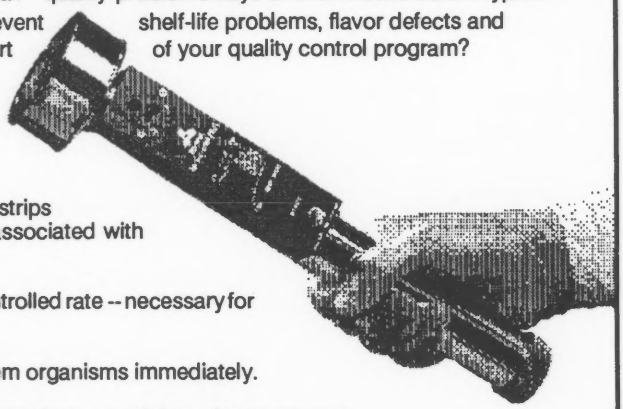

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Thoughts From the President . . .

By
Harold Bengsch
IAMFES President

During the past three years that I have been privileged to serve on the IAMFES Executive Board, I have been continuously impressed with the dedication of the many Committees, Professional Development Groups and Task Forces whose members contribute so much of their time and energy to this organization.

Without that dedication and commitment, it would be impossible for the Executive Board to carry forward the vast array of activities which make this association both unique and great.

The design of this association is truly built around the philosophy of professional enhancement and service to its members. This philosophy is what makes all of the volunteer efforts so essential to the continuing success of our association.

As we look to our long range planning efforts and the impact of global economy upon our varied professional responsibilities and interests, we must ask ourselves some very soul-searching questions. Among these questions are:

- What strengths do our committees, work groups and task forces bring to the table of organizational capacity?
- Are there any needed changes in the focus of their efforts?
- Do they have the needed resources to accomplish the tasks for which they are held responsible?
- Is the Executive Board reacting to their concerns in a timely manner?
- As IAMFES become more involved at the international level in concerns of food protection and environmental sanitation, what challenges lie ahead for our committees?

I am sure the list could go on. These are but some of the questions the Executive Board will be addressing as we move through this new year. In other words, it is time for "visioning" to be taking place. The Executive Board is preparing for that process.

Perhaps many readers are already aware of the scope of volunteer activities that so greatly serve this association. For those who are not, the following provides a listing of the various Committees, Professional Development Groups and Task Forces.

COMMITTEES —
41 members total

- Journal of Dairy, Food and Environmental Sanitation Management
- Journal of Food Protection Management
- Nominating Committee
- Program Advisory Committee
- Past President Advisory Committee
- Teller Committee

PROFESSIONAL DEVELOPMENT GROUPS —
117 members total

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- Council of Affiliates

The total 47 members of the Task Forces does *not* include the number of affiliate delegates.

When one looks at the magnitude of overall volunteer services through the committees, professional and development groups and task forces, the importance of that service to our association becomes obvious.

As your incoming president, I want to express my appreciation for the efforts of each and every member. It is also my desire to assure you and all our membership that the IAMFES shall not lose sight of our association's history that has made us great and the potential that the future holds for enhancing our organization's position of leadership in the field of food protection and environmental sanitation.

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On My Mind . . .

By
Steven K. Halstead, CAE
IAMFES
Executive Manager

is flooding....

Its hard not to think about flooding if you live in Iowa this summer. Nearly everyone who has called me this week has inquired about the situation--even a salesman from New York City!

I suppose that those of you who have never visited Iowa expect it to be flood prone. You have been led to believe that Iowa is table top flat. Once and for all, Iowa is not flat! While there are some ancient lake beds that are very flat, for the most part, Iowa is best described as gently rolling.

Because of our hills, we have a great many rivers and streams. Just like everyplace else, our towns and cities built up along these streams because they were sources of power and transportation. Just like everybody else, we built our cities right to the edge of the water. When the streams get full, the cities get wet. You've seen enough pictures to know that many Iowa cities are wet--very wet.

To give you an example of what it is like here, my highly unscientific rain gauge showed nearly two inches of rain on Monday; nothing on Tuesday; a quarter of an inch on Wednesday; one inch on Thursday; and two and a quarter inches so far on Friday. Last week was about the same and the week before and the week before and the week before...

The eight month period from November, 1992 through June, 1993 have been the wettest in our recorded history. The ground is so saturated that rain no longer soaks in. It just runs off into the rivers. It is so wet that one inch rains are causing flash floods on very small streams and while you don't see pictures of these on the TV, these flash floods are killing people and destroying homes and businesses.

I ask you to change your focus for just a minute. Get the picture of rushing water out of your mind and replace it with a picture of mud. Lots of mud. Mud everywhere you look. Hundreds of thousands of acres of mud. Literally millions of acres of mud.

That's what Iowa really looks like right now. And that's the real problem--and the one that will impact far more people than the rushing water.

That impact will come from the acres of cropland that will not bear a crop this year. The Iowa farmer is perhaps the most modern farmer in the world--he/she can take huge tractors and equipment and plant hundreds of acres of corn and soybeans in hours. If the soil conditions are right. Mud is not the proper soil condition for planting crops.

The experts say that over a million acres of Iowa cropland will not be planted at all this year because of the wet conditions. That will be the real cost of the flood.

You see, a city dweller may lose his/her home to the flood water, but still has a job to go back to. If a farmer can't plant a crop, he/she has no other job. And no income for over a year. To me, that is the tragedy. And it is one nearly all of us will feel in both the quality of food that is available and the prices we will have to pay for it.

To tie in food protection, we believe that plant stress somehow contributes to the formation of aflatoxins. We generally think of drought as a significant factor. What about excessive moisture? What about mold formation? These and related questions will have to wait until harvest time--if it dries up enough to harvest!

And the weather forecast for tomorrow is...RAIN!

Dairy, Food and Environmental Sanitation, Vol. 13, No. 8, Pages 450-453 (August 1993)

Improving Inspection Scores Through Training/Certification of Foodservice Workers

Albert Metts, Dr. P.H. University of Wisconsin-Eau Claire, Eau Claire, WI 54702-4004; and
Vay Rodman, Dr. P.H. University of Wisconsin-Whitewater, Whitewater, WI 53190

ABSTRACT

Currently there is renewed interest in foodservice worker certification programs. This paper briefly examines published research findings on this topic and offers suggestions for the successful development and implementation of future programs. While the programs should be oriented toward improved establishment sanitation, the following major functions are expected to be associated with successful outcomes: standardizing regulatory agency inspections, industry self-inspections, adjusting inspection frequency to level of compliance, coupling training/certification with enforcement actions, and evaluating performance of certification programs. Improved cooperation between the foodservice industry and the regulatory agencies is stressed.

The enactment of state and local legislation in the United States that requires commercial foodservice operations to be regulated according to certain sanitation standards, as specified in regulations (frequently patterned after the Model Food Service Sanitation Ordinance of the U.S. Food and Drug Administration (1)), date back to the nineteenth century when the classic "Shattuck Report" (2) was published. Following as an adjunct to such legislation, has been the voluntary training and certification of food service workers. Many regulatory agencies with food protection responsibilities have encouraged those functions within the foodservice industry and some actually provide the training (either on a sporadic or routine basis). The content of the training courses usually involves the basic principles of food protection/sanitation and may include topics relating to food microbiology, prevention of contamination, product temperature control, warewashing, good housekeeping methods and other code requirements. Some training programs require the participants to take a written examination at the conclusion of the course, but some do not. Other programs conduct pre- and post- examinations to determine cognitive gain as a result of having completed the course (3).

The need for training in the foodservice industry has long been recognized within the industry and among the regulatory agencies, but some local and state laws now have mandated training and certification provisions. This represents legal actions that go far beyond requirements for meeting minimum sanitary conditions and practices in the foodservice industry. Such laws are actually aimed at requiring foodservice workers to acquire a certain level of public health knowledge that is specific to food protection.

The rationale for the enactment of mandatory training and certification laws would appear to be much the same as that for regulating foodservice operations in general: (l) protection of the public's health i.e. prevention of foodborne diseases and unsanitary conditions/practices and (2) economic considerations which relate to the prevention of legal action against those establishments where foodborne illnesses occur (and can be proven), keeping unfair competition (unsanitary operations) out of the market: and maintenance of a favorable public image by the foodservice industry. Given that, it would appear that many more state mandatory certification laws would have been enacted by now. Even though state directors of regulatory food protection programs seem to favor at least voluntary certification programs, apparently only three states had enacted such laws in 1989 (4). There are several factors that may be responsible for so few state mandatory certification laws but the number of local laws within a state is likely to be a determining factor. Based on the experience in the state of Wisconsin (5), strong support for such legislation is most likely to be expected from the food industry (a necessity for enactment) when several local mandatory certification laws exist, especially when major differences exist between them.

Certification and Compliance

Although the motives of the foodservice industry for the support of state mandatory certification laws may parallel those of the regulatory agencies, they are probably not the same. For many years the foodservice industry has argued for one set of regulatory standards rather than several, some of which may conflict. The regulatory agencies' primary motive for state mandatory certification seems to center around improved compliance (with food protection regulations). The final answer concerning whether or not mandatory certification (or even training) actually leads to improved compliance levels has yet to be answered. The research results surrounding this question are, at best, mixed with little evidence to support a positive correlation. Of the five studies reported in the literature, three have indicated that foodservice sanitation training has led to improved inspection scores (3,4,6); however, two of those studies (3,4) were based on empirical evidence.

Kneller and Bierma (6) conducted a retrospective study of an unspecified number of establishments that were di-

vided into two groups according to the type of public served and the number of hours open per day (24 hours per day vs. less than 24 hours per day). Sanitation scores were plotted over a three year period prior to self-reported certification (before a foodservice worker from an establishment included in the study was certified) to predict sanitation scores after certification. Total sanitation scores were reported to have increased by "an average of 3.8 points over the scores predicted by trends in pre-certification scores." This increase was reported as statistically significant and apparently occurred over a period of approximately 18 months. Only those items in the structural category failed to show significant improvement while all the other categories (critical, critical-weighted by number of violations, procedural and procedural/structural) carried the positive side of the study and showed improvement. Although this study was much more objective in terms of answering the question of improved sanitation scores than the ones by Penninger/Rodman (3) or Speer/Kane (4), it is quite possible that the study was biased in several ways, some of which the authors acknowledged:

1. The establishments included in the study may not have been representative of all the establishments in the study area. The certification dates were reported to range over a ten year period but nearly one-half of the establishments that obtained certification of workers did so during the last year. Establishments that maintain higher sanitation scores may be more likely to have personnel certified before the establishments with lower sanitation scores. The effective mandatory certification date was January 1, 1992 (7). Therefore, unless all of the establishments in the study area had personnel certified prior to 1986, those establishments with the more inferior sanitation scores may have sought certification between 1986 and December 1990, thus being excluded from the study.
2. The average score improvement of less than four points might have been due to factors unrelated to certification, such as industry-wide improved sanitation practices, changes in ownerships that resulted in higher sanitation scores, and improved enforcement actions.
3. Two foodborne disease outbreaks occurred during the 10 year study period in the region which may have prompted at least marginal improvements in sanitation scores after 1983.
4. As with any retrospective study, bias may have been introduced because of recall difficulty. In this study the investigators made direct contact with the establishments to obtain information relating to "the earliest date when a certified food handler [foodservice worker] was on the premise."

The study results by Casey and Cook (8) and Wright and Feun (9) show a more negative side of the training/certification— compliance question. Casey and Cook determined that establishment sanitation scores among 22 foodservice workers who had completed the National Institute Foodservice Industry (NIFI) course were not significantly higher than the 35 establishments which had no NIFI trained worker. And interestingly enough, these investigators also found that the final NIFI examination scores were not "significant predictors of post-NIFI sanitation scores within the NIFI group."

Wright and Feun (9) arrived at similar conclusions from their prospective study conducted in the 1980s. In spite of the fact that the 28 foodservice managers who constituted the experimental group were largely self-selected (they agreed to participate in the training course after being asked to do so by the regulatory agency), no statistically significant difference was found between the "merit" scores (all inspection items) of the experimental group and the control group (27 managers who did not attend the training course). In fact, the merit scores generally increased in both groups from the pre-training inspection through the three post-training inspections with scores in the control group consistently running ahead of the experimental group in four item categories of the inspections (operational, operational-equipment-structural, equipment-structural, and total merit). Moreover, improvements in the operational and operational-equipment-structural categories among the experimental group lagged behind the control group: the opposite of that which would be expected from the training courses that were apparently operationally oriented.

Not only is there considerable doubt about improved sanitation scores as a result of training activities, there is scant published evidence that much is actually learned by the participants in the training programs. Penninger and Rodman (3) reported improvements in pre- and post- test scores in voluntary and mandatory training programs but that was based on a response rate of less than 35 percent of the agencies surveyed. Although Wright and Feun (9) have also reported improvements in pre- and post- test scores, the gain was not significant (81% vs. 85%).

In summary, the evidence linking the training of foodservice workers in food protection to improved establishment sanitation/inspection scores is tenuous. Therefore, the promotion of such training courses with the expectation of them producing an outcome of improved establishment sanitation could be disappointing, depending on the nature of predetermined goals and evaluation of the program for effectiveness. Nevertheless, under suitable conditions, training/certification may be one of several properly directed activities that have potential for the improvement of establishment sanitation.

Requirements for Successful Outcome

If the success of foodservice worker/manager training and certification programs is judged on the basis of improvements in establishment sanitation (and this paper argues for such as an appropriate measure of outcome) a balance of cooperative efforts by the regulatory agencies and the foodservice industry is essential. The foodservice industry's responsibilities include taking the training (learning), providing most of the training (especially in those areas where manager certification has been mandated), and cooperation with the regulatory agencies.

Although the foodservice industry must assume and demonstrate these responsibilities as indicated above, future successful programs will require considerable changes and additional program responsibilities among the regulatory

agencies as they perform their dual role of regulator and supporter of training. The following are some of the major functions that are expected to be associated with successful certification programs:

1. **Standardization of Regulatory Agency Inspections.**
   To the maximum degree possible, inspections made by the regulatory agencies must be stardardized within and between each jurisdiction. This will require a cooperative effort on the part of federal, state, and local officials. Until this is accomplished, meaningful program evaluations are not possible and the foodservice industry will continue to point this out as a weakness of food protection programs in general and outcome evaluation efforts in particular.

2. **Self-inspections**
   Greater emphasis will need to be placed on self-inspections in much the same way that the U. S. Environmental Protection Agency and many state regulatory agencies have emphasized monitoring and proper record keeping by permit holders regulated under the National Pollutant Discharge Elimination System (10). As more foodservice managers receive the appropriate training and thus become certified, they may be more willing to assume some, if not most, of the inspection responsibilities.

3. **Inspection Frequencies**
   The frequency of establishment inspections should be determined according to the level of compliance (9) and the nature of the foods being processed. In other words, assuming similar food hazards, the number of inspections per establishment should be on a gradient with the establishments operating under superior sanitary conditions receiving the fewer number of inspections and those which tend to operate under less desirable conditions receiving more.

4. **Support for Training**
   The regulatory agencies need to provide as much training support as possible to the certified foodservice managers without taking on an uneven distribution of the direct training responsibilities. A lack of training support by the regulatory agencies may be an important and sufficient reason for an apparent breakdown in effective training by certified foodservice managers (9).
   The Occupational Safety and Health Act (11) has authorized mandatory training of several occupational groups. For example, training is specifically required for workers exposed to bloodborne pathogens, asbestos, hazardous waste, and hazardous chemicals in laboratories (12). Also, training is a general requirement of the federal hazard communication standard (13). The public health reasons for foodservice workers receiving effective inhouse training in food protection are suggested as being at least equally important as mandatory training of other workers. In fact, there may be greater potential for poor food protection practices to adversely affect the health of more people (by causing foodborne diseases) than poor occupational health protection practices.

5. **Coupling Training/Certification with Enforcement.**
   As suggested by Wright and Feun (9), training and certification programs must be coupled with effective enforcement actions by the regulatory agencies. In fact, one could expect the foodservice regulatory agencies to assume more enforcement responsibilities rather than fewer; however, success may very well depend on changes in enforcement methods, e.g. greater emphasis on self-inspections, frequency of inspections according to compliance level, and so on. Certification without effective enforcement is unlikely to produce any desirable outcome results.

6. **Program Planning and Evaluation.**
   In order to determine the effect of training/certification on sanitation levels, the regulatory agencies have a responsibility to incorporate the effects of training into their program plans. Objectives should be quantifiable and outcome oriented in terms of foodborne disease prevention and improved sanitary conditions.

7. **Public Relations and Communications**
   The degree of success of training/certification programs depend, in part, on the public relations efforts by the regulatory agencies. Essential to desirable public relations are excellent two-way communications with the foodservice industry. It is through such efforts that the regulatory agencies can enhance their image as a helper (in terms of lending support to the training activities) and that would seem to hold some interesting possibilities for allowing the training to become a significant determinant of positive program outcome objectives.
   The regulatory agencies may need to initiate more changes in their programs than the foodservice industry in order to make training/certification have productive outcomes; however, the legal weight of responsibility for training seems to be shifting from the regulatory agencies to the foodservice industry. In that respect, it is ironic that the three states (Florida, Illinois, and Wisconsin) that have enacted mandatory certification laws are without mandatory registration of sanitarians (14). And, as pointed out by the National Conference for Food Protection (NCFP) (15), certification historically is a step beyond what traditionally has been viewed as registration.
   Certification in a legal sense may, although not by intent, regulate the activities of individuals. There has also been "strong sentiments" expressed by some NCFP committee members that regulatory officials should, at a minimum, be required to "demonstrate the same competency level as the industry officials" (15). Laws that require regulatory officials to be credentialed would also seem to hold promise as desirable image builders for the regulatory officials, not to mention the potential for improving program outcomes.

Although there is little evidence that foodservice worker/manager training/certification have been a significant factor in improving the sanitation practices of foodservice establishments, programs of this type may prove to be an important factor in moving sanitation scores upward. Improvements, however, will depend on the degree to which the foodservice industry and the regulatory agencies assume certain associated responsibilities.

Conducting training courses (a process) may improve the public relations of the regulatory agencies but is unlikely to result in desirable behavior change (outcome) among the foodservice workers/managers in the absence of firm enforcement actions. It is important that the regulatory agencies (federal, state and local) work together to arrive at valid and standardized inspections (a common complaint of the food industry). Other essential regulatory agency responsibilities include providing support for in-house manager directed training, emphasizing self-inspections by the foodservice industry, and basing the frequency of inspections on levels of compliance with prompt legal action against managers/owners who continue to operate substandard establishments. Training/certification activities alone are likely to serve only short term, self-interest, process objectives and are not strong enough to meet the more demanding outcome objectives that are dependent on change of behavior.

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Safety in the Processing Plant

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Safety in the workplace, specifically safety in food processing plants, was abruptly brought into the public's eye in 1991. It was on the Tuesday following September's Labor Day holiday when a fire broke out in the Imperial Food Products plant in Hamlet, NC, killing 25 people and hospitalizing 56 more.

The plant was producing chicken nuggets and marinated chicken breasts for fast food and grocery sales. The fire began with a rupture in a hydraulic line powering a conveyor belt that carried chicken parts to the deep-fat fryer. The hydraulic fluid and vapors then came into contact with the gas jets heating the fryer and burst into flame. The fire generated thick choking smoke, which likely was the cause of most of the deaths.

What made this tragedy even more terrible was that plant workers were unable to escape. At least two fire doors were padlocked, and another was blocked by a delivery truck. (1,2)

In the aftermath of the fire, 83 additional safety violations were discovered. Among these were a sprinkler system, which apparently did not work, locked exits, inadequate lighting and unmarked exits. It was also discovered that the 11-year-old facility had never been inspected by the state safety officials.

Imperial Food Products owners have been fined $808,150 for these and other violations by the State of North Carolina Labor Commissioner. (3) Heavier fines are expected once federal officials complete their investigation. Criminal indictments were handed down in March 1992 against two owners and the plant's manager. Imperial has also closed its other plants and disconnected telephones at its former headquarters.

This was, obviously, a tragedy of monumental proportions, especially in a small town. Legally, the fault lies with management. They were the ones responsible for operating a safe plant and failed to do so, and they will be the ones who will pay.

What makes this even more tragic is that some blame must also be placed on the work force, including several of those who paid with their lives as a result of the accident. Interviews with survivors indicated that doors were routinely locked to prevent workers from stealing chickens. (4) Some of the conditions that caused people to die were, therefore, present before the fire, yet the employees elected to continue working in what was obviously an unsafe plant. Participative management practices probably would have prevented the entire scenario.

This is the point that we wish to focus on in this piece, that is, safety is everyone's responsibility. Management is ultimately responsible, but each worker must contribute to assuring that the workplace is safe.

The Imperial Food Products fire did more than destroy a plant and kill people. The incident galvanized regulators to take a closer look at worker safety and the agency, the Occupational Health and Safety Administration (OSHA), that is responsible for ensuring worker safety.

The feelings of some of our Representatives is that OSHA is not doing a good job. They feel that OSHA must take a more active role in enforcement at the state level, believing that the federal law allowing states to set up their own worker safety regimes is inadequate. OSHA workers state that they do not have the resources or manpower to police the thousands of locations under their jurisdiction.

OSHA is not totally ineffective, as some will have you believe. This federal agency is generally more stringent than the states. In 1990, OSHA issued citations for more than 99,000 violations and collected fines totaling $63,000,000. These figures are two to three times greater than those levied by the states. (4)

New legislation is probably on the way, however. In Congress, proposed bill S.1622, H.R. 3160 includes the following provisions: (4)

- Committees: Employers with 11 or more workers must set up management/employee committees to review safety and health plans and records, conduct inspections and make recommendations.
- Standards: States with weak safety plans would have six months to improve before the federal rules take over. Also, timetables would be set for issuing safety standards.
- Enforcement: Inspections would be required after complaints or if two or more workers are hospitalized. Employers would have to correct violations more quickly and would face stiff penalties if they don't.
- Worker Protections: Workers would have stronger rights to refuse hazardous work.

A recent survey conducted by the National Workplace Institute ranked the 50 states for job safety performance using a formula that incorporated prevention laws and workman's compensation. (5) They found that the safest two states were California and New Jersey, with Arkansas bringing up the rear. North Carolina ranked 24th. The

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article states that even California has a great deal more to do, even if they are No. 1.

Where does the baking and snack industry stand on safety issues? To the uninitiated observer, a food processing plant may seem like a very dangerous place. There is constant activity, much of which probably seems disjointed. The machinery or unit operations may seem threatening. There are slicers, choppers, kneaders, sheeters, blenders, grinders, mills, cutters, dicers, ovens, fryers and a whole host of other intimidating units. Many of the units are marked with the "Danger" or "Pelligro" sign that shows four fingers with the tips separated dripping blood.

Move beyond the equipment and you have cleaners and sanitizers, all marked as being poisons. There are insecticides and rodenticides, marked with skull and crossbones. There are toxic chemicals used in the laboratory. Some of the food ingredients may be dangerous in large concentrations, and unrestrained powders can flash or explode.

There are also steam lines, hot water lines, hydraulic lines, high-pressure air lines, gas lines, gas cylinders, electrical lines and oil lines.

Workers must deal with wet or oily floors, lift trucks, heat, cold, steam and repetitive, often mundane tasks. The processing plant is basically an assembly line in which workers repeat the same tasks hour after hour, day after day. Monotony can lead to loss of concentration with dire consequences, and carpel tunnel syndrome (repetitive action) injuries can slow responses needed to avert accidents.

So is a food plant an inherently unsafe place to be? Probably not, and statistics would probably bear this out. It is an environment where one has to know his or her job and take care to do it properly. In fact, many plants are proud of their safety records and proclaim it to all visitors. Signs hang near the entrance with spaces to chalk in numbers. These signs read:

"This facility has gone ____ days without losing time to a work related injury."

But we have also seen some of these signs that are very old and have obviously not been updated in recent years.

What Drives Safety? How does a company go about assuring the safety of its employees? There are certain points basic to worker safety. These happen to be very similar to those that apply to food safety, plant sanitation and other operations. They include:

- Management commitment to assuring a safe workplace.
- Education of management and staff.
- Safe plant design and maintenance.
- Proper equipment design and maintenance.
- Knowledge of adherence to federal, state and local safety regulations.
- Posted warnings or directions.
- Monitoring to assure compliance.
- Maintenance of records of inspections and upkeep.
- A commitment by all to maintain a safe environment.

Why maintain a safe work environment? The first and most obvious reason is to protect the workers. Besides the pain to the injured party, injuries cost the company in many other ways. Losing a skilled worker means reduced operational efficiencies.

Each injury must be investigated. Depending upon the type of injury, there will be time spent working with insurance adjusters and examiners, fire marshals, OSHA employees, Environmental Protection Agency (E.P.A.) officials, or officials involved with enforcing the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA). (6) In many cases, more than one agency will appear, each with their own view on the matter. The operation is also liable for fines, depending upon what the agents discover.

Any time an agency is involved, there is the potential for adverse publicity. Investigative news reporters love to research such leads, and too often these persons ignore the good things (or reality) in pursuit of a story whose main sources are Mr. Hearsay and Ms. Innuendo.

Another reason for maintaining a safe work environmental is liability. Each time there is an on-the-job injury, the company's insurance takes care of it. With each injury, there is a potential for a rate increase. The California Association of Insurance Companies has objected to the spiraling costs of insurance in their state; (5) and this is the state that has the top job safety rating!

Assuring Worker Safety. How does a company go about assuring worker safety?

Management commitment: Everything starts at the top. If management is behind something and committed to it, that program has a very good chance of succeeding. This is one of the points that proponents of Hazard Analysis and Critical Control Points (HACCP) constantly emphasize.

Education: All supervisory staff and workers must be given a basic class in worker safety. This program should include plant safety rules, specific safety issues for each work area, a specific description of where required safety regulations and such are posted, a statement of the rights of a worker ("Right to Know"), First Aid instruction, how to behave in a fire, and both manager and worker responsibilities for their own safety and for others. It may be this last point where the workers at Imperial Food Products failed.

CAL/OSHA (California OSHA) specifically states in their "Model Injury and Illness Prevention Program" that workers who "follow safe and healthy practices will have this documented in their performance reviews." (7) It also states in boldface type that "No employee will be retaliated against for reporting hazards or potential hazards or making suggestions related to safety."

Safe plant design and maintenance: The work environment contributes to a person's attitude about safety. A plant that is designed so that it is difficult to maintain or get around in will be more prone to problems. This is not so much of a problem with new plants, but old ones can be nightmares.

There should be easy access through work areas, easily accessible exits with lit signs, good lighting, floors and walls that are easily cleanable, floors that are non-skid and safety walkways to avoid confrontations with vehicles. The accesses in particular need to be maintained.

Equipment design and maintenance: Equipment should be designed and maintained so that it is safe and operates properly. Each unit should be checked regularly.

The hydraulic line that ruptured at Imperial may have shown signs of failure. The mayor of Hamlet said that a safety inspection could not have prevented the incident: "... a hose broke, and a safety inspection would not have prevented it." (8)

Who knows if it would have or not, but most items that fail usually show some indicative sign of impending failure. Workers must also use equipment as it was designed to be used.

Knowledge of and adherence to federal, state and local safety regulations: All employees have a right to know what are the laws governing their industry. It is the responsibility of management to make these laws and regulations known and to develop programs so workers are updated and aware of new developments. They must also implement programs to assure compliance with the regulations.

Not knowing something was required is no excuse. One point that is new in California involves the reclassification of anti-microbials — disinfectants, sanitizers and bacteriostats — as pesticides. These materials now require the same regulatory labels as insecticides, rodenticides and other pesticides. (9) You also still need the appropriate Material Safety Data sheets on file.

Posting of appropriate warning/directions: Regulations require that a large number of operations be marked. Areas where toxic materials are stored need to be marked appropriately. All dangerous materials need to be labelled. Danger signs should be posted on equipment. Exits should be marked. And handling protocols for substances need to be stated. There are many more examples.

A simple marker, which all too few plants use, is color. For example, steam lines might be red, cold water lines green, oil lines yellow, etc. This will prevent people from touching hot pipes or lines and burning themselves.

Monitoring to assure compliance: This is common sense. There should be a safety committee in all plants whose task is to monitor safety concerns. They should be aware of such issues at all times while on the job and plan safety inspections at regular intervals.

It is also recommended that companies invite an outside agency or third party in to inspect the facilities. CAL/OSHA offers free consultation services through CAL/OSHA Consultation Services without citation or penalty. These consultation services include:

- Information, advice and recommendations on specific safety and health problems in the workplace.
- Help to the employers in instituting an effective accident and illness prevention program or improving an existing program.
- Training in good safety and health practices, and in recognition and correction of hazards through on-site surveys. (10)

Similar services are offered by other organizations such as the American Institute of Baking. (9)

Maintenance of records of inspections and upkeep: Record keeping is essential in any operation, especially in a food plant. Without records, problem solving is hamstrung, performance histories of equipment are unknown, and maintenance and/or replacement of parts or equipment can be compromised. If a manufacturer's recommendation states that a part must be replaced every 1,000 hours, how do you tell where you are in that cycle? If you wait for it to fail, failure could be catastrophic, like that hose at Imperial Food products.

You should also maintain records of inspections, both internal and external. This allows you to observe progress toward what is hopefully a more safe environment. This can be a part of a Total Quality Management (TQM) program.

A commitment by all to maintain a safe environment: Safety is everyone's business. Each line worker is responsible for maintaining a safe work area for himself and others. This also includes maintaining himself in a condition wherein he is not a hazard to himself or others. This is where the issue of drug and/or alcohol testing comes in. Such tests may be a violation of individual rights, but if an individual comes to work intoxicated, he or she is a menace to others. Supervisors and fellow workers should take steps to get that person out of the workplace. Workers are not doing anyone any favors by protecting an alcoholic or drug abuser. The actions of an individual not in control of their faculties can hurt others.

Worker safety is crucial to operating a food plant. People must be made to feel that management has their best interests at heart. The key is one set of rules for all and no deviations.

One safety/sanitation issue that crops up on occasion is wedding bands. Good Manufacturing Practices state that insecure jewelry should be removed or covered. People often cannot remove wedding bands and fail to cover them. The band probably will not fall off and get into the food, but we have all met persons who are minus a finger because the band got caught, and the machinery took the whole finger.

Management can show their commitment to safety by going beyond the laws and trying to anticipate anything that might go wrong. This is a similar approach to the HACCP system. HACCP is a proactive system developed to identify food hazards and control them by establishing and monitoring Critical Control Points or CCPs. (11) Take the same approach to worker safety. Look at the plant, processing equipment, work stations, transport lanes and the workers themselves. Put yourself in the shoes of the infamous Murphy who wrote Murphy's Law ("Anything that can go wrong will go wrong.") and determine what can go wrong. Develop systems to prevent these events from happening.

Let's look at Imperial Food Products as an example. Could the company have used a non-flammable hydraulic fluid? Maybe food processors should get away from operating direct-fired gas fryers and move to external heat exchangers. There's also the alternative of assuring sufficient fresh air makeup to ensure against flash-backs and worker anoxia while yielding comfortable working conditions. Should gas masks be located in a plant? How often should we test the sprinkler systems or CO_2 systems?

Be proactive; try to anticipate.

There is one thing, however, that no one can anticipate. That is, for want of a better word, worker stupidity. What percentage of the injuries in a plant are caused by workers taking a short cut, using the wrong tool for a job or trying

to do something without shutting off the machine? We heard recently of a woman who had her finger crushed because a rag she was using to clean a moving belt got stuck in the machine and pulled her finger into the unit. The employee was perhaps careless, but management pays and is at fault. The bottom line is "safety is everyone's responsibility," so management must make sure that all employees work with that in mind and that they know management is behind them.

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Zoonotic Origins of Human Salmonellosis in Australia

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Summary

The most common serovars in the human population of Australia are found in food animals, however there are differences in both the distribution of serovars and also phage types between different animals and human isolates. The distribution of serovars in the human population indicates that all food animals provide a source of Salmonella for the community, although serovars differ in their significance across the animal and human population. Geographical distribution is also a significant factor and some regional localisation cannot be attributed to food animals.

Introduction

The level of human Salmonellosis in Australia has not changed significantly over many years and there have not been major changes in the range of serovars. Infections are classically associated with foods of animal origin although in Australia not all serovars follow this pattern. There has not been an emergence of Salmonella serovar Enteritidis (S. Enteritidis) as a major serovar as has occurred in Europe and the USA during the 1980s. S. Enteritidis has always been part of the Salmonella flora in Australia, being isolated at a low frequency with the most common phage types being 4 and 26.

Serovars from food animals show some similarity to those from humans although there are significant differences. The most dramatic difference is the dominant serovar in chickens, S.II Sofia which is uncommon in humans yet in 1990 accounted for 67% of all isolations from chicken.

Materials and Methods

Serotyping is performed by standard methods. Phage typing is performed by the method of CALLOW (1959) for S. Typhimurium, an unpublished scheme developed by the author at the Australian Salmonella Reference Laboratory (ASRL) is used for S. Bovismorbificans and the scheme of WARD et al (1987) is used for S. Enteritidis. The distribution of serovars is extracted from records collated at the ASRL and the National Salmonella Surveillance Scheme (NSSS).

Results and Discussion

The most common serovars isolated from humans in 1990 are shown in Table 1. The distribution and frequency of serovars in the top 10 has not changed significantly over a number of years.

Table 1. The 10 most common serovars isolated from humans in 1990 showing the total recorded and the percentage of total isolations.

Serovar	Number	%
Typhimurium	2045	38.0
Virchow	266	4.9
Bovismorbificans	221	4.1
Saintpaul	219	4.0
Anatum	150	2.8
Chester	149	2.8
Muenchen	147	2.7
Birkenhead	145	2.7
Infantis	139	2.6
Heidelberg	128	2.4
other serovars	2074	33.0

The frequency of isolation of the top 10 serovars from humans in 1990 compared with the frequency of those serovars from food animals and occurrence in raw red meats in the years 1984-1990 is shown in Table 2. The number of isolates recovered from some food animals is low, as apart from chickens, there is no routine monitoring, hence the extended period is used to provide more representative data. The data presented is extracted from records of 5683 human cases acquired in Australia, 3077 bovine, 1575 ovine, 1347 porcine, 3348 red meat and 27094 chicken isolates. The numbers reflect the level of testing rather than the level of Salmonella contamination.

Table 2. The 10 most common serovars from humans in 1990 and their frequency in food animals and red meats over the period 1984-1990.

Serovar	Humans %	Cattle %	Sheep %	Pigs %	Chicken %	Red Meat %
Typhimurium	38.0	39.5	58.3	14.0	22.2	8.4
Virchow	4.9	0.1	-	0.1	1.2	2.5
Bovismorbificans	4.1	2.9	25.9	4.5	0.9	7.5
Saintpaul	4.0	0.7	0.1	0.4	0.3	1.8
Anatum	2.8	1.6	0.3	15.1	4.3	11.0
Chester	2.8	0.6	0.2	0.7	<0.1	3.7
Muenchen	2.7	0.3	0.1	0.6	0.7	2.4
Birkenhead	2.7	0.2	-	-	<0.1	<0.1
Infantis	2.6	0.1	0.7	3.2	3.9	9.2
Heidleberg	2.4	-	0.2	0.6	0.5	0.5

Bovine, ovine and porcine isolations are predominantly from veterinary investigations of animals, chicken isolations are from extensive routine monitoring which is carried out by the broiler industry and the red meats are from abattoir and meat processing. There is no routine monitoring of Salmonella performed by meat producers other than the chicken industry. The red meat and chicken isolates do represent the serovars being distributed directly into the human food chain by these meats.

Phage typing of *S. typhimurium* and *S. bovismorbificans* provides more useful information about the distribution of strains across the range of food animals in an effort to follow the spread into the human food chain.

The 10 most common phage types of *S. typhimurium* in humans are associated with food animals although there are differences in the frequency of occurrence in animals. These phage types from humans for 1990 compared with the frequency of these types in food animals for 1987-1990 are shown in Table 3.

Table 3. Frequency of phage types of S. Typhimurium from humans in 1990 compared with their frequency of isolation from food animals in 1987-1990.

Phage type	Human %	Cattle %	Sheep %	Pigs %	Chicken %
9	16.6	21.4	26.9	1.3	0.7
135	11.8	16.7	4.4	2.7	15.4
170	6.4	1.4	-	-	0.6
20	4.8	0.1	0.7	1.3	0.1
Untypable	4.3	4.0	8.2	19.2	17.9
145	4.2	-	-	-	6.8
12a	3.8	3.5	0.9	5.4	0.5
108	3.3	2.6	2.4	-	1.7
179	2.8	-	-	-	4.4
101	2.6	0.2	0.2	-	-

These figures indicate that cattle and sheep are the main contributors of phage type 9, the most common type, while phage type 135 is significantly associated with both cattle and chicken. The untypable strains could be differentiated by the phage typing scheme which is unable to distinguish between the pig and chicken strains and the human strains. The untypable strains in chickens did not persist. Phage type 20 was common in humans during 1990 but did not persist. It was found in low frequency in animals over a similar period but again did not become established. Phage types 145 and 179 have been chicken types for many years. All the top 10 phage types in humans are found in at least one animal source.

A number of serovars do show distinct geographical distribution. S. Virchow is a common serovar; for many years it has been the second most common serovar from humans in Australia, although it is mainly confined to Queensland. It emerged in Australia in the 1970s. In Queensland, the highest attack rates in humans are found in the north, in the Townsville and Cairns region (tropical climate) where ASHDOWN and RYAN (1990) reported rates of infection in humans with S. Virchow approximately 10 fold higher than in the more southerly, Brisbane region which is sub-tropical. More than 70% of the isolates are found in the 5 month wet season. Further south in the temperate regions, the serovar is uncommon. The serovar is found in chickens in Queensland at a low frequency; is found in beef in northern Australia and has also been found in horses and horse meat in Queensland. The geographical localisation of the serovar has been constant for many years but there is no information as to the reasons for its localisation. A number of serovars do show geographical localisation as noted by MURRAY (1991).

S. Bovismorbificans has been a significant serovar in Australia for several decades. It is commonly involved in human infections and is common in food animals. The serovar has been phage typed in Australia since 1980, using an ASRL developed scheme. The range of phage types in humans and animals shows that not all phage types are found in all animals and that some phage types are associated with particular animal sources. The 10 most common phage types in humans and their frequency of occurrence in animals for the period 1987-1990 is shown in Table 4.

Table 4. The 10 most common phage types of S. Bovismorbificans in humans and the frequency of occurrence of these types in food animals for 1987-1990.

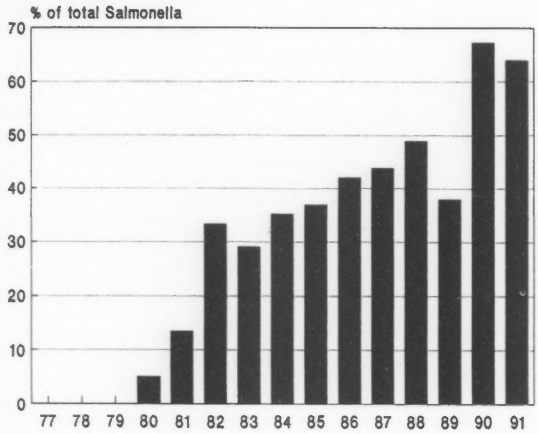
Phage type	Human %	Cattle %	Sheep %	Pigs %	Chicken %
7	27.3	25.0	3.6	-	-
13	16.4	6.3	2.1	13.3	-
4	11.3	31.3	27.8	-	-
23	8.5	6.3	19.6	3.3	-
24	7.2	-	8.2	3.3	-
14	4.5	6.3	-	36.7	51.9
21	4.4	6.3	13.4	-	-
16	2.8	6.3	1.0	3.3	-
11	2.0	-	0.5	-	-
12	1.9	-	-	13.3	42.3

Another type, phage type 10 accounts for 16% of isolates from sheep but is found in only 1.5% of human infections. Other less common phage types are found in food animals as well as humans.

S. Saintpaul is found from humans in all states of Australia, although Queensland isolates account for over 50% of all human isolates. It is not common in food animals, with less than 10 isolates per year being recorded from cattle, sheep, pigs and chickens combined since 1987. The serovar has been recorded only once in sheep in 8 years. It had been common in chickens in the early 1980s, accounting for up to 11% of chicken isolates in 1978-1980, but rapidly declined in chickens from that time, accounting for well below 1% of isolates since that time. This serovar declined as S.II Sofia spread through chickens. However, while the incidence of S. Saintpaul declined significantly in chickens, there has been no decrease in its incidence in humans. Its low level of occurrence in food animals suggests that they may not be a direct source of this serovar for humans and other factors may be involved.

S. subspecies 2 serovar Sofia (S. II Sofia) is an interesting serovar in Australia. It appeared in the broiler industry in mid 1980 and rapidly spread throughout the flocks. Since that time it has constituted almost 50% of

Figure 1. Frequency of isolation of Salmonella subspecies 2 serovar Sofia among Salmonella isolates from chickens in Australia from 1977 to 1991.



Salmonella isolations from chickens and this frequency is continuing. Figure 1 shows the annual frequency of this serovar among chicken serovars. It does not appear to have any pathogenic effects in chickens and more importantly is effectively a non-pathogen for humans. It accounts for only 0.3% of human isolations and was present in humans before appearing in chickens. The level of S. II Sofia infection in the human population did not change with the spread of the serovar in poultry even though humans are undoubtedly exposed to this serovar.

S. Anatum is found in humans in all states of Australia, but less frequently in Tasmania (only 2 isolates in 4 years 1987-90) than in other states. The disproportionately high number of cases in Queensland seen with S. Virchow and S. Saintpaul do not occur with S. Anatum. The serovar occurs in cattle, sheep, pigs and chickens and is now the third most common serovar in chickens although averaging approximately 5% of isolates from this source. Its frequency of occurrence in chickens did not change with the spread of S.II Sofia in chickens. S. Anatum is commonly isolated during surveys of raw red meats (17% in 1990). It is found from a wide variety of sources including animal feeds as well as environmental sources including water and environmental animals. Its occurrence in humans appears to be directly related to its occurrence in food animals.

S. Chester has been part of the Salmonella flora of food animals for many years, albeit at a low frequency. The distribution in humans, food animals, environmental animals, water and the environment is virtually the same as for S. Anatum although at a lower frequency. It is rarely seen from chickens with only 2 isolates in the 4 year period 1987-1990; it had been more common early in the 1980s but its incidence decreased with the spread of S.II Sofia through the chicken population. The incidence in humans has remained unchanged for many years and did not decrease with its decline in the chicken population.

S. Muenchen is also found at a low frequency in all food animals as well as being isolated from environmental sources as seen with S. Anatum and S. Chester. There has not been any significant change in the distribution and frequency of the serovar for many years although it has been involved in 2 large outbreaks in the early 1980s; one associated with chickens in Western Australia and the other from an unknown source in southern Queensland.

S. Birkenhead is one serovar which has shown an increase in humans during the 1980s, increasing approximately 3 fold since the 1970s. The majority of cases are found in Queensland, more commonly in the southern parts of the state and with a narrower geographical distribution than with S. Virchow. It is a rare serovar in food animals, which do not appear to be a significant reservoir of the serovar. Isolates are occasionally seen from the environment including water. The serovar is probably dispersed in the environment and passed to humans.

S. Infantis has been a common serovar in humans for decades, and its frequency has not changed significantly for many years. It is found in all states of Australia and does not show geographical bias as seen with some other serovars. It is found in all food animals however it is more common in pigs than other animals. Its frequency in chickens has decreased since the spread of S. II Sofia. It is common in meats used for small goods (mixed beef and pork).

S. Heidelberg has emerged as a common serovar from humans in Australia since 1984. Previously, isolations had been rare (0-6 isolations per year). Human notifications peaked in 1988 with 268 cases - some associated with an outbreak in Queensland, but decreased in following years, with 128 cases in 1990 including some associated with another outbreak. A strain with multiple antibiotic resistance appeared for some time in Victoria. The number of outbreaks associated with S. Heidelberg is more than would normally be expected for a less common serovar, suggesting that it may have some characteristics which increased its virulence compared with some other serovars. An increased incidence of S. Heidelberg was reported in France by LE MINOR and GRIMONT (1989) in the early 1980s but its frequency then decreased.

As S. Heidelberg increased in frequency in humans it appeared in food animals. It was first seen in raw meats for small goods manufacture in 1983, pigs in 1984, chickens in 1985 and sheep in 1986; however it did not appear to spread in food animals as it did in humans. A phage typing scheme was developed at ASRL for this serovar. Phage type 1 accounts for over 50% of isolations from humans and most isolates from food animals. Phage type 2, the second most common type in humans (25% of isolations) is rarely isolated from animals. Food animals are a likely source of phage type 1, however the sources of other phage types are not clear. The source of the serovar into the Australian human and food animal chain is unknown, but one could speculate that it was imported.

The most common serovar in each group of food animals does show species specificity. S. Dublin is 44.3% of bovine isolates but 0.2% of human, S. Typhimurium is 58.3% of ovine, S. Derby is 15.5% of porcine but 1.9% of human and S.II Sofia, over 50% of chicken with only 0.3% of human isolates.

Conclusions

Food animals appear to be a significant source of Salmonella for the human population as has been widely accepted. There are significant differences in the distribution of strains among the major food animals in Australia. The distribution of serovars in chickens in Australia is different from that reported from many other countries.

The diversity of Salmonella serovars between human and animal species, adds further evidence that Salmonellosis should be regarded as a range of diseases with respect to their epidemiology.

Caution should be used in attributing the sources of Salmonella for human infections to animal groups without detailed consideration of the serovars and phage types involved. There has been a trend to regard chicken as a major source, although the information in Australia shows that some of the most common strains in humans are from other animal sources. The poultry industry does far more extensive monitoring than other meat producers and the numbers of isolations annually from chicken compared with other meats reflects the level of testing rather than the level of contamination.

Geographical differences in the distribution of serovars cannot be explained by the occurrence in food animals and offer another direction for study of factors influencing the spread of serovars into the human population.

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Milkline Cleaning Dynamics: Design Guidelines and Troubleshooting

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Introduction

Most modern milking systems are cleaned using air injected CIP systems. Cleaning and disinfection is accomplished by a combination of physical, thermal and chemical processes. The circulation of sufficient volume of cleaning solutions at sufficient velocity and temperature is required to adequately clean milk contact surfaces. Failure of CIP systems often results from inadequate velocity or contact time of the cleaning solution. A small amount of residual soil can facilitate bacterial attachment, survival and growth. If not inactivated or removed during cleaning, remaining bacteria may eventually detach and contaminate the milk supply. This may affect the quality, and if pathogens are present, safety of the milk.

Current methods for clean-ability assessment of CIP treated milking systems employ microbiological tests (standard plate count). There are several limitations to the use of these tests. First, they require several days to obtain results, and second, it is difficult to locate the source of the cleaning failure. Cleaning problems are generally detected by elevated bacterial counts in the product after many soiling/cleaning cycles. When this occurs, bacterial contamination is likely to have had effect on a large volume of product. The development of rapid and reliable methods to assess cleaning will improve the design, installation and performance of cleaning systems and thereby improve milk product quality and safety. This paper presents the results of a theoretical and experimental study performed to characterize the dynamics of air injected CIP flows and presents preliminary recommendations for the design and trouble shooting of milking CIP systems.

Air Injected CIP Flow Dynamics

The amount of hot water and detergents required to flood pipelines increases proportionally with the square of the pipeline diameter. Air injection has been widely used on milking CIP systems to produce 'slug' flow in milklines. Air injection increases the circulating velocity of the wash solution and reduces the water requirements for cleaning when compared to fully flooded lines.

Reprinted from the National Mastitis Council Annual Meeting Proceedings (1993).

Slug flow is characterized by the passage of discrete liquid slugs. The slugs usually have a significant volume of gas bubbles entrained in them. Slug length may vary from a few centimeters to several meters. The area between the slugs contains a slower moving liquid layer in the bottom of the pipe with air moving at approximately the slug velocity above the liquid layer.

The objective in air injected flow is to form a 'slug' of cleaning solution and move this slug around the system to provide adequate turbulence and contact time on all surfaces to perform the cleaning and sanitizing functions. The formation of a single slug in milking CIP systems occurs because of the cyclic introduction of air and water.

Experimental Apparatus

The experimental system consisted of two straight 36 meter pipe sections with 73 mm inner diameter (3 inch nominal diameter) joined by a 180° U bend. Shorter runs of 48 mm and 98 mm (2" and 4" nominal) pipelines were also tested. Each pipe section was sloped to drain toward the receiver jar with an inclination of 1%. A wash valve was installed in the pipeline between the point of water entry and the receiver jar. This valve is closed during the cleaning process to prevent short circuiting of cleaning solution to the receiver jar. The cleaning solution is directed through the entire pipe loop, traveling first uphill in the first pipe section leg and downhill in the return leg. A transparent acrylic section was installed at both the beginning and end of the pipe loop for flow observation.

The cleaning solution was transported from the wash tank into the system through a 35 mm (1.5") stainless steel pipe. A pneumatically actuated air injector was mounted at junction of the wash supply line and the milk pipeline. When the air injector is in the 'closed' position, cleaning solution is drawn by vacuum from a wash tank into the test loop. The air injector is then switched to the "open" position allowing air at atmospheric pressure to enter the pipeline. This stops the draw of cleaning solution from the wash tank and propels the cleaning solution around the pipe circuit. The amount of the cleaning solution drawn into the system during one air injection cycle can be controlled by the air injector "close" time.

The air flowrate entering the system through the air injector during the injector 'open' phase was controlled by

using orifice plates offering varying restriction to air flow. The system vacuum was generated by a liquid-ring pump with a maximum air flow capacity at 50 kPa (15" Hg) vacuum of 3000 L/m (110 scfm). The pump displacement could be reduced to half of its full capacity by isolating one half of the pump from the system. Further details of the experimental apparatus, procedures and results are presented in Reinemann et al, 1992 (1).

Experimental Results

Conditions for Slug Formation and Maintenance: The air injector open and closed time settings required for the production and maintenance of a slug around the 72 meter (236 ft), 73 mm (3 in) diameter test loop are shown in Figure 1. Note that the injector cycle times required to consistently form and maintain a slug are longer than those commonly encountered in round-the-barn pipeline systems of equivalent pipeline length in the field.

The slug acts, in some respects, like a wave as it moves through the pipeline. It picks up liquid at its face and looses liquid at its tail as it travels. As will be shown, the rate of water pickup is directly proportional to the fill depth in the pipe ahead of the slug. If the standing liquid layer in the pipe is not of sufficient depth the slug length will loose liquid at its tail faster than it is being accumulated at its face. The slug will therefore, decrease in length until finally it disappears. This process occurs during the first several air injection cycles as the liquid layer is forming. After several cycles an equilibrium is established between the water being admitted and removed during each injection cycle. If too little water is drawn in during each cycle (injector close time too short) the liquid layer in the pipe bottom will be depleted. Likewise, increasing increased duration of air flow (by increasing the injector open time) acts to reduce the amount of water remaining in the pipeline. If the bottom film is not of sufficient depth the slug breaks before completion of the pipeline circuit.

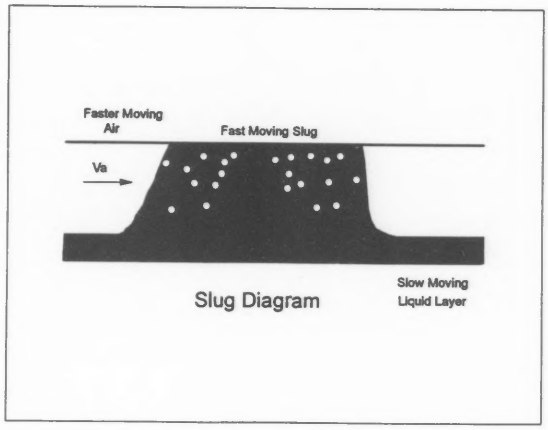
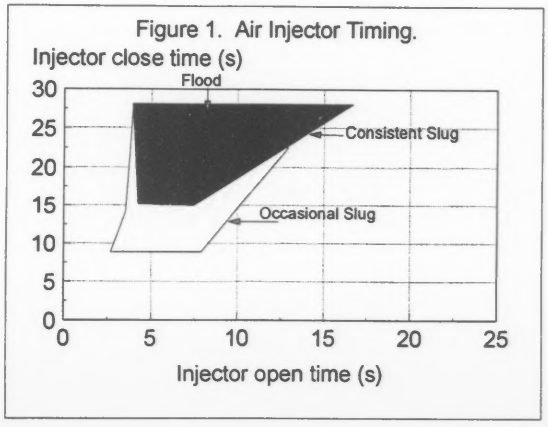


Figure 1. Air Injector Timing.



Increasing the amount of water drawn in during each cycle (increasing injector close time) and decreased duration of air flow (decreasing injector open times) act to increase the film depth in the pipeline. This results in very large slugs which flood the receiver. If the injector open time is not sufficient to allow the slug to completely travel the pipeline circuit, the slugs break and travel the remaining distance to the receiver as a wave. The combination of short open and close phases results in a high film depth (50-60% of the pipe), and low velocity slugs reaching the receiver occasionally (i.e. not on each injection cycle). It is difficult to assure that all surfaces are receiving adequate turbulence and contact time when this condition exists. The water flow to the receiver in this situation also tends to be extremely variable and it is difficult to prevent flooding.

There are four requirements for consistent slug formation and maintenance, based on these observations:

Sufficient liquid volume to form a slug at the beginning of the pipe circuit.

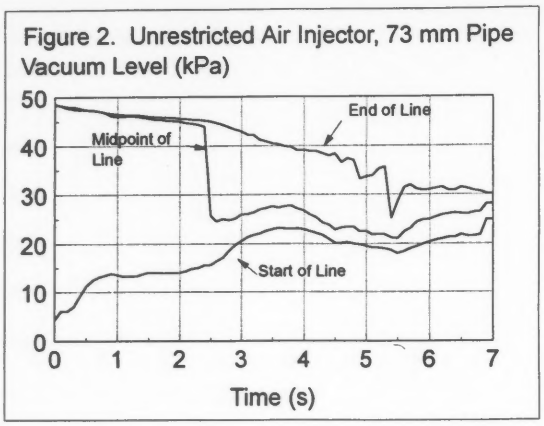
Sufficient standing liquid layer in the pipe to maintain the slug during its travel

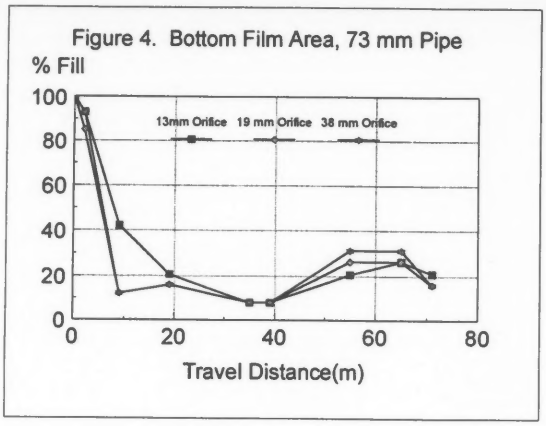
Sufficient volumetric air admission rate to form and maintain the slug.

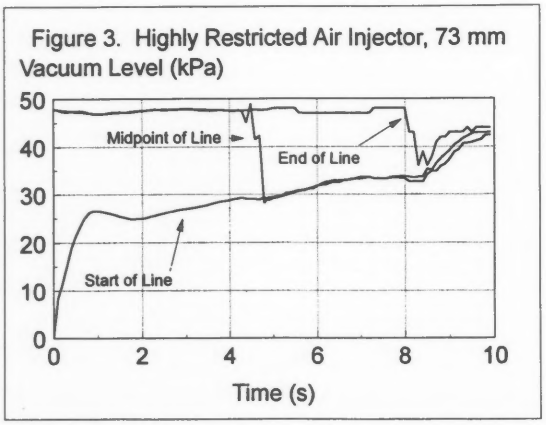
Sufficient duration of air flow for the slug to completely travel the pipeline.

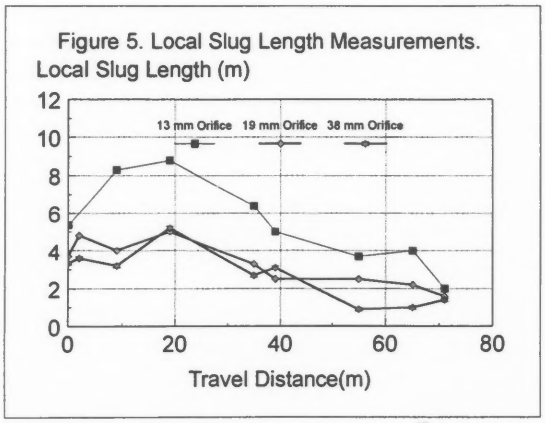
Air Flowrate and Vacuum relationships: Typical pressure traces with an unrestricted air injector (38 mm, 1.5", orifice) and highly restricted air injector (13 mm, 0.5" orifice) are shown in Figures 2 and 3. If the pump capacity is larger than the air flow being admitted the system vacuum will be maintained (Figure 2). If the air admission during the injector open phase exceeds the air removal capacity of the pump, the overall system vacuum and vacuum ahead of the slug will fall (Figure 3). The rate and magnitude of the vacuum drop will depend on the air flowrates entering and being removed and the total volume of the system. Considerable energy can be stored in the system and released during air admission by when the system vacuum fluctuates. Increasing system vacuum level and increasing system volume both act to increase the amount of stored energy available. This stored energy can compensate for an undersized vacuum pump if the injector close phase is long enough to allow the vacuum pump to recover system vacuum.

The pressure at the tail of the slug is atmospheric pressure minus frictional losses at the entrance (through the air injector) and losses as the air travels through the partially filled pipe. As the air injector opening is reduced the air flow rate entering the system is reduced. The pressure at the









beginning of the pipe is also reduced (vacuum level is increased) which reduces the pressure difference driving the slug. The reduced pressure (increased vacuum) in the system may also prevent the feed line from draining or result in water being drawn in to the milkline during the injector open phase.

The system can thus be controlled by adjusting injector open and close times, restriction to airflow through the air injector, system vacuum set point, and restriction to water entry in the wash draw line. The system volume and vacuum pump capacity may also be adjusted during installation.

Bottom film velocity and fill depth: The percentage of pipe cross section occupied by the bottom film at the end of the injector close phase is shown in Figure 4. During the injector closed phase the film is draining from the high point to the receiver jar. This causes a thinning of the bottom layer near the high point and a buildup of the layer near the wash valve. Cleaning solution is also being added to the pipe at this point, accounting for a major increase in the depth of the bottom layer. The bottom layer at the end of the pipeline, at which point it is free to drain into the receiver, remains relatively constant.

The two forces propelling the bottom layer are gravity and the shear created by the faster moving air over the film. Gravity acts to move the film in the opposite direction as the slug in the first half of the pipe and in the same direction as the slug in the second half of the pipeline. The measured velocity of the bottom layer between slugs ranged from 0.4 to 0.8 m/s. When the slug passes the bottom film is rapidly accelerated to the slug speed. This is an indication that the slug is a region of intense liquid mixing. There is a long 'tail' in which the liquid being shed from the slug decelerates and stratified flow redevelops.

Local slug length: The local slug length measurements are presented in Figure 5. The cleaning solution is introduced into the milk line at the bottom of one slope. A slug is formed immediately upon opening of the air injector. The slug length increases rapidly in the initial pipe section. The slug length grows to a length substantially longer than can be accounted for by the water injected. This is because the slug is picking up water from the bottom layer in the pipe.

The growth rate of the slug is directly related to the fill depth. This adds to the initial water charge and accounts for the rapid growth of the slug in the early portion of its traverse. After about 20 meters of travel the slug length begins to decline for the rest of its travel through the loop. This is an indication that the rate of water shed at the tail of the slug is higher than the rate of water pick up at the leading face of the slug.

Local slug velocity: The local slug velocities for the various air injector restrictions are illustrated in Figure 6. The slug is rapidly accelerated and reaches a relative maximum in the first few meters of pipe. The velocity then stabilizes, or slowly increases depending on system param-

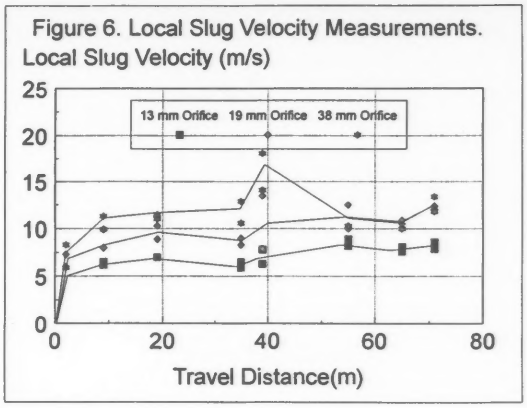


Figure 6. Local Slug Velocity Measurements.

eters. As the slug shrinks the resisting frictional forces are reduced. The slug driving pressure also decreases as the slug travels along the pipe. If the resisting frictional forces decrease faster than the driving forces the slug accelerates. In the cases with high air flowrates the slug accelerates rapidly near the end of the pipeline and dissipates.

Air to Water Velocity Ratio, estimates of slug void fraction: A parameter of interest in two phase flow is the slip coefficient. This coefficient is a measure of the relative velocities between the air and liquid. The slip coefficient also gives an indication of the void fraction of the slug.

The slip coefficients were regressed against the pressure difference across the slug, slug velocity and slug length. Both pressure difference and slug length produced significant correlations. Increased pressure difference across the slug and a shorter slug resulted in a higher the slip coefficient. The greatest effect was due to the pressure difference across the slug. The ratio of the actual air and slug velocities ranged from about 1 to over 2. The inverse of this velocity ratios is an estimate of the slug void ratio (water volume/ total volume). The slug void fraction based on this method of estimation ranged from 0.5 to 1 with most values falling between 0.7 and 0.8. These values correspond with estimates made from high speed photographs of the slugs.

The slug acts as an imperfect piston resisting the pressure differences across it which act to propel it through the pipe. As the pressure difference across the slug in increase the 'slip' between the air and water increases. Thus increasing the pressure difference across the slug does not produce a proportional increase in slug velocity.

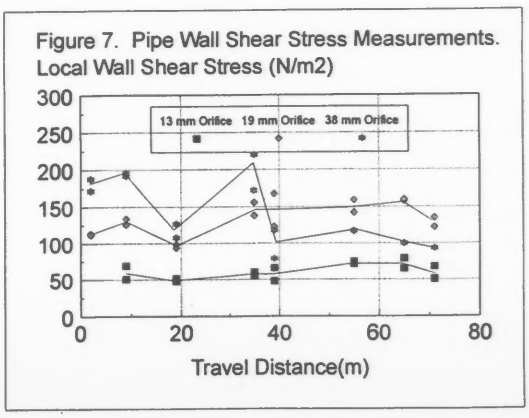


Figure 7. Pipe Wall Shear Stress Measurements.

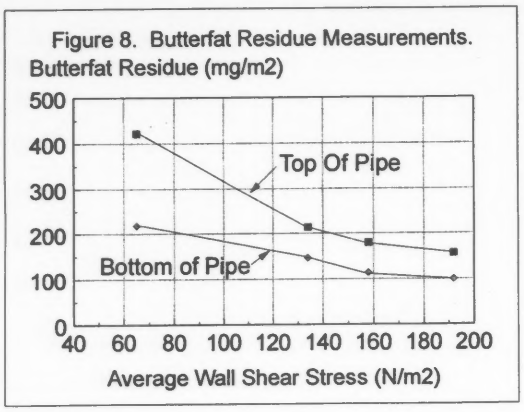
Average Local wall shear stress: The wall shear stress can be calculated from the slug velocity, and slug density. The pressure difference across the slug can also be used to estimate the shear stress on the pipe wall if corrections are made for the other factors affecting the force balance on the slug. The pipe wall shear stresses are illustrated in Figure 7. These are average shear stress around the pipe cross section (i.e. top to bottom). Further investigations were done to determine the distribution of shear stresses around the pipe section.

The shear stresses developed in air injected flows are considerably higher than those found in fully flooded flows. Note from Figure 7 that the shear stresses are relatively uniform along the pipe length for the two smaller injector orifices (lower air flow rates). With the largest injector orifice (highest air flowrate) there is little increase in the average shear stress along the pipe length but considerably more variation (i.e. some parts of the pipe are subjected to substantially higher shear stress than others).

This indicates that it is possible to inject too much air into the pipe. Excessive air admission will increase the slip coefficient (ratio of air to slug velocity) and also increases the amount of air entrained in the slug. Increased air in the slug reduces the shear stress it is capable of developing and also acts to break down the slug. This phenomena was observed for 73 mm and 98 mm (3" and 4") pipelines. In 48 mm pipelines, increasing the air injector opening from 13 mm to 38 mm (0.5" to 1.5") did not result in substantially higher air flowrates. This is because the maximum airflow rate is limited by the friction in the pipe itself rather than by the restriction at the air injector.

Assessment of Mechanical Cleaning Action: A method described by Grasshoff, 1983 (2) was used to assess the mechanical cleaning action of air injected cleaning flows. Anhydrous butterfat was melted, dyed with sudan red and applied to the interior surface of an acrylic pipe section. The coating process resulted in a layer of crystallized butterfat of about 1 mm thick on the interior of the acrylic section. The test section was then placed in the cleaning circuit and subjected to specified flow conditions using a solution of 0.3% NaOH maintained at a temperature above the melting point of the butterfat. The residual butterfat was then removed from top and bottom halves of the test section independently using petrol ether as a solvent. The concentration of the residual butter fat dissolved in the petrol ether was then measured using a spectrophotometer. The results of one series of butterfat tests is shown in Figure 8.

The acrylic surface is hydrophobic (repels water) while melted butterfat adheres to it. A balance is established between the mechanical forces acting to remove the melted butterfat (pipe wall shear stress) and the attractive force adhering the butterfat to the acrylic surface. The level of residual butterfat is thus an indicator of the mechanical cleaning action which has taken place. A very good correlation was found between the butterfat residue and the wall shear stress determined by detailed flow measurements.



Bacteriological studies are being used as a third method of assessing mechanical cleaning action. A section of stainless steel pipe has been constructed with removable, stainless steel test chips mounted flush with the interior of the pipe wall. The stainless steel section is inoculated with bacteria, placed in the milking system and subjected to specified flow conditions. The test chips are then removed and examined under a scanning electron microscope. A fluorescent dye technique is used to distinguish between living and dead cells and standard plate culture is performed.

These tests indicate the combined effects of mechanical shear stress and contact time on removal of bacteria from the pipe surface. These tests are currently underway. Future work will be directed at investigating the interactions between mechanical, thermal and chemical cleaning actions. Final confirmation of the level of shear stress required for adequate cleaning action will be obtained after completion of the bacterial and chemical studies.

Applications for milking CIP systems: Some preliminary recommendations can be made based on the results of these flow studies.

Air Injector Timing: It is necessary to form one slug and maintain that slug around the entire pipe loop to assure that all pipe sections have adequate contact and turbulence. Average slug velocities range from 6 to 10 m/s. Thus to determine the approximate length of the injector open phase in seconds divide the total pipe length in meters by 8 (divide pipe length in feet by 25). For a typical round-the-barn pipeline of 90 meters (300 ft) the injector open time should be about 11 to 12 seconds. The Injector close time should then be increased until a slug reaches the receiver with enough volume to thoroughly wash all of its surfaces. Fine adjustments can then be made to the injector open time so that the injector closes just before the slug reaches the receiver. A method of adjusting the effective air injector restriction and thereby air flowrate entering the system allows for considerably improved control over the air injection process.

Pipeline Configuration: It is very difficult to assure that all sections of milklines with multiple flow paths ('Tee' or 'Y' lines) will receive adequate slug action, particularly if the two sections are of unequal length. The air injector timing can be optimized for only one side of the line. The other side is likely to be over or under filled. One solution to this problem is to separate the pipeline into two separate flow circuits and supply each circuit with its own air injector. Another possible solution is to install an automatically controlled wash valve at the intersection and use a 4 cycle air injector (i.e. separate open and close phases for each loop).

Estimating Water Requirements for Cleaning: The average fill fraction of the pipeline ranged from 15 to 25 percent when good slug formation was achieved. A range of 20 to 25 percent of the pipe volume should be used for estimating the water required for each cleaning cycle if the system is set up as described above. This water is in addition to the reserve water volume required for the receiver, wash vat, milking units and ancillary equipment.

Vacuum Levels: The vacuum difference across the slug decreased as line diameter increased. This is because the slug must support the pressure difference across it. As the line diameter increases the wall of water that is the slug looses its ability to seal the pipe cross section. In large diameter lines, [73 mm (3") or greater] the vacuum level in the system may be dropped without loss of cleaning performance. The vacuum pump will run more efficiently and the 'slip' of air past the slug will be reduced. The restriction through the air injector must however be decreased to allow enough air to enter the system.

Required Air Flows: The range of airflows required to form and maintain a slug and the average slug velocity produced for a single loop of different diameter pipelines are given below:

Line Diameter	Air flow Rate	Average slug Velocity
48 mm (2")	450-750 L/m (16-26 scfm)	7-10 m/s (23-32 ft/s)
73 mm (3")	850-1500 L/m (30-55 scfm)	7-10 m/s (23-32 ft/s)
98 mm (4")	1700-2500 L/m (60-90 scfm)	7-10 m/s (23-32 ft/s

Note that the increase in slug velocity and resulting shear stress is not directly proportional to the superficial air velocity. This is because the slip coefficient increases as more air is admitted into the system. A larger pipe diameter will also increase the slip coefficient. Increasing airflow above the maximums suggested above will not improve cleaning action in the milkline. A vacuum pump smaller than the suggested levels will provide adequate cleaning action if the system volume is large enough to provided sufficient stored energy.

These air flows will generally be met or exceeded by recommended air flowrates for milking. These should be considered preliminary results as investigations into the interaction of mechanical and chemical cleaning processes have not been completed. These air flowrates also apply only to single looped pipelines. Milklines with Tee's or Y's (introducing a second flow path) and parlor CIP systems may require higher air flowrates. Investigations into these systems are continuing.

Setup and Troubleshooting of Milking CIP systems: A slug produces a very definite vacuum drop signal in the milkline (Figures 2 and 3). A pulsation analyzer with sufficiently rapid response time is an excellent tool for the setup and trouble shooting of milking pipeline CIP circuits. Pressure traces done at various points along the milkline will

provide information as to the presence of a slug in the line. If air injection setting are correct and a good slug is formed and maintained, the vacuum drop as the slug passes will gradually decrease as the slug moves around the line. The authors are presently working to develop a method of performing and interpreting these measurements.

References

1. Reinemann, D.J., and A. Grasshoff, 1991, Power Requirements for Cleaning Milklines, ASAE Technical Paper No. 953514
2. Grasshoff, A., 1983. Local flow of fluid and its influence on the cleaning process in cylindrical dead spaces. Kieler Milchwirtschaftlich Forschungberichte 35(4) 471-492 (1983).

News

Dr. Gilbert Gives Second Frazier Memorial Lecture

The internationally renown food microbiologist, Dr. Richard J. Gilbert, presented the second annual Frazier Memorial Lecture on May 13, 1993 at the University of Wisconsin-Madison. Dr. Gilbert, who is Director of the Food Hygiene Laboratory of the Public Health Laboratory Service in the United Kingdom, discussed "Microbial Food Safety - a European Perspective." In his lecture, Gilbert described recent foreign outbreaks of salmonellosis (associated with eggs in Germany), listeriosis (associated with pork tongue in aspic in France and with smoked mussels in New Zealand) and hemorrhagic colitis (associated with hamburger sandwiches in England and caused by *Escherichia coli* O157:H7). Dr. Gilbert also indicated how changes in trade in the European Community will affect food safety. The lecture was given in conjunction with the annual meeting of the Food Research Institute. Former colleagues, students and friends of the late Professor William C. Frazier, a pioneer in food microbiology at the University of Wisconsin-Madison, contributed funds to establish The Frazier Memorial Lectureship. While perpetuating the memory of Professor Frazier and his outstanding career as a teacher, researcher and administrator, the lectureship annually brings to the campus a noted food microbiologist for consultation with faculty and students and to give the lecture. The lectureship is administered jointly by the Departments of Food Microbiology and Toxicology, Food Science and Bacteriology.

Ebenezer R. Vedamuthu Named the First Recipient of the International Dairy Foods Association Award

Ebenezer R. Vedamuthu, Chief Research Microbiologist at Quest International, Sarasota, Florida, was named the first recipient of the International Dairy Foods Association Award. The award, given in recognition of Vedamuthu's contributions in dairy foods research, was presented on June 15th during the awards ceremony of the 88th Annual Meeting of the American Dairy Science Association, held recently on the campus of the University of Maryland, College Park.

Vedamuthu has contributed to the dairy foods industry for over 30 years as a researcher, lecturer, consultant, writer, and academic and industry mentor; in each of these activities, he has reflected exceptional excellence. He is a humble, yet deeply motivated and intelligent scientist. The dairy foods industry has profited from his research on developing new processing procedures and bacterial strains used for the manufacture of cultured dairy foods. The consumer, too, now enjoys greater variety and higher quality of cultured dairy foods. Processors and academic audiences have also benefited from the excellence of his lectures and writings.

Vedamuthu received his B.S. in biology from University of Madras in India in 1953. He received his M.S. degree in dairy technology in 1962 from the University of Kentucky and his Ph.D. degree in microbiology in 1965 from Oregon State University.

The International Dairy Food Association, award sponsor, is composed of three constituent organizations: Milk Industry Foundation (MIF), National Cheese Institute (NCI), and International Ice Cream Association (IICA). Activities range from legislative and regulatory advocacy to market research, education, and training. MIF has 214 member companies that process 80% of the fluid milk and fluid milk products consumed nationwide; NCI has 93 member companies that manufacture 85% of the cheese consumed in the US; and IICA has 175 member companies that manufacture and distribute an estimated 85% of the ice cream and ice cream-related products consumed in the US. IDFA also provides management services for the American Butter Institute (ABI), which was established in 1908 and currently has 35 member firms.

For more information contact Cheryl Nimz at the American Dairy Science Association, 309 West Clark Street, Champaign, IL 61820; (217)356-3182; FAX (217)398-4119.

CAST Presents Scientific Information on Bovine Somatotropin (BST)

Somatotropin is produced by the pituitary gland of all farm animals and humans. Each species of animal produces somatotropin that is different in composition. Somatotropin produced by cattle is known as bovine somatotropin (BST) or bovine growth hormone (BGH). BST is a naturally occurring protein hormone that contains 191 amino acids. These amino acids are the same as those that are in other plant, animal, and milk proteins. BST is required for controlling normal growth processes in animals, for normal growth and development of the mammary gland, and for normal milk production.

Research with an estimated 30,000 to 40,000 dairy cows in the United States and throughout the world indicates that administering controlled dosages of BST increases milk production by 10 to 15%. The increase in milk production has been observed for dairy cows of different breeds, genetic potential, numbers of lactation, and milk production. Efficiency of feed utilization is normally improved 5 to 15%.

In the 1980s, biotechnology techniques became available to genetically alter bacteria, which resulted in the production of biological products that normally are produced only by animals. Utilizing these techniques, bacteria can be

grown in large quantities to produce the animal product. The bacteria are killed and the animal product is separated and highly purified. This biotechnology now is being used to make vaccines for disease prevention, for production of the protein insulin to treat diabetes in humans, and for production of the protein, BST. Utilizing this biotechnology and the cow gene for somatotropin results in the production of a relatively inexpensive source of BST that is essentially the same as the natural BST. Both natural BST and BST produced by biotechnology improve the efficiency of milk production but do not elicit biological activity in humans.

Prior to commercial use of BST by dairy farmers, each company wanting to market BST must prove to the U.S. Food and Drug Administration (FDA) that their product is safe and effective. The safety evaluation determines that the milk and meat are safe for human consumption and that BST has no adverse effects on the health and well-being of dairy cows. Effectiveness simply means that BST does what the company claims it will do.

The FDA has concluded that milk and meat from cows given BST are safe for human consumption. This also is the conclusion of the American Medical Association, National Institutes of Health, Office of Technology Assessment, Inspector General of the Department of Health and Human Services, a joint expert committee of the World Health Organization and the United Nations Food and Agriculture Organization, regulatory agencies in over 30 countries, and editorial commentaries in the journals of the American Association for the Advancement of Science, Endocrine Society, American Dietetic Association, and American Academy of Pediatrics. After years of research, no scientific evidence exists to suggest that humans are at risk in consuming milk or meat from cows given BST.

Despite these findings by some of the leading universities and nutrition, health, and medical organizations in the world, critics are questioning the use of BST on biological functions to improve the efficiency of milk production. Their criticisms are centered around the following claims:

1. Critics claim: Milk and meat from cows given BST have not been proven to be safe.

Scientific finding: Scientific evidence indicates that milk and meat produced by cows given BST are safe to drink and eat and do not cause health hazards for several reasons.

A. BST is a protein and a natural component in cow milk. Milk produced by cows given BST contains normal concentrations of BST.

B. The nutrient (fat, protein, lactose, mineral) composition of milk from cows given BST is not different from milk produced by control cows. There may be minor changes, mostly in fat content of milk during the early stages of BST supplementation as the cow's metabolism and feed intake adjust. These changes are similar to that occurring during a normal lactation cycle. Administration of BST to dairy cows has no impact on manufacturing or cheese-making properties of milk. The meat derived from BST-treated cows has a lower fat content but is otherwise identical.

C. BST is a protein, and like other proteins in milk, meat, fruits, and vegetables it is broken into small peptides and amino acids in the digestive tract before being absorbed. The peptide fragments of the protein do not produce biologically active effects. Therefore, BST is destroyed in the stomach and small intestine of humans before it can be absorbed. This is the reason that insulin, another protein hormone, can not be consumed by mouth but must be injected if it is to produce biological effects required to control diabetes in humans.

D. BST is species limited; it will not elicit its biological actions even if it were accidentally injected into humans.

2. Critics claim: The use of BST increases the concentration of Insulin-Like Growth Factor-I (IGF-I) in milk.

Scientific finding: IGF-I does not have harmful effects on humans. IGF-I is a protein and a natural component of cow and human milk. The amount of IGF-I in human milk is greater than the amount in cow milk. The amount of IGF-I in cow milk increases slightly after BST supplementation but does not exceed normal concentrations in cow milk or the concentrations found in human milk. IGF-I in concentrations in milk vary widely among individual cows and herds and are especially high during the first few weeks of lactation, an interval in the lactation cycle that is prior to the period in which BST is used. IGF-I, like other proteins, is broken into small peptides and amino acids in the digestive tract of humans before it can be absorbed. These small fragments of the protein do not produce biologically active effects. Therefore, IGF-I, like BST, is destroyed in the stomach and intestine of humans before it can be absorbed. IGF-I also is destroyed during the processing of infant formula and does not cause allergies in infants.

3. Critics claim: Cows given BST have increased incidence of metabolic and infectious diseases and decreased reproductive performance.

Scientific finding: Scientists have monitored health status and reproductive performance on virtually all cows given BST. Health status and reproductive performance of cows given BST are similar to those of nonsupplemented cows producing similar amounts of milk. Giving BST to cows produces no effects of biological importance that would represent human health concerns. Cows that are stressed and sick produce less milk and are less efficient in their use of nutrients. Data from studies throughout the United States and the world have consistently indicated that cows given BST produce more milk and are more efficient in their utilization of nutrients. BST has been reported to play a positive role in an animal's immune function and resistance to disease.

4. Critics claim: The use of BST will increase the risk that milk will be contaminated with antibiotics.

Scientific finding: Use of BST will not increase the contamination of milk with antibiotics. Milk is the most highly regulated food and one of the most nutritious and wholesome foods consumed by humans. All dairy farmers must be licensed by their state health department to sell milk. Dairy farms are inspected at frequent intervals by inspectors from the state health departments to ensure that milk is produced and handled in a safe, clean, and sanitary environment. If antibiotics are used to treat disease in cows, the milk

is destroyed by the farmer. Every farm tank of milk is sampled before it is picked up for delivery to a dairy processing plant. Every truckload of milk shipped by the dairy farmer is tested for antibiotics prior to being used by the milk processing plant. If antibiotics are found in the milk, the milk is destroyed by the milk processing plant. The offending dairy farmer loses income from the sale of the whole truckload of milk, can not sell milk for a specific number of days, and upon repeat occurrences may even be permanently prohibited from selling milk. Consequently, there is considerable financial incentive to decrease the treatment of cows with antibiotics and to destroy milk from every cow treated with antibiotics.

5. Critics claim: The use of BST will drive small family farmers out of business.

Scientific finding: BST is another example of technological changes that have been impacting dairy farming for many years and will undoubtedly continue to do so in the future. Fortunately, BST will be equally effective in both small and large dairy herds. The cost of giving BST to a cow in a small herd will be the same as giving BST to a cow in a large herd. Expensive equipment is not required and financial returns to the dairy farmer should be realized within a few days. The cost of BST will be small compared with other costs of dairy farming. However, good management is essential for obtaining a beneficial response from BST. Inadequate farm management programs, including herd health, milking practice, nutrition, and environmental cleanliness, can limit the magnitude of the production response to BST.

6. Critics claim: The use of BST will adversely affect the environment.

Scientific finding: The dairy industry is concerned about environmental problems. Scientists have reviewed the impact of BST utilization on urine, feces, nitrogen, and phosphorus outputs by cattle; cropland for feed; soil losses; and requirements for water and fossil fuel energy. All studies have concluded that utilization of BST has beneficial effects on resource utilization and environmental impact per unit of milk produced, because the same quantity of milk can be produced with fewer cows.

Over 1,500 scientific studies on BST have been published and these studies have encompassed the range of management and environmental conditions that characterize world-wide dairy production. Results indicate that cows supplemented with BST are healthy and produce milk with a normal composition. BST allows the animal to utilize nutrients more efficiently, which results in beneficial effects on resource use and environmental impact. Medical and health agencies throughout the world have evaluated BST and concluded that use of BST represents no human health risk and results in meat and milk that are safe for human consumption.

CAST is a nonprofit educational organization of 31 scientific societies with composite membership of over 100,000 members and many individual, student, company, nonprofit, and associate society members. CAST provides the latest information in the scientific literature on key national issues in food and agriculture to policymakers, the news media, and the public.

For more information contact: D. M. Barbano, Cornell University, (607) 255-5482; D. L. Bath, University of California, (916) 752-1276; D. E. Bauman, Cornell University, (607) 255-2262; J. H. Clark, University of Illinois, (217) 333-0123; W. R. Gomes, University of Illinois, (217) 333-0460; H. A. Tucker, Michigan State University, (517) 353-8778; R. E. Stuckey, CAST, (515) 292-2125.

24th National Conference on Interstate Milk Shipments

The 24th National Conference on InterstateMilk Shipments (NCIMS) was held at the Marriott Hotel, Arlington, Texas, May 2 - 7, 1993.

Delegates were present from all states except Alaska, Rhode Island and the District of Columbia. One U.S. Trust Territory, Puerto Rico, also seated a delegate. Registration of 339 included persons from local and state regulatory health and agriculture agencies, academia, dairy industry, service companies and publications. Registrants were present from Canada, Mexico, New Zealand and Belgium.

A record number of problems (204) were submitted to the Conference for deliberation. Procedures of NCIMS require that problems passed must be concurred with by FDA prior to their becoming effective. The NCIMS Executive Board will meet with FDA, August 5, 1993, at the Stouffer Waverly Hotel, Atlanta, Georgia to work out any difference to the problems passed.

A newsletter will be sent to all 1933 Conference Registrants after this meeting with FDA summarizing NCIMS Actions.

At the Executive Board at the end of the 1993 Conference Dan Rackley, OK Dept. of Health, Oklahoma City, OK, was re-elected Chairman and Larry Claypool, Mid-America Dairymen, Inc., Springfield, MO was elected Vice-Chairman. New Board members elected during the Conference included Robert Gales, NY Dept of Agriculture, Albany, NY; Joe Harman, Springfield/Green Co. Health Dept., Springfield, MO; Ted Hickerson, Associated Milk Producers. Inc., Arlington, TX; Ralph McDonald, Wake Co. Health Dept., Raleigh, NC; Richard Nordeck, MD Dept. of Health, Baltimore, MD; and John O'Connor, West Lynn Creamery, Lynn, MA.

Persons wishing additional information on NCIMS should contact: Leon Townsend, NCIMS Executive Secretary, 110 Tecumseh Trail, Frankfort, KY 40601. Telephone and/or FAX 502/695-0253.

Updates . . .

Minnesota Nutrition Conference will be September 20-22

A gathering of leading scientists in animal nutrition at the national and international level will take place in Bloomington, MN, September 20-22. The scientists will be taking part in the 54th Minnesota Nutrition Conference and National Renderers Technical Symposium.

The Marriott Hotel in Bloomington is the site of the conference and symposium. Swine, poultry, beef, and dairy nutrition topics are on the agenda. The events are designed for animal nutritionists, animal industry representatives, veterinarians, educators, and livestock producers.

Registration for the conference is $60 in advance and $75 at the door. Program and registration information is available from Extension Special Programs, 405 Coffey Hall, University of Minnesota, St. Paul, MN 55108-6068; telephone (612)625-1214 or 1-800-367-5363.

Emergency Disinfection of Drinking Water

This information is provided for the use of the individual householder when the water treatment and distribution facilities cannot be operated on a normal basis, and the bacterial quality of available water is suspect. The methods described in this section will not remove or reduce toxic chemical or radiological contaminants and water exposed to each contamination should not be used.

Boiling

If the available water contains any floating material, the water is to be strained through several layers of clean cloth or the water allowed to settle and the clearer water drawn off into a clean, covered container.

Boil the water vigorously at or near 212°F (100°C) for one (1) full minute to kill any disease causing bacteria that may be present in the water.

The flat taste of boiled water may be improved by pouring it back and forth between two clean containers before use.

Liquid Chlorine Bleach

When boiling is not practical, common household laundry bleach such as Clorox contains a chlorine compound that will disinfect water.

If the water has material floating in it, strain the water through several layers of clean cloth or allow to settle and draw off the cleared water.

Find the indication of a 5.25% solution of sodium hypochlorite on the product label and add the appropriate number of drops per the following table to the water to be disinfected. If you do not have a dropper, use a clean utensil such as a knife to dip into the bleach and let the drops fall into the water as you count them.

Liquid Chlorine Bleach to be Added
(Label should read 5.25% sodium hypochlorite)

No. of Drops	Clear Water	Cloudy Water
Per Quart	2 drops	4 drops
Per Gallon	8 drops	16 drops

Mix thoroughly by stirring or shaking and let stand for 30 minutes. A slight chlorine odor should be detectable in the treated water. If it is not, repeat the chlorine dose and let stand for an additional 15 minutes before use.

The taste of the treated water may be improved by pouring it back and forth between two clean containers or by allowing it to stand for a few hours before use.

Iodine

A two percent (2%) U.S. Pharmacopoeia tincture of iodine from the home medicine chest, first aid kit or the local pharmacy may be used to disinfect water.

If the water has material floating in it, strain the water through layers of clean cloth or allow to settle and draw off the cleaner water into a clean container.

Add the number of drops of two percent (2%) iodine to the water to be treated as indicated in the chart below.

Tincture of Iodine to be Added

No. of Drops	Clear Water	Cloudy Water
Per Quart	5 drops	10 drops
Per Gallon	20 drops	40 drops

Mix water and iodine by thoroughly stirring or shaking water in container. Allow to stand for 30 minutes after which time the water is safe to use.

General Comments

1. Keep the disinfected water in clean and covered containers until use.
2. All water used for drinking, cooking, making prepared drinks or brushing teeth should be properly disinfected.

For more information contact General Mills Restaurants, Inc., at (407)850-5330.

FOREIGN POSTAGE INCREASE

Effective September 1, 1993 foreign postage will increase to $22.50 per journal.

Federal Register

Department of Health and Human Services

Food and Drug Administration

Regulatory Flexibility Analysis of the Final Rules to Amend the Food Labeling Regulations; Availability

Agency: Food and Drug Administration, HHS.

Action: Notice.

Summary: The Food and Drug Administration (FDA) is announcing the availability of a document entitled "Final Regulatory Flexibility Analysis of the Regulations Implementing the Nutrition Labeling and Education Act of 1990" that the agency has prepared under the Regulatory Flexibility Act (Pub. L. 96-354) on the impact of the food labeling regulations issued in the Federal Register of January 6, 1993. The agency has prepared this comprehensive document for these final rules because, when taken together, they will have a significant impact on a substantial number of small firms.

Addresses: Submit written requests for single copies of the document "Final Regulatory Flexibility Analysis of the Regulations Implementing the Nutrition Labeling and Education Act of 1990" to the Economics Branch (HFS-726), Food and Drug Administration, 200 C St., SW., Washington, DC 20204. Requests should be identified with the docket number found in brackets in the heading of this document. Send two self-addressed adhesive labels to assist that office in processing your requests. The document is available for public examination in the Dockets Management Branch (HFA-305), Food and Drug Administration, rm. 1-23, 12420 Parklawn Drive, Rockville, MD 20857, between 9 a.m. and 4 p.m., Monday through Friday.

For Further Information Contact: Richard A. Williams, Jr., Center for Food Safety and Applied Nutrition (HFS-726), Food and Drug Administration, 200 C St., SW., Washington, DC 20204, (202)205-5271.

Supplementary Information: In the Federal Register of January 6, 1993 (58 FR 2066 et seq.), FDA published final rules implementing the Nutrition Labeling and Education Act of 1990 (the 1990 amendments). The Regulatory Flexibility Act requires the agency, as part of that rulemaking, to examine the effect that the rulemaking will have on small entities, including small businesses. Because of the statutory timeframes imposed by the 1990 amendments for completion of the final food labeling regulations, FDA delayed the completion of its regulatory flexibility analysis (see 58 FR 2927) in accordance with section 608(b) of the Regulatory Flexibility Act.

FDA has now completed its comprehensive analysis of the food labeling final rules and has determined that the final rules, when taken together, will have a significant impact on a substantial number of small firms. The agency is hereby announcing the availability of its Regulatory Flexibility Act analysis for the food labeling final rules.

Federal Register/Vol. 58, No. 127/Tuesday, July 6, 1993/Notices

Pesticide Tolerances for Carbon Disulfide

Agency: Environmental Protection Agency (EPA)

Action: Final rule.

Summary: This regulation establishes a tolerance for residues of the nematicide, insecticide, and fungicide carbon disulfide in or on the raw agricultural commodities (RACs) grapefruit, grapes, lemons, and oranges at 0.1 part per million (ppm) from the application of sodium tetrathiocarbonate. This regulation to establish the maximum permissible level of residues of the pesticide in or on these commodities was requested in a petition submitted by Unocal Corp.

Effective Date: This regulation becomes effective June 21, 1993.

Addresses: Written objections, identified by the document control number, (PP 8F3580/R2001), may be submitted to: Hearing Clerk (A-110), Environmental Protection Agency, Rm. 3708, 401 M. Street, S.W., Washington, DC 20460.

For Further Information Contact: By mail: Cynthia Giles-Parker, Product Manager (PM) 22, Registration Division, Environmental Protection Agency, 401 M. Street, SW, Washington, DC 20460. Office location and telephone number: Rm. 229, CM #2, 1921 Jefferson Davis Hwy., Arlington, VA 22202, (703)305-5540.

Supplementary Information: EPA issued a notice, published in the Federal Register of October 12, 1988 (53 FR 39783), which announced that Unocal Corp., 461 S. Boyston C5, Los Angeles, CA 90017, had submitted a pesticide petition (PP 8F3580) to EPA requesting that the Administrator, pursuant to section 408(d) of the Federal Food, Drug, and Cosmetic Act (FFDCA), 21 U.S.C. 346a(d), establish a tolerance for residues of the nematicide, insecticide, and fungicide carbon disulfide in or on the raw agricultural commodities (RACs) grapefruit, grapes, lemons, organes, potatoes, and tomatoes at 0.1 part per million (ppm) from the application of sodium tetrathiocarbonate.

Sodium tetrathiocarbonate stoichiometrically converts to carbon disulfide, sodium hydroxide, hydrogen sulfide, and sulfur in the soil after application to the RACs. Carbon disulfide is the pesticide's active compound.

Unocal Corp. subsequently amended PP 8F3580 to delete the proposed tolerance for potatoes. The Agency is not at this time establishing a tolerance for tomatoes since this RAC is not proposed for registration with the concurrent application for registration under the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA), as amended. Unocal Corp. will have to petition the Agency for establishment of a tolerance in tomatoes when it makes an application for registration under FIFRA for use on this RAC.

For this complete article see the Federal Register/Vol. 58, No. 117/Monday, June 21, 1993/Rules and Regulations

HAZCON-Based Total Quality Management

Hazard and Quality-Assured Recipe Development for Chilled, Stored Foods (Part XV) cont.

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Ingredient Control

Type and amount of ingredients must be specified. Writing specifications for ingredients ensures uniform sensory quality from batch to batch. The following is a list of ingredients and suggestions for use in chilled food systems.

Spices and Herbs

Spices and herbs are used to impart desired and distinctive flavors to food. They may also be used to mask undesirable or off-flavors that develop in food over a period of time in refrigerated storage due to oxidative changes as well as off-flavors due to the growth of spoilage microorganisms.

Spices and herbs can be purchased in many forms. Whole dried spices and herbs should not be used for food to be stored more than 5 days. If whole bay leaves, pepper corns, and allspice are used, they can become hazardous foreign objects if not placed in a cheese cloth bag or tea strainer that can be removed at the end of cooking. Ground spices and herbs have more surface area exposed and have greater flavor potential. A much smaller amount of ground spices and herbs will be needed if substituted for their whole counterparts. Ground spices and herbs will affect the color of the food (i.e., ground oregano—green; turmeric—yellow) when they are dispersed or dissolved in a product. This color change may or may not be desired, and the type of spice should be chosen accordingly.

In order to get standardized flavors and seasonings, spice companies produce concentrated essential oils (extracts from spices that are usually water soluble) and oleoresin extracts, which carry lipid soluble flavors. These resins and extracts can be encapsulated to ensure freshness and promote ease of use. Spice and herb companies such as Milwaukee Seasoning and McCormick also produce blends of specific amounts of spices and herbs for defined batch sizes of product. Using the pre-measured amounts in these "flavor buds" for specific batch sizes enables producers to produce food with a high degree of quality control. The type and amount of spices and herbs in products as well as their form and exact use must be determined accurately during recipe development.

Sterilized Spices and Herbs

Only sterilized (irradiated or those treated with ethylene oxide) spices and dried herbs should be used for the production of extended shelf life chilled food. Unsterilized spices have been shown to have microbial counts of up to 100,000 APC per gram. If unsterilized spices are used in a pasteurized chilled food product, they will be a source of both spoilage and pathogenic microorganisms.

For optimal flavor, spices should be no more than 14 days old. Capsicum (pepper) spices become more intense in flavor when stored for more than 2 or 3 days. Since compounds which contribute to flavor are volatile, many other spices lose flavor during storage. When spices are stored, they should be placed in tightly covered containers in a dark, cool, dry area.

Amounts of Spices and Herbs

For initial recipe development, spices and herbs should be reduced by about 15 percent, especially aromatic herbs such as oregano, sage, and basil, if food products are cook-then-package products; 50 percent if they are cook-in-package products. For maximum flavor in cook-then-package products, spices and herbs should be added less than 20 minutes before the end of the cooking period. Spices can also be extracted in a small quantity of liquid and added at the end of the cooking period.

It is also important to note that strong-flavored vegetables such as onions, cauliflower, broccoli, and cabbage should either be pre-cooked before their addition to products or they should be reduced in amount by about 10 percent.

A good spice blend for a beef rub prior to inserting roast into bags for tank cooking is Griffith Labs #012-1978. Griffith Labs #951-1220 is a good seasoning blend for a pork rub. McCormick Ingredients also has a wide variety of standardized herbs and spice for use in the production of chilled foods.

Acidulants

Pasteurized products (thermally treated to eliminate acid-tolerant spoilage bacteria such as *Salmonella* spp., yeasts, and molds) in hermetically sealed containers with a pH below 4.6 are shelf stable at room temperature. Examples include salad dressings, olives, pickles, sauerkraut, most canned fruits, and a wide variety of tomato sauces. The addition of tomato juice (citric acid), vinegar (acetic acid), and fruit or fruit juice (citric acid) used to prepare chilled food products decreases the pH of the products. This decrease in pH, as has been already discussed, aids in inhibiting bacterial growth, especially when combined with low temperatures.

Food grade formulations of citric, lactic, phosphoric, tartaric, as well as ascorbic acid are available for use in food. Note that the requirement that food must have a pH below 4.6 to be considered shelf stable assumes no other preservatives or hurdles. If a_w and nutrients are not optimal for microbiological growth, temperatures even above 50°F (10.0°C) may be safe with a pH of 5.3 to 5.5.

Thickeners

To increase the viscosity and prevent separation of sauces or gravies, modified starches should be used. Modified starches can be used alone or combined with other thickening agents such as flour, potato flour, and cornstarch. The starches or combination of starches can be incorporated by preparing a roux or by dispersing them in cold liquid and gradually adding to the hot ingredients. Starches for thickening products should be added at the end of the cooking period to reduce burn-on problems. They must be heated to temperatures of 180°F to 210°F (82.2°C to 98.9°C) to achieve maximum gelatinization or swelling of starch granules. Acids and excessive heating will cause cooked starch mixtures to become thinner.

Pre-gelatinized starches and guar gum can be used in recipe development and production of cold sauces and salad dressings. These products are acid tolerant. Producers of modified starches often provide suggestions for use in products.

After gelatinization (cooking) and cooling, the component fractions of starches recrystallize. As a result, starch-thickened products separate (synerisis). Modified starches are produced with compounds that prevent the starch components from recrystallizing. Waxy corn starches (waxy maize) and tapioca contain higher amounts of amylopectin, the branched chained starch fraction that does not crystallize readily. Either waxy starches, modified starches, or a 1:1 flour/modified starch blend can be used when necessary to ensure a stable product.

Potato Flour

Potato flours and starches are also finding a wide application in chilled food products. Potato flour and starches can be used in combination with other starches in the production of sauces, soups, and gravies. Potato starch is also available in a pre-gelatinized form which has been used in the production of ice cream (as a stabilizer), creamy Italian dressing, and snack dips. Potato starch contains higher amounts of amylose and therefore, contributes to the opacity of products, which may be desired in some instances.

Potato starches lose their thickening ability when subjected to prolonged heating cycles, high shear systems, and acidic conditions. This characteristic may be utilized by processors as a "filling aid" for foods containing suspended particulated in open-kettle systems. Particles can be kept uniformly suspended throughout while filling soups, stews, and gravies. Some thinning will occur during this operation, which results in a product of optimum viscosity.

Pre-Gelatinized Starch

Corn starches (regular or waxy) and flour require temperatures of 180°F to 210°F (82.2°C to 98.9°C) for maximum gelatinization (thickening due to swelling of starch granules). If an increase in viscosity is necessary in a product that will not reach these temperatures, pre-gelatinized starches or vegetable gums must be used, or a starch-thickened sauce must be prepared separately and added to other ingredients at a lower temperature.

Examples of starches and other viscosity agents from the National Starch Company that can be used as ingredients in chilled food products include:

Uncooked starches	Base
Colflo	Waxy Maize
National Frigex	Tapioca
National 465	Waxy maize
Pre-Gelatinized Starch	Base
Instant Jel	Tapioca
National 78-0104	Tapioca
Guar Gum	
Dyeol 3600 FC	

Salt

A high-purity salt (not more than 0.5% impurities) that is low in copper and iron levels should be used in products that are to be stored frozen or refrigerated for an extended period of time. The minerals catalyze oxidative changes in the lipids, which leads to the development of off-flavors and odors in food, particularly those of higher fat content. Culinox 999 by Morton Salt meets this specification.

Antioxidants

BHA (butylated hydroxyanisole) and TBHQ (tertiary butylhydroquinone) added as 0.02% of the oil or fat content of the food are antioxidants in foods containing higher amounts of fat. These compounds retard or delay the onset of oxidation of lipids and hence, delay the development of off-flavors in chilled food products during storage.

Citric and ascorbic acids can also be added to inhibit nutrient losses and prevent color changes in red and white fruits and vegetables due to other oxidative reactions.

Water Binding

Phosphates can be used as a combination water-binding/antimicrobial/antioxidant to increase percent yield, reduce oxidation, and improve texture of meat and poultry products. Kena (90 percent sodium tripolyphosphate and 10 percent sodium metaphosphate) used at 0.3 percent concentration is a good example of this type of product. It is produced by the Stauffer Chemical Company.

Antimicrobials

Potassium, sodium or calcium benzoate (salts of benzoic acid) at less than 0.1 percent, and potassium, sodium or calcium sorbate (salts of sorbic acid) at less than 0.2 percent can be used to inhibit yeast and mold growth. These compounds are also inhibitory to some pathogens.

DL Sodium Lactate

DL sodium lactate, when used up to 3.5 percent, helps to ensure good quality in beef and poultry products for up to 84 days. This product reduces the threat of *Clostridium botulinum* by increasing the time and temperature necessary for spore outgrowth.

Antagonists

After a food has been pasteurized (cooked) and is manipulated in an open environment (i.e., slicing), bacterial fermentation cultures can be added, so that if there is temperature abuse, there will be another barrier to prevent the product from becoming pathogenic. For example, under temperature abuse, *Streptococcus lactis* subsp. *lactis* lowers the pH and produces the bacteriocin nisin. Nisin inhibits spore outgrowth and controls the growth of other pathogens. *Bacillus subtilis* produces the bacteriocin subtilin, which also inhibits pathogen growth.

Shelf Life Testing

Once all of the variables have been defined and a product that is acceptable at zero days storage has been produced, shelf life testing must be done. The longer the storage time is, the poorer the overall quality of the product will be, and more money will be tied up in inventory. Most producers of chilled foods agree that 14 to 21 days, chilled foods storage at 28°F to 30°F (-2.2°C to -1.1°C) is the maximum length of time foods can be stored to still produce a product that is better than a frozen product.

The following shelf life form should be used to assess product quality during refrigerated storage.

SHELF LIFE ASSESSMENT

Product Name Storage Temperature: °F

Reheat: Yes / No Temperature °F Time:

Day	Appearance/ Color	Aroma	Flavor	Texture	APC Micro	Vacuum/ 0
0						
2						
4						
7						
14						
21						

References

A.E. Staley Manufacturing Company. 2200 Eldorado Street. Decatur, IL 62525. (217) 423-4411. Request: food starch technology; how to choose food starches and gums; bulletins.

Beuchat, L. R., and Golden, D.A. 1989. Antimicrobials occurring naturally in foods. Food Technol. 43(1): 134-142.

Daeschel, M.A. 1989. Antimicrobial substances from lactic acid bacteria for use as food preservatives. Food Technol. 43(1):164-167.

Ettinger Corp., The. 2970 Maria Avenue. Northbrook, IL 60062 (708)564-5020. Request: technical bulletins for potato flour and starch.

Fischer, J. R., Fletcher, D.L., Cox, N.A., and Bailey, J.S. 1985. Microbiological properties of hard-cooked eggs in a citric acid based preservative solution. J. Food Protect. 48:252-256.

Gobas, D.E. 1989. Biological competition as a preserving mechanism. J. of Food Safety 10:107-117.

Griffith Laboratories, U.S.A. Inc. 1 Griffith Center. Alsip, IL 60658. (708) 371-0900. Request: seasonings and spices.

Haarmann & Reimer Corp. Food Ingredients Division. P.O. Box 932. Elkart, IN 48515-0932. (800) 348-7414. Request: technical information for citric acid, citrates, benzoates, colors, and xanthan gum.

McCormick Ingredients. 10901 Gilroy Road. Hunt Valley, MD, 21031-1307. Request: spices, oleoresins, oils, tomato, natural colors product data sheets; Harvest Calender [(301) 771-5078]; Certified color product data sheets [(312) 733-6945].

Milwaukee Seasoning, Inc. Germantown, WI 53022. (414) 251-9230. Request: spices, oleoresins, essential oils, data sheets for flavoring agents.

Morton Salt Div. Morton-Thiokol, Inc., Industrial Div. 110 North Wacker Drive. Chicago, IL 60606. (312) 621-3406.

Moustafa, A.E., and Marth, E.H. 1988. Inhibition and inactivation of *Listeria monocytogenes* by sorbic acid. J. Food Protect. 51(11):842-847.

National Starch and Chemical Company. Food Product Division. Finderne Avenue. Bridgewater, NJ 08807. (908) 685-5337. Request: food starch technology; how to choose food starches and gums; bulletins.

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Saleh, M.A. and Ordal, Z.J. 1955. Studies on growth and toxin production of *Clostridium botulinum* in precooked frozen food. II. Inhibition by lactic acid bacteria. Food Res. 20, 340-350.

Saroni Total Food Ingredients. P.O. Box 1918. Oakland, CA 94604. (415) 895-5681. Request: technical bulletins for potato flour and starch.

Scott, V.N. 1989. Interaction of factors to control microbial spoilage in refrigerated foods. J. Food Protect. 52(6):431-435.

Stauffer Chemical Company. Rhone-Poulenc Group. One Corporate Drive. Box 881. Shelton, CT 06484. (203) 925-3464. Request: technical information for phosphates used in foods.

USDA. 1991. 21CFR (Code of Federal Regulations). Parts 170-174. Office of the Federal Register. National Archives and Records Adm. Washington, D.C.

Food and Environmental Hazards to Health

Preliminary Report: Foodborne Outbreak of Escherichia coli O157:H7 Infections from Hamburgers — Western United States

During January 1-29, 1993, 230 persons with culture-confirmed infection with *Escherichia coli* O157:H7 resulting in bloody diarrhea and, in some cases, hemolytic uremic syndrome (HUS) were reported in the state of Washington. Culture results are pending for 80 others with similar illnesses. Preliminary investigations by public health agencies linked cases to consumption of hamburgers from one fast-food restaurant chain. *E. coli* O157:H7 has been isolated from epidemiologically implicated lots of ground beef; an interstate recall was initiated by the restaurant on January 18. Meat from the same lots of ground beef had been distributed to at least three other western states in which increased numbers of cases of bloody diarrhea have been reported. CDC, the U.S. Department of Agriculture, state and county health departments, and state agriculture investigators are investigating whether cases of bloody diarrhea in the other states are linked to consumption of meat from the same lots of ground beef and are determining the possible sources of the contaminated meat.

Editorial Note: *E. coli* O157:H7 is an emerging infectious agent first linked to human illness in 1982; its importance as a human pathogen appears to be increasing. Infection with *E. coli* O157:H7 may result in a spectrum of illnesses, including mild diarrhea, severe bloody diarrhea (hemorrhagic colitis), HUS often leading to acute renal failure requiring dialysis, and death. Infection with this organism has been associated with consumption of contaminated beef and raw milk and through person-to-person transmission by the fecal-oral route. Measures to prevent transmission include thorough cooking of beef, pasteurization of milk, and careful handwashing with soap. In particular, ground beef should be cooked until it is no longer pink. Diagnosis of *E. coli* O157:H7 infection in the clinical laboratory setting requires specific culture of stool specimens for the organism on modified MacConkey medium containing sorbitol.

Morbidity and Mortality Weekly Report, 2/5/93

Pulmonary Fibrosis Associated with Occupational Exposure to Hard Metal at a Metal-Coating Plant—Connecticut, 1989

On July 21, 1989, a 35-year-old worker in an industrial plant was examined at a university-based occupational health clinic (OHC) in Connecticut because of a 21-month history of shortness of breath and interstitial abnormalities visible on chest radiograph. In addition, examination of an open-lung biopsy performed in June 1989 had shown interstitial fibrosis and the presence of numerous macrophages and multinucleated giant cells in the alveolar spaces. The clinical and pathologic findings were compatible with a diagnosis of hard-metal pulmonary disease, a condition associated with occupational exposure to metallic alloys of cobalt and tungsten carbide. An energy-dispersive radiographic analysis of the biopsy material identified particulate iron, potassium, calcium, zinc, and lesser amounts of other metals in the lung tissues, but cobalt and tungsten were not specifically identified. Based on these findings, the OHC initiated an investigation to determine the source of exposure.

The patient was employed as a helper in a detonation-gun coating process that used heated, aerosolized metal powder to coat premanufactured metal parts within an enclosed chamber; except for 12 months during 1982-1983, he had worked continuously on the process from 1981 through 1989. His duties included setting up the metal parts to be coated in an enclosed, well-ventilated chamber and then reentering the chamber after the coating process was completed to remove the finished parts. A review of information provided by his employers confirmed that powdered hard metal (tungsten carbide mixed with cobalt) was used routinely in the coating process.

During the period the process helper was employed at the plant, exposure levels for cobalt were measured routinely as part of the plant's industrial hygiene program. Although the patient had never been monitored directly, personal breathing-zone exposures measured for other workers in his department had not exceeded 100 $\mu g/m^3$ (as an 8-hour, time-weighted average), the then-applicable Occupational Safety and Health Administration (OSHA) permissible exposure limit (PEL) for cobalt. However, cobalt concentrations within the coating chamber were not measured during process operation and probably exceeded this level. At the conclusion of the coating process, the chamber was thoroughly ventilated before the helper reentered it to remove the completed parts.

In 1988, a supervisor for the same coating-process department at the plant had died of a progressive, diffuse pulmonary fibrosis that was clinically and histopathologically diagnosed as hard-metal pulmonary disease. During 1984, a transbronchial lung biopsy had shown findings consistent with, but not specific for, hard-metal pulmonary fibrosis, including interstitial fibrosis with honeycombing, mononuclear cells, intraalveolar giant cells, and an increased number of alveolar macrophages. His exposure to hard metal may have occurred during earlier employment as a grinder of completed metal parts and/or while he supervised the detonation-gun coating process. As part of the OHC investigation, reexamination of biopsy materials confirmed the presence of large quantities of tungsten and lesser amounts of cobalt in his lung tissue.

An OSHA plant inspection conducted after the diagnosis of pulmonary fibrosis in the process helper documented one airborne cobalt level at 90% of the OSHA PEL. As a result of these two cases and the investigation findings reported here, the plant reviewed its industrial hygiene program for the metal-coating process and instituted a chest radiograph surveillance program for the approximately 40 coating-process employees.

Editorial Note: Exposure to respirable cobalt dust (particle size <10 μm) has been recognized as a cause of respiratory disease since 1940, when illness occurred in industrial workers exposed to dust generated by metallurgic processes. Exposure to cobalt most commonly occurs during the production or use of hard metal, an extremely durable alloy of cobalt and tungsten carbide. A recent case series in the United States emphasized the spectrum of respiratory diseases associated with exposure to hard metal, including reversible airway obstruction, reversible hypersensitivity pneumonitis or alveolitis, and pulmonary fibrosis. Giant-cell interstitial pneumonia is a particular form of pulmonary fibrosis that, in an occupational setting, is believed to be highly specific for cobalt-induced disease.

Detonation welding—the metal-coating process by which the two employees in this report were exposed—has not previously been associated with hard-metal disease. This process and the allied process of plasma coating are widely used in industry to produce smooth, durable surface coatings by the generation and deposition of high volumes of finely divided metal aerosols; these processes can, at the same time, constitute potential respiratory hazards.

Exposure-response relations in hard-metal respiratory disease are complex. For example, in one survey of hard-metal production facilities, although the overall prevalence of interstitial lung disease among exposed active workers was low (0.7%), 10% had work-related manifestations of obstructive airway disease. Furthermore, the presence of interstitial disease was not strongly correlated with measured exposure levels, suggesting that susceptibility factors other than total dose are important in the causation of disease. It is not known whether the recently adopted OSHA PEL of 50 $\mu g/m^3$ prevents sensitization or protects persons who have become hypersensitive.

The failure to identify tungsten in the lung biopsy of the process helper is note-worthy. Because cobalt has a relatively high biological solubility, it often may not be detected in lung biopsy specimens obtained from workers with documented hard-metal disease; however, tungsten generally is present. The absence of tungsten in this case may be related to the character of the exposures associated with the specific process reported here; this process generates an unusually fine and highly heated aerosol characterized by particles that may be cleared more rapidly from the lung interstitium.

The diagnosis of hard-metal disease in these two workers is an example of an occupational sentinel health event (i.e., a condition that indicates both the failure to protect the affected worker from a preventable occupational illness and the existence of risk for similar illnesses for co-workers) and indicates the occurrence of potentially fatal toxic exposures in a process previously considered to have adequate engineering controls. The episode also emphasizes the need for medical surveillance and a review of workplace practices in facilities that use cobalt in similar processes. Surveillance for the respiratory effects of cobalt may require a review of symptoms, spirometry, measurement of diffusing capacity, and chest radiographs.

Morbidity and Mortality Weekly Report 1/31/92

Pneumonic Plague—Arizona, 1992

On August 26, 1992, a 31-year-old male resident of Tucson, Arizona, died of an illness subsequently diagnosed as primary pneumonic plague. This is the 10th case of plague reported in the United States in 1992, the first pneumonic plague case this year, and the first plague fatality reported since 1987 (CDC, unpublished data). This report summarizes the investigation of this case by county, state, and federal public health officials in Arizona and Colorado.

On August 22, the man had onset of abdominal cramps, 2 days after returning home by private automobile from a friend's residence in Chaffee County, Colorado. On August 23, he had onset of fever (103 F [39.6 C]), nausea, vomiting, severe diarrhea, and cough. The next day, he consulted a primary-care physician because of diarrhea and vomiting. On examination, he was febrile (104 F [40 C]) and dehydrated; no abnormal chest sounds were heard, and there was no lymphadenopathy. He was treated for gastroenteritis with intramuscular prochlorperazine and lincomycin and given oral ciprofloxacin to be taken the following day. On August 25, he was hospitalized with cyanosis and septic shock. Chest radiograph revealed a right upper lobar pneumonia. A Gram stain of a sputum sample obtained at hospital admission showed numerous gram-negative rods. Antibiotic therapy with ceftazidime, erythromycin, and one dose each of penicillin and tobramycin was initiated for treatment of overwhelming sepsis and pneumonia. He died 24 hours after admission.

One week postmortem, biochemical tests at the hospital identified as *Yersinia pestis* an organism that had been isolated from sputum. The organism was also identified as *Y. pestis* by fluorescent antibody and bacteriophage tests at the state laboratory; this identification was confirmed by CDC. Antemortem blood and urine samples were culture negative. Postmortem cultures of blood, cerebrospinal fluid, and lung tissue were also negative.

After the patient died, a rapid microbiological testing device used at the hospital identified the organism isolated from sputum as *Y. pseudotuberculosis*. The testing device subsequently was determined not to have been programmed to recognize *Y. pestis*, thus delaying the initial identification of the organism.

All persons who had contact with the man after he became ill were considered to be at risk for plague, including two friends, the physician and his staff, one patient in the physician's waiting room, and hospital staff contacts. All contacts were traced and were asymptomatic 8 or more days after exposure. Although no contacts required prophylactic treatment, two nurses requested and received tetracycline for plague prophylaxis.

Investigation by Chaffee County public health officials indicated the patient had become infected on August 19 through respiratory exposure to an infected domesticated cat that he had removed from, the crawlspace of a house in rural Chaffee County. The cat, reported to have submandibular abscesses and oral lesions consistent with feline plague, died on August 19 before being evaluated by a veterinarian and was cremated without diagnostic studies. A dead chipmunk found in the area where the cat lived was culture-positive for *Y. pestis*. Rodent die-off in a nearby arroyo was also evident.

On September 10-11, the house and rodent burrows within a 100-yard radius of the house were dusted with the insecticide carbaryl to control flea populations. Cats and dogs living at the house were dusted, and the owners were advised to continue periodic dusting of their pets.

Editorial Note: Although plague has enzootic foci among wild rodent populations in North America from the Pacific coast eastward to Texas, Oklahoma, Kansas, and the Dakotas, human cases have been concentrated in two principal regions: 1) a southwestern area that includes New Mexico, northeastern Arizona, southern Colorado, and southern Utah and 2) a Pacific Coast region located in California, Oregon, and western Nevada. Pneumonic plague, which is rare in the United States, can spread among humans and can be rapidly fatal unless detected and treated early. Onset of symptoms for primary plague pneumonia usually occurs within 2-3 days after exposure.

Cases of pneumonic plague in the United States have occurred secondary to septicemic plague or as a result of direct exposure (i.e., primary) to respiratory droplets from infected cats). Health-care providers, especially in areas with enzootic plague, should suspect plague in persons with unexplained fever, suspected sepsis, or pneumonia with or without lymphadenopathy or a classic plague bubo (i.e., an enlarged, inflamed lymph node). Buboes may not be present in persons with septicemic or pneumonic plague; however, nausea, vomiting, diarrhea, and abdominal pain may be prominent features. Persons suspected to have pneumonic plague should be placed in respiratory isolation and reported immediately to public health authorities so that rapid diagnosis, environmental assessments, and control measures (including flea control, rodent control, health education, and investigation of contacts) can be initiated. Streptomycin is the treatment of choice for persons suspected to have plague; alternates include tetracycline, chloramphenicol, and sulfonamides.

Veterinarians and veterinary assistants in areas enzootic for plague are at risk for plague infection from infected cats or wild rodents. Cats with unexplained lymphadenopathy and/or oral or submandibular abscesses should be suspected of having plague, and procedures for appropriate laboratory testing should be followed. Reporting of suspected cases by veterinarians to public health officials is essential to identify and monitor animal sources of infection and to minimize the potential for transmission to humans.

This case underscores the need for manufacturers marketing rapid microbiological testing devices to ensure that identification of *Y. pestis* is possible or to advise users that isolates of *Y. pestis* will not be identified and alternative tests need to be performed. In addition, this report is a reminder that persons with pneumonic plague may travel during the incubation period or while ill to areas where plague does not occur. In such cases, plague may not be considered in the diagnosis, increasing the potential for death and transmission to other persons.

MMWR 10/9/92

Industry Products

Nevastane 6, the First Food Grade Lubricant in the Revolutionary New Safegard, Continuous Spray, Non-Aerosol Container!

An improved food grade lubricant, Nevastane® 6, is now available in a new formula, and packaged in the remarkable new SafeGard® spray container. This container is friendly to the environment because it contains no propellants and is totally free of CFC gases and solvents which are regarded as harmful to the ozone layer.

This will help reduce the estimated 188,000 tons of propellants that escape into the atmosphere annually from the 3 billion aerosol containers used by Americans each year.

Nevastane 6 is a general purpose SAE 30 food machinery lubricant that provides far better lubricity than white oils, plus corrosion protection, with no silicone additives. Its superior wetting ability displaces moisture and it will resist water, steam and mild acids.

As a U.S.D.A. H-1 lubricant, Nevastane 6 can handle all multi-purpose lubrication applications in meat and poultry, dairy, pharmaceutical, beverage and food processing plants, on such items as conveyors, slides, guides, bearings, chains and sanitary valves as well as can-making machinery.

Because of its non-staining qualities, textile producers, manufacturing plants and hospitals use Nevastane 6 as a general purpose, light duty lubricant.

THE ENVIRONMENTALLY FRIENDLY SPRAY LUBRICANT

Most aerosols used in industry, in the home and in the workshop have been a great concern to environmentalists and health experts because the gases (CFC's) used to propel the contents are thought to be harmful to the environment.

Now, improved Nevastane 6, a universal lubricant, comes in a spray container that is the ultimate solution to eliminating aerosol propellant gases.

The ultimate solution turns out to be: Use no propellant gases at all! Not a pump spray, Nevastane 6 lubricant comes in the new SafeGard® container that sprays a fine mist similar to ordinary aerosol cans. It works like this: Inside the SafeGard container, Nevastane 6 lubricant is contained within a very strong rubber bladder. When the nozzle is pressed, the bladder forces the lubricant out, creating the atomized spray. There are no gases to be released to the atmosphere.

Keystone Lubricants - King of Prussia, PA

Please circle No. 250 on your Reader Service Card

Salmonella *Antisera Portfolio Types Top 50 Commonly Occurring* Salmonella

Difco Laboratories has reintroduced 15 *Salmonella* H Antisera for diagnostic and epidemiological purposes. The new antisera are for serotypes f, h, m, p, s, t, w, x, z_3, z_{13}, z_{15}, z_{23}, z_{28}, single factor 2 and single factor 6. This brings to 97 the number of *Salmonella* antisera available from this single source. The resulting portfolio provides all the *Salmonella* O and H antisera needed to type the 50 most commonly occurring serotypes of *Salmonella* worldwide.

Salmonella continues to be one of the leading causes of foodborne illness in the world. In addition to gastroenteritis, *Salmonella* cause bacteremia, septicemia and enteric fever. After biochemical testing, antisera are used to confirm identification and determine the specific serotype of the organism.

Difco *Salmonella* antisera have high titer and are absorbed to provide clear-cut, easy-to-read reactions. The lyophilized products are provided in a 3 ml package size and are available from authorized Difco Distributors.

Difco Laboratories - Detroit, MI

Please circle No. 251 on your Reader Service Card

Vidas® Staph Enterotoxin (SET) Assay

Staphylococcal enterotoxins are among the most common causes of food poisoning. Although Staphylococci can be destroyed by heat treatment, the preformed toxins are heat stable and can survive heat processing and even retorting. Coagulase-negative Staphylococci have occasionally been reported to produce enterotoxin; therefore, coagulase-negative Staphylococci present in large numbers in food should be investigated for enterotoxin production.

bioMérieux Vitek, Inc. announces the availability of the VIDAS® Staph Enterotoxin (SET) Assay for the detection of Staphylococcal enterotoxins in food and food ingredients. This qualitative enzyme-linked fluorescent immunoassay is performed in the fully-automated VIDAS or mini VIDAS® instruments.

A patented Solid Phase Receptacle and Special Reagent Test Strip contain all pre-dispensed reagents required for on-line processing. Following a simple extraction protocol of the food sample, results are available in approximately 80 minutes. VIDAS SET detects Staphylococcal enterotoxins A, B, C1, C2, C3, D and E.

In addition to VIDAS SET, other assays available to the food industry include VIDAS Salmonella (SLM) and Listeria (LIS). Following specified enrichment protocols for food and environmental samples, qualitative results are available in approximately 45 minutes.

bioMérieux Vitek, Inc. - Hazelwood, MO

Please circle No. 252 on your Reader Service Card

Sani-Tech Publishes New Sight Glass Brochure

Sani-Tech Inc., Sparta, NJ has just published a new brochure discussing their complete SIGHT GLASS product line.

This full color, 4-page brochure offers Sight Glasses for all applications including food, pharmaceutical, cosmetic, biotech and chemical. The materials of construction include the (PS Series) durable glass like polysulfone, the (PP Series) Pyrex/Plexiglas good for higher pressures, the (Sani-Pro C Series) FDA grade clear PVC and the (Teflon Series) excellent for corrosive and hard-to-process applications. Compatible End Caps are also discussed.

Most Sight Glasses are available from stock in lengths up to 10' long and 1/4" to 4" in diameter with sanitary end connections. Other style end connections available upon request.

Sani-Tech Inc. - Sparta, NJ

Please circle No. 253 on your Reader Service Card

Microza AV Series High Performance Hollow Fiber Ultrafiltration Modules Now Available from Pall Corporation

Microza AV Series high performance hollow ultrafiltration modules are new from Pall Corporation. Microza ultrafiltration modules provide outstanding benefits in food and beverage as well as general industrial applications. The modules feature the Microza double-skinned, hollow fiber membrane in a construction of exceptional strength. These unique ultrafiltration membranes have a uniformly tight skin on both the inside and outside of the fiber, providing extra assurance of removal efficiency in clarification, concentration and purification in general industrial applications.

Microza AV Series ultrafiltration modules are available with molecular weight cut-off (MWCO) retention ratings of 6,000, 13,000 and 50,000 daltons, and in membrane areas ranging from 33 ft^2 to 132 ft^2. Applications include the purification and concentration of latex and various organic emulsions, concentration of pigments, treatment and recovery of oily waste water, recovery and clarification of waste streams, purification of ceramic slurries, and concentration and purification of photo-emulsions.

Pall Corporation - East Hills, NY

Please circle No. 254
on your Reader Service Card

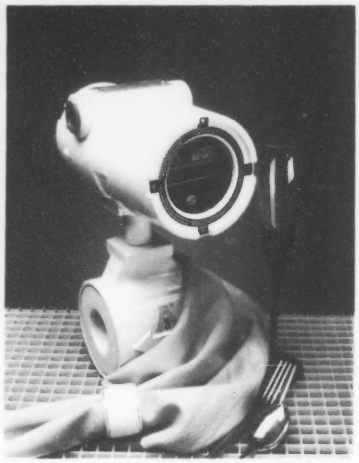
The 10 Second Wonder - Saves Time and Money for Laboratories

It takes just 10 seconds to snap open this Pre-filled Dilution Bottle and be ready for testing. Gone is the up-to 45 minutes of dilution blank preparation, bottle washing and autoclaving. This means a significant savings in time and money for a laboratory and improved laboratory efficiency.

These inexpensive bottles come pre-filled to test dairy and food (Butterfield's Buffer), water/wastewater (Phosphate Buffered), or cosmetic and pharmaceuticals (Peptone Water).

Aid-Pack, Inc. - Gloucester, MA

Please circle No. 255
on your Reader Service Card



3A Approved Magnetic Flowmeter

Sparling Instruments Company, Inc. of El Monte, CA announces the introduction of PTFE (Teflon*)-lined magnetic flowmeters that meet the requirements of the 3A Sanitary Council.

Tigermag FM625 meters from 1-4" are available with 316 stainless steel electrodes and stainless steel mounting bolts.

Individually wet-flow tested in Sparling's NIST-traceable lab, the Tigermag has a standard ±1.0% accuracy and repeatability of ±0.1%.

The meters are housed in corrosion-resistant, hosedown-proof aluminum housings coated with tough epoxy paint. Isolated 4-20 mA current output and scaled pulse output allows for interfacing with allied equipment.

Equipped with switching power supply and interchangeable electronics module, the Tigermag can be field-programmed quickly and easily from outside of the enclosure—maintaining the dust-free, moisture-free integrity of the housing. Clean-in-place solutions can be tolerated.

Liquids with conductivity as low as 3 micromhos/cm can be measured at temperatures up to 300°F (149°C).

Applications include: water, soups, sauces, beverages, milk and milk products, food additives, flavorings, and a wide range of pharmaceutical and cosmetic preparations. The Tigermag is also available with a ceramic liner meeting the requirements of the 3A Sanitary Standard.

*Teflon is a registered trademark of E.I. Dupont.

Sparling Instruments Co. - El Monte, CA

Please circle No. 256
on your Reader Service Card

Environetics®, Inc. Introduces Quanti-Cult™

Environetics®, Inc. is pleased to announce the availability of bacterial cultures for the quality control of Colilert or other tests for total coliforms and *E. coli*.

The Quanti-Cult product offers simple ready-to-use, pre-quantitated low level bacterial cultures for quality control of microbiological test methods.

Quanti-Cult bacterial cultures can be reactivated quickly and easily without any dilution steps. Inoculation of the test is very simple and will ensure that the method being tested is giving the correct result.

With Quanti-Cult, the bacteria are preserved by a proprietary process in the cap of a small tube. Quanti-Cult is reactivated by simply unscrewing the cap from its tube and putting onto a vial containing rehydration fluid. After 10 minutes incubation at 35°C, the cultures are ready-to-use. An easy-to-read visual indicator is included to ensure that all of the bacteria have been rehydrated.

The bacteria are then added to sterile water containing Colilert reagent or other test method and the test performed in the usual way. Final readings are checked to ensure that they correspond to the correct results.

Three sets of three different bacteria are available in each kit. The organisms are *Escherichia coli, Klebsiella pneumoniae* and *Pseudomonas aeruginosa*. These bacteria are recommended by the EPA as being suitable for quality control of a method for testing coliforms in water, as they provide a complete range of possible reactions (coliform positive, coliform negative, *E. coli* positive).

Quanti-Cult offers several advantages over QC samples available in disk format. Quanti-Cult is pre-quantitated to low levels (typically less than 50 cfu), so there is no need to prepare dilutions. Not only is this quicker and easier, it eliminates the trial and error associated with dilutions.

Quanti-Cult reactivation takes less than 1 minute of hands-on time and only 10 minutes incubation - a further time and labor saving compared to disks impregnated with bacteria.

Environetics®, Inc. - Branford, CT

Please circle No.257
on your Reader Service Card

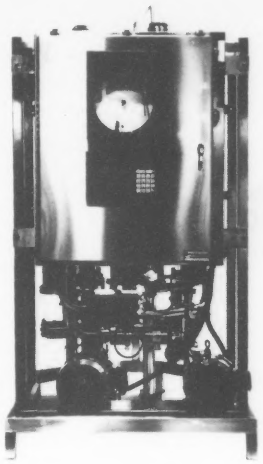
Bacteria and Yeast Identification System

The Biolog Microstation System is the only test panel system that can identify a broad range of ENVIRONMENTAL microorganisms along with virtually ALL MEDICALLY IMPORTANT species. Over 1100 species of organisms can be identified using a 96-well plate format of just 3 test panels that cover all major groups: Gram-negative bacteria, Gram-positive bacteria, and Yeast.

The four simple steps to set up a test take about one minute of labor, and the test results are analyzed in seconds with the aid of user-friendly computer software. Software systems allow the user to create their own data bases for research or epidemiologic studies, compare species within their own and the Biolog data base, gather comparative species information, store data and prepare customized report forms. Both manual entry and automated plate reader systems are available.

Biolog, Inc. - Hayward, CA

Please circle No. 258
on your Reader Service Card



Product Additions, Line Expansions Planned for DFISA by Tri-Clover, Inc.

Major product additions and the introduction of several industry firsts will be unveiled by Tri-Clover Inc. at the Food & Dairy EXPO '93, scheduled October 16-19 in Atlanta, GA.

The company will capitalize on the biennial technology showcase to introduce the industry's first Reverse Acting Valve. The valve's patented design addresses the common problems of hydraulic shock and hammer with a unique design that diverts flows by closing valves against the flow.

The Tri-Flo® line of Clean-In-Place systems also will be expanded with Tri-Clover's introduction of a compact, modular CIP unit. The new unit meets all sanitation requirements and minimizes space and solutions for cleaning lines. Designed for maximum flexibility, the modular CIP unit can be purchased as a single unit or used with other modules as part of a system.

Also featured at DFISA will be Tri-Clover's expanded line of Tri-Flo® air-actuated valves. The line's 761 Series includes Satttop controls for efficient computerized automated process control. With Satttop, each valve has its own microprocessor which mounts easily on the back of the module and provides decentralized control and monitoring of communications to the main panel. In large process systems, within a single panel loop, one cable and one air line can accommodate up to 120 valves.

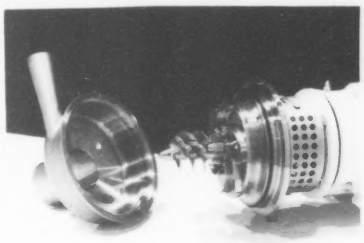
Tri-Clover also will exhibit its complete lines of centrifugal and positive displacement pumps, and Tri-Blender® Liquid/Dry Ingredient Blenders. A new, dual-stage Tri-Blender will be featured. This new, double chamber model provides double blending for difficult products, such as sugars. The need for additional pumps and/or strainers can be eliminated via use of a new dual-stage unit.

The company's booth number at the DFISA '93 is 406.

Headquartered in Kenosha, Wis., Tri-Clover Inc. is a leading manufacturer of sanitary stainless steel valves, pumps and fittings, as well as flow control, batch/weigh and Clean-In-Place systems. Founded in 1919, Tri-Clover Inc. is now an Alfa Laval Flow Company.

Tri-Clover, Inc. - Kenosha, WI

Please circle No. 259
on your Reader Service Card



Centrifugal Pump Helps Solve Cavitation Problems

New from APV, the model "Wi" sanitary pump features a UNIversal Inducer which lowers the required NPSH to 50 - 70% of normal value.

The model "Wi" Series pump raises the suction pressure, thus effectively lowering the threshold for cavitation, preventing the vibration and noise due to implosion of entrained gases. A side benefit is the elimination of wear-and-tear to pump components.

The inducer, a helical screw with high suction speed, is mounted in front of the impeller at the pump inlet, increasing the net positive suction pressure available to the pump. The UNIversal Inducer performs this function over the full operating range of the pump.

The use of the APV UNIversal Inducer increases the application of APV's "W" Series pumps in five important areas:

- Vacuum Services (evaporators, deaerators, crystallizers)
- Volatile Liquids (including most solvents)
- High Temperature Liquids at or near their boiling point
- Liquids with Entrained Gases due to aeration, carbonation or fermentation
- Viscous Liquids; where 500 centipoise was the normal limit and 1500 centipoise a practical limit, the viscous range is increased three-fold.

Flexibility: The APV UNIversal Inducer is available as a close-coupled "Wi" inducer pump; for field conversion of standard "W" Series pumps; and adjustable to special "W" Series designs such as the WHP High Pressure, "Wa" Aseptic pump, and W-140/50 Multi-Stage pump.

APV Crepaco - Fluid Handling - Lake Mills, WI

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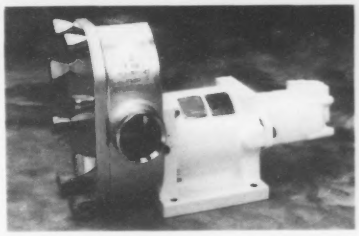

S Series Positive Displacement Sanitary Gear Pump

The S Series is a positive displacement sanitary gear pump specifically designed to pump liquid food products. Materials of construction options enable the S series to meet 3A and FDA requirements. The S series features drive options for power take off, hydraulic motor direct mount, or electric motor drives.

The S series design offers many benefits not provided by sanitary lobe pumps. The S series eliminates the need for costly timing gears, dual shaft seals, and expensive stainless steel lobes.

The S series is the first pump to offer an economical solution to sanitary pumping requirements without a compromise in performance or quality.

"S" Series Advantages:

- 3A Approved
- FDA Approved Materials Are Used for All Product Contact Surfaces
- Simplistic Helical Gear Design
- No Timing Gears
- One Shaft Seal Required
- No Lock Nuts on the Gears Simplifies Disassembly and Cleaning.
- Four Position Case Allows for Various Mounting Options
- Adjustable Roller Bearings Extend Pump Life
- Adaptable to Hydraulic Motors, Power Take Off Shafts and Electric Motor Drives
- Bidirectional Externally Adjustable Relief Valves Available
- Self-Priming

Roper Pump Company - Commerce, GA

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on your Reader Service Card

New IAMFES Members

Alabama

Warren Hambright
US Army
Anniston

Omar Oyarzabal
Auburn University
Auburn

California

Dianne Balas
Alta Loma

Florida

Carlos A. Riveros
Provilac S.A.
Miami

Georgia

Alan K. Hathcox
University of Georgia
Athens

Illinois

Mary Maiorano
Baxter Healthcare
Round Lake

John White
Hidden Valley Ranch Company
Wheeling

Iowa

Timothy A. Freier
Cargill Analytical Services
Cedar Rapids

Kansas

Jack W. Maybee
Johnson County Environmental Dept.
Lenexa

Michigan

Robert G. Taylor
Michigan Department of Agriculture
Lansing

Minnesota

Craig Hedberg
Minnesota Department of Health
Minneapolis

Peter Nash
Camas Diagnostic Company
Minneapolis

Missouri

Larry Steenson
Raskas Foods, Inc.
St. Louis

Montana

Roslyn Hill
Laurel

New Jersey

Kelly Wyrough
R.A.S. Process Equipment, Inc.
Trenton

New York

Robert L. Karches
Upstate Milk Coop, Inc.
Cheektowaga

Oklahoma

Frank Barcellos
Oklahoma State Department of Health
Tulsa

Pennsylvania

Diana M. Reed
Hershey Foods Corp.
Hershey

Rose Sorgenfrei
Lancaster Laboratories
Lancaster

South Carolina

Susan F. Barefoot
Clemson University
Clemson

Texas

Ken Hendricks
Bell County Health District
Belton

Cynthia Sheffield
Lynntech, Inc.
College Station

Virginia

Walter Hartman
Virginia Tech
Blacksburg

Washington

Nancy A. Byers
Seattle

Mansour Samadpour
University of Washington
Seattle

Canada

Carl Bader
Cuddy Food Products
London, Ontario

Frank Bartlett
Agriculture Canada
Ottawa, Ontario

Pierre Daniel
Agriculture Canada
Farnham, Quebec

M. Khan
Provincial Laboratory
Vancouver, British Columbia

John J. Oggel
Agriculture Canada
Nepean, Ontario

England

W. H. Brockbank
ABB Kent-Taylor, Ltd.
Stonehouse, Gloucestershire

Ghana

Alice Hayjord
Food Research Institute
Accra

New Zealand

Lindsay Pearce
NZ Dairy Research Institute
Palmerston North

Dairy, Food and Environmental Sanitation, Vol. 13, No. 8, Pages 483-495 (August, 1993)

Holders of 3-A Symbol Council Authorization on August 15, 1993

Questions or statements concerning any of the holders authorizations listed below, or the equipment fabricated, should be addressed to: Administrative Officer, 3-A Symbol Council, 4403 First Avenue, Suite 404, Cedar Rapids, IA 52402 (319) 395-9151.

01-07 Storage Tanks for Milk and Milk Products

2 APV Crepaco, Inc. (5/1/56)
100 South CP Ave.
Lake Mills, Wisconsin 53551

28 Cherry-Burrell Corporation (10/3/56)
(A Unit of AMCA Int'l., Inc.)
575 E. Mill St.
Little Falls, New York 13365

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

76 Damrow Company (10/31/57)
(A Div. of DEC Int'l., Inc.)
196 Western Ave., P.O. Box 750
Fond du Lac, Wisconsin 54935-0750

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

440 Scherping Systems (3/1/85)
801 Kingsley St.
Winsted, Minnesota 55395

571 Viatec Process/Storage Systems (8/21/89)
500 Reed St.
Belding, Michigan, 48809

31 Walker Stainless Equipment Co., Inc. (10/4/56)
Elroy, Wisconsin 53929

02-08 Pumps for Milk and Milk Products

63R APV Crepaco, Inc. (4/29/57)
100 South CP Ave.
Lake Mills, Wisconsin 53551

636 Abel Pumps Corporation (7/10/91)
79 North Industrial Park
503 North Drive
Sewickley, Pennsylvania 15143-2394
(Mfr: Abel Pumps, Buchen, Germany)

214R Ben H. Anderson Manufactures (5/20/70)
Box A
Morrisonville, Wisconsin 53571

212R Babson Brothers Company (2/20/70)
Dairy Systems Division
1400 West Gale
Galesville, Wisconsin 54630

709 Conexiones Inoxidables (01/18/93)
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

205R Dairy Equipment Co. (5/22/69)
1919 S. Stoughton Rd., P. O. Box 8050
Madison, Wisconsin 53716

462 Enprotech Corporation (12/5/85)
335 Madison Avenue
New York, New York 10017

671 Flowtech, Inc. (4/1/92)
1900 Lake Park Drive
Smyrna, Georgia 30080

466 Fluid Metering Inc. (1/10/86)
29 Orchard St.
Oyster Bay, New York 11771

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

65R G & H Products Corp. (5/22/57)
7600-57th Avenue
P.O. Box 1199
Kenosha, Wisconsin 53141

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

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

603 Johnson Pumps (UK) Ltd (8/16/90)
(Not Available in the U.S.A.)
Highfield Industrial Estate
Edison Road, Eastbourne
East Sussex, England BN23 6PT

325 Highfield Industrial Estate (8/16/90)
Edison Road, Eastbourne
East Sussex, England BN23 6PT
U. S. REP: Johnson Pump of America, Inc.
4825 Scott Street, Suit 306
Schiller Park, Illinois 60176

604 Johnson Pumps (UK) Ltd. (8/16/90)
(Not Available in the U.S.A.)
Highfield Industrial Estate
Edison Road, Eastbourne
East Sussex, England BN23 6PT

673 MGI Pumps, Inc. (4/16/92)
9201 Wilmot Road
Kenosha, Wisconsin 53141

654 Mono Pumps Ltd., Dresser Pump Division (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 (8/15/83)
119 Pickering Way
Exton, Pennsylvania 19341-139

684 PCM.POMPES (7/9/92)
17 Rue Ernest Laval
B. P. 35 - 92173 Vanves Cedex

France
U.S. Rep: MGI Pumps
9201 Wilmot Road
Kenosha, WI 53141-1426

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

595 Seepex, Inc. (3/16/90)
(Formerly Pumpen - und Maschinenbau)
1834 Valley Street
Dayton, Ohio 45405

241 Puriti, S.A. de C.V. (9/12/72)
Alfredo Nobel 39
Industrial Puente de Vigas
Tlalnepantla, Mexico

148R Robbins & Myers, Inc. (4/22/64)
1895 Jefferson St.
Springfield, Ohio 45506

364 Roper Pump Company (7/28/82)
P.O. Box 269
Commerce, Georgia 30529

568 Shanley Pump & Equipment, Inc. (5/15/89)
(Mfg. by Allweiler, West Germany)
2255-1 Lois Dr.
Rolling Meadows, Illinois 60008

678 Shanley Pump & Equipment (5/11/92)
2255-1 Lois Drive
Rolling Meadows, Illinois 60008

507 Sine Pump (7/21/87)
Division of The Kontro Co., Inc.
500 West River Street
Orange, Massachusetts 01364

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

72R L.C. Thomsen Inc. (9/14/57)
1303-43rd St.
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

175R Universal Dairy (10/25/56)
11100 N. Congress Ave.
Kansas City, Missouri 64153

52R Viking Pump, Inc. (12/31/56)
A Unit of IDEX Corporation
406 State Street
Cedar Falls, Iowa 50613

29R Waukesha Fluid Handling (10/3/76)
(Formerly Cherry-Burrell
Fluid Handling Division)
611 Sugar Creek Road
Delavan, Wisconsin 53115

408 Westfalia Systemat (10/18/83)
(Mfg. by Westfalia, West Germany)
1862 Brummel Drive
Elk Grove Village, Illinois 60007

04-03 Homogenizers and High Pressure Pumps of the Plunger Type

37 APV Crepaco, INC. (10/19/56)
100 South CP Ave.
Lake Mills, Wisconsin 53551

75 APV Gaulin, Inc. (6/26/57)
500 Research Dr.
Wilmington, Massachusetts 01887

309 APV Rannie, Inc. (7/19/78)
(Formerly Niro Atomizer Food & Dairy, Inc.)
445 Etna Street
Suite 57
St. Paul, Minnesota 55106

722 APV Rannie AS (03/23/93)
Roholmsvej 8, DK-2620
Albertslund, DENMARK
(Not Available in USA)

247 Alfa-Laval (4/14/73)
8400 Lake View Parkway
Suite 500
Pleasant Prairie, Wisconsin 53158

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

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

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

486 Fowler Products Company (11/18/86)
150 Collins Industrial Blvd.
P.O. Box 80268
Athens, Georgia 30608-0268

657 Microfluidics Corp. (11/4/91)
P. O. Box 9101
90 Oak Street
Newton, Massachusetts 02164-9101

558 Niro Soavi S.p.A. (1/389)
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

714 Union Homogenizer (02/25/93)
4600 W. Dickman Road
Battle Creek, MI 49015

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

379 Bar-Bel Fabricating Co., Inc. (3/15/83)
N 3760 Hwy 12 & 16
Mauston, Wisconsin 53948

70R Brenner Tank, Inc. (8/5/57)
450 Arlington Ave., 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

201 Paul Krohnert Mfg. Ltd. (4/1/68)

(not available in USA)
811 Steeles Ave., P.O. Box 126
Milton, Ontario, Canada L9T 2Y3

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

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

653 Tremar (10/10/91)
(Not available in the U.S.A.)
1, Tougas Street
Iberville, Quebec, Canada J2X 2P7

25 Walker Stainless Equip. Co., Inc. (9/28/68)
618 State Street
New Lisbon, Wisconsin 53950

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

437 West-Mark (11/30/84)
2704 Railroad Ave., P.O. Box 418
Ceres, California 95307

08-17 Rev. Fittings Used on Milk and Milk Products Equipment and Used on Sanitary Lines Conducting Milk and Milk Products

349 APN, Inc. (12/15/81)
400 W. Lincoln
Caledonia, Minnesota 55921

260 APV Crepaco, Inc. (08-17 A&B) (5/21/75)
100 South CP Avenue
Lake Mills, Wisconsin 53551

470 Advance Stainless Mfg. Corp. (3/30/86)
218 West Centralia Street
Elkhorn, Wisconsin 53121

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

79R Alloy Products Corp. (11/23/57)
1045 Perkins Ave., P.O. Box 529
Waukesha, Wisconsin 53187

682 Andron Stainless, Ltd. (6/30/92)
(NOT AVAILABLE IN THE USA)
4610 Burgoyne Street
Mississauga, Ontario
Canada L4W 1G1

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

688 Cajon Company (8/4/92)
9760 Shepard Road
Macedonia, Ohio 44056

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

696 Conexiones Inoxidables (10/1/92)
de Puebla S. A. de C. V.
Vicente Guerrero No. 112
Xicotepec de Juarez
Edo. Puebla, Mexico

528 Dayco Products Inc. (3/16/88)
333 West First Street
Dayton, Ohio 45402-3042

677 EXCEL-A-TEC, Inc. (5/8/92)
W141 N5984 Kaul Avenue
Menomonee Falls, Wisconsin 53051

455 Flowtech Inc. (9/17/85)
1900 Lake Park Dr. Suite 345
Smyrna, Georgia 30080

271 The Foxboro Company (3/8/76)
33 Commercial Street
Foxboro, Massachusetts 02035

676 HBS Products, Inc. (4/29/92)
181 Elliot Street
Beverly, MA 01915

67R G & H Products Corp. (6/10/57)
7600-57th Avenue
P.O. Box 1199
Kenosha, Wisconsin 53141

369 IMEX, Inc. (11/3/82)
(Mfg. by Lube Corp., Japan)
4040 Del Ray Ave. Unit 9
Marina del Rey, California 90292

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

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

239 Lumaco, Inc. (6/30/72)
P.O. Box 688
Teaneck, New Jersey 07666

703 Parker Hannifin Corp. (11/6/92)
Instrument. Connectors Div.
9400 South Memorial Pkwy
Huntsville, AL 35803

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

726 Pure Fit, Inc. (04/14/93)
924 Marcon Blvd.
Allentown, Pennsylvania 18103

242 Puriti, S.A. de C.V. (9/12/72)
Alfredo Nobel 39
Industrial Puente de Vigas
Tlalnepantla, Mexico

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

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

719 Schott Process Systems (03/09/93)
1640 SW Blvd.
Vineland, New Jersey 08360

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

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

357 Tanaco Products (4/16/82)
3860 Loomis Trail Rd.
Blaine, Washington 98230

449 Tech Controls Enterprise Co., Ltd. (8/2/85)
(Mfg. in Taiwan)
2940 SE 200th Avenue
Issaquah, Washington 98027

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

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

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

707 Valvinox, Inc., SGRM Div. (01/05/93)
650 - 1st Street
Iberville, Quebec, Canada J2X 3B8
(Not available in USA)

82R Waukesha Fluid Handling (12/18/57)
(Formerly Cherry-Burrell
Fluid Handling Division)
611 Sugar Creek Road
Delavan, Wisconsin 53115

08-17A Compression Type Valves

533 APV Crepaco, Inc. (5/21/75)
100 S. CP Ave.
Lake Mills, Wisconsin 53551

484 APV Crepaco, Inc. (10/22/86)
100 South CP Avenue
Lake Mills, Wisconsin 53551

730 APV Rockford, Inc. (04/21/93)
1303 Samuelson Road
Rockford, Illinois 61109

552 Alloy Products Corp. (11/23/57)
1045 Perkins Ave.
P.O. Box 529
Waukesha, Wisconsin 53187

245 Babson Brothers Company (2/12/73)
Dairy System Division
1400 West Gale Ave.
Galesville, Wisconsin 54630

443 Badger Meter, Inc. (4/30/85)
6116 East 15th Street
P. O. Box 581390
Tulsa, Oklahoma 74158-1390

686 Bardiani Valvole S.R.L. (8/3/92)
Via G. Vittorio, 53
43045 Fornovo (PR) Italy
U. S. Rep: Sanchelima Int.
1763 Northwest 93rd Ave.
Miami, FL 33172

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

538 Cipriani, Inc. (7/31/86)
(Mfg. by Fratelli Tassalini, Italy)
23195 La Cadena Drive, Suite 103
Laguna Hills, California 92653

716 Conexiones Inoxidables (03/04/93)
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 Definox Division (1/25/83)
Defontaine, Inc.
17044 W. Victor Road
New Berlin, Wisconsin 53151

530 G & H Products Corp. (6/10/57)
7600-57th Ave.
P.O. Box 1199
Kenosha, Wisconsin 53141

480 GEA Food and Process Systems Inc. (8/8/86)
8940 Route 108
Columbia, Maryland 21045

607 Kammer Valve, Inc. (9/25/90)
510 Parkway View Drive
Pittsburgh, Pennsylvania 15205

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

594 Oden Corp. (3/6/90)
255 Great Arrow Ave.
Buffalo, New York 14207

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.
601 Thompson Road N.
Syracuse, New York 13211

551 Puriti, S.A. de C.V. (9/12/72)
Alfredo Nobel 39
Fracc. Ind. Puente de Vigas
Tlalnepantla, Mexico

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

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

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

467 Tuchenhagen North America Inc. (1/13/86)
(Mfg. by Otto Tuchenhagen, West Germany)
8949 Deerbrook Trail
Milwaukee, Wisconsin 53223

561 VACU-PURG, Inc. (1/26/89)
214 West Main St.
P.O. Box 272
Fredericksburg, Iowa 50630

584 Valvinox Inc. (11/27/89)
654 1ere Rue.
Iberville-QUE-Canada J2X 3B8

86R Waukesha Specialty Co., Inc. (12/20/57)
P.O. Box 160, Hwy 14
Darien, Wisconsin 53144

08-17B Diaphragm-Type Valves

565 APV Rosista, Inc. (10/22/86)
(Mfg. by APV Rosista, Inc. W. Germany & Denmark)
1325 Samuelson Rd.
Rockford, Illinois 61109

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

617 Definox Division (2/1/91)

Defontaine, Inc.
17044 W. Victor Road
New Berlin, Wisconsin 53151

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

514 H. D. Bauman Assoc., Ltd. (8/24/87)
35 Mirona Road
Portsmouth, New Hampshire 03801

203R ITT Grinnell Valve Co., Inc. (11/27/68)
Dia-Flo Division
33 Centerville Rd.
Lancaster, Pennsylvania 17603

494 Saunders Valve, Inc. (2/10/87)
15760 W. Hardy, #440
Houston, Texas 77060

08-17D Automatic Positive Displacement Sampler

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

284 Bristol Engineering Co. (11/18/76)
210 Beaver St.
P.O. Box 696
Yorkville, Illinois 60560

693 Micropure Filtration, Inc. (9/17/92)
2323 6th Street, PO Box 7007
Rockford, Illinois 61125

08-17E Inlet and Outlet Leak-Protector Plug Valve

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

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

08-17F Tank Outlet Valve

531 G & H Products Corp. (6/10/57)
7600-57th Ave.
P.O. Box 1199
Kenosha, Wisconsin 53141

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

08-17G Rupture Discs

422 BS & B Safety Systems, Inc. (6/12/84)
7455 E. 46th St.
Tulsa, Oklahoma 74133

407 Continental Disc Corp. (10/14/83)
4103 Riverside NW
Kansas City, Missouri 64150

08-17H Thermoplastic Plug Type Valves

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

08-17I Steam Injected Heaters

728 APV Crepaco, Inc. (04/14/93)
395 Fillmore Avenue
Tonawanda, New York 14150

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

08-17L Hose Assemblies

721 Dixon Valve & Coupling Co. (03/23/93)
800 High Street
Chestertown, Maryland 21620

695 Couple-Up, Inc. (9/28/92)
420 Dixon Street
Compton, California 90222

727 Pure Fit, Inc. (04/14/93)
924 Marcon Blvd.
Allentown, Pennsylvania 18103

698 Sanitary Couplers, Inc. (10/23/92)
9151 Normandy Lane, S.
Centerville, Ohio 45458

700 Titan Industries, Inc. (10/23/92)
11121 Garfield Avenue
South Gate, California 90280

08-17M Vacuum Breakers and Check Valves

376 Definox Division (1/25/83)
Defontaine, Inc.
17044 W. Victor Road
New Berlin, Wisconsin 53151

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

09-09 Instrument Fittings and Connections Used on Milk and Milk Products Equipment

32 ABB Kent-Taylor Inc. (10/4/56)
(Formerly Taylor Instruments)
P.O. Box 20550
Rochester, New York 14602-0550

428 ARI Industries, Inc. (9/12/84)
381 ARI Court
Addison, Illinois 60101

321 Anderson Instrument Co., Inc. (6/14/79)
RD #1
Fultonville, New York 12072

586 Beta Technology, Inc. (12/14/89)
105 Harvey West Blvd.
Santa Cruz, California 95060

315 Burns Engineering, Inc. (2/5/79)
10201 Bren Rd., East
Minnetonka, Minnesota 55343

206 The Foxboro Company (8/11/69)
33 Commercial Street
Foxboro, Massachusetts 02035

592 Claud S. Gordon Co. (2/27/90)
5710 Kenosha St.
P.O. Box 500
Richmond, Illinois 60071

620 Larad Equipment (2/25/91)
26 Pearl Street
Bellingham, Massachusetts 02019

588 Minco Products, Inc. (12/20/89)
7300 Commerce Lane
Minneapolis, Minnesota 55432

418 Niro Hudson (4/2/84)
(Formerly Niro Atomizer Food & Dairy)
1600 County Road F
Hudson, Wisconsin 54016

487 Pyromation, Incorporated (12/16/86)
5211 Industrial Road
Fort Wayne, Indiana 46825

367 RDF Corporation (10/2/82)
23 Elm Ave.
Hudson, New Hampshire 03051

495 Rosemount Analytical Division (2/13/87)
2400 Barranca Pkwy.
Irvine, California 92714

732 SensorTec, Inc. (05/18/93)
16335-7 Lima Road
Huntertown, Indiana 46748

420 Stork Food Machinery, Inc. (4/17/84)
P.O. Box 1258/Airport Parkway
Gainesville, Georgia 30503

32 Taylor Instrument (10/4/56)
Combustion Engineering, Inc.
400 West Avenue, P.O. Box 110
Rochester, New York 14692

690 Texas Thermowell, Inc. (8/25/92)
PO Box 1535
Hwy. 96 North
Silsbee, Texas 77656

444 Tuchenhagen North America (6/17/85)
8949 Deerbrook Trail
Milwaukee, Wisconsin 53223

612 Viatran Corp & Haenni Druckmittler (12/13/90)
300 Industrial Drive
Grand Island, New York 14072

522 Weed Instrument Company, Inc. (12/28/87)
707 Jeffrey Way
Round Rock, Texas 78664

10-03 Milk and Milk Products Filters Using Disposable Filter Media, as Amended

371 Alloy Products Corp. (12/10/82)
1045 Perkins Ave., P.O. Box 529
Waukesha, Wisconsin 53187

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

704 Pall Trinity Micro Corp. (11/6/92)
3643 State Route 281
Cortland, NY 13045-0930

720 R-P Products (03/19/93)
Box 388, 407 Jefferson Street
Three Rivers, Michigan 49093

435 Sermia International (11/27/84)
740-212 Boul. Industriel
Blainville, Quebec
Canada J7C 3V4
U. S. Rep: United Dairy
Machinery Corp.
301 Meyer Road
Buffalo, New York 14224

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

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

11-04 Plate-type Heat Exchangers for Milk and Milk Products

365 APV Baker AS (9/8/82)
(not available in USA)
Platinvej, 8
P.O. Box 329
DK-6000 Kolding
Denmark

20 APV Crepaco, INC. (9/4/56)
395 Fillmore Ave.
Tonawonda, New York 14150

17 Alfa-Laval Food & Dairy Co. (7/28/82)
(Div. of Alfa-Laval Inc.)
8400 Lake View Parkway
Pleasant Prairie, Wisconsin 53158

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

718 Babson Bros. Co. (03/08/93)
Dairy Systems Div.
1400 West Gale Avenue
Galesville, Wisconsin 54630

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

14 Chester-Jensen Co., Inc. (8/15/56)
5th & Tilghman Sts., P.O. Box 908
Chester, Pennsylvania 19016

468 GEA Food and Process Systems Inc. (2/2/86)
8940 Route 108
Columbia, Maryland 21045

622 ITT Standard (2/25/91)
175 Standard Parkway
Cheektowaga, New York 14227
P.O. Box 1102
Buffalo, New York 14240-1102

326 Karbate Vicarb Inc. (2/4/80)
(Mfg. by vicarb, France)
21945 Drake Rd.
Strongsville, Ohio 44136

15 Kusel Equipment Co. (8/15/56)
820 West St., P.O. Box 87
Watertown, Wisconsin 53094

360 Laffranchi Wholesale Co. (7/12/82)
P.O. Box 698
Ferndale, California 95536

657 Microfluidics Corp. (11/4/91)
90 Oak Street
P.O. Box 9101
Newton, Massachusetts 02164-9101

491 On-Line Instrumentation, Inc. (1/2/87)
P.O. Box 541
Hopewell Junction, New York 12533

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

279 The Schlueter Company (8/30/76)
(Mfg. by Samuel Parker, New Zealand)

3410 Bell Street
Janesville, Wisconsin 53545

650 Schmidt-Bretten, Inc. (10/3/91)
20475 Woodingham Drive
Detroit, Michigan 48221

670 Skellerup Engineering, Ltd. (4/1/92)
2 Robert Street
P. O. Box 11-020
Ellerslie, Auckland 5
New Zealand
U. S. Rep: Masport, Inc.
6140 McCormick Drive
Lincoln, Nebraska 68507

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

610 Universal Dairy Equipment (12/13/90)
(Mgr. Skellerup Engineering,
Auckland, New Zealand)
11100 N. Congress Avenue
Kansas City, Missouri 64153

12-05 Tubular Heat Exchangers for Milk and Milk Products

614 Alfa-Laval Food & Dairy (12/27/90)
(Manufactured by Spiraflo Indus.
Australia)
8400 Lake View Parkway, Suite 500
Pleasant Prairie, Wisconsin 53158

628 Alfa-Laval Food & Dairy Company (5/2/91)
8400 Lakeview Parkway
Suite #500
P.O. Box 500
Pleasant Prairie, Wisconsin 53158

438 APV Crepaco, INC. (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
140 West Gale
Galesville, Wisconsin 54630

734 Berdell Industries (05/19/93)
62 Scott Avenue
Brooklyn, New York 11237

605 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

613 Efrex Corp. (12/27/90)
11 Kitty Hawk Drive
Pittsford, NY 14534-1620

712 Enerquip, Inc. (02/24/93)
611 North Road
P. O. Box 368
Medford, WI 54451

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

307 G & H Products Corp. (5/2/78)
7600-57th Avenue
P.O. Box 1199
Kenosha, Wisconsin 53141

217 Girton Manufacturing Co. (1/31/71)
Millville, Pennsylvania 17846

616 ITT Standard
175 Standard Pkwy
P.O. Box 1102
Buffalo, New York 14240-1102

711 Kusel Equipment Co. (02/24/93)
820 West Street
Watertown, WI 53094

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

96 C. E. Rogers Co. (3/31/64)
So. Hwy #65, P.O. Box 118
Mora, Minnesota 55051

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

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

591 Thermotech/Div. of Fristam Pumps, Inc. (2/8/90)
2410 Parview Rd.
Middleton, Wisconsin 53562

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

13-08 Farm Milk Cooling and Holding Tanks

240 Babson Brothers Company (9/6/72)
Dairy Systems Division
1400 West Gale
Galesville, Wisconsin 54630

4R Dairy Equipment Co. (6/15/56)
1919 So. Stoughton Rd.
Madison, Wisconsin 53716

179R Heavy Duty Products (Preston) Ltd. (3/8/66)
(Not available in USA)
1261 Industrial Rd.
Cambridge (Preston)
Ontario, Canada N3H 4W3

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

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

254 APV Crepaco, Inc. (1/7/74)
165 John L. Dietsch Square
Attleboro Fall, Massachusetts 02763

132 APV Crepaco, INC. (10/26/60)
395 Fillmore Ave.
Tonawanda, New York 14150

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

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

Winsted, Minnesota 55395

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

311 GEA Food and Process Systems Inc. (8/28/79)
8940 Route 108
Columbia, Maryland 21045

273 Niro Evaporators, Inc. (5/20/76)
(Formerly Niro Atomizer
Food and Dairy)
9165 Rumsey Road
Columbia, MD 21045

107R C.E. Rogers Co. (7/31/58)
So. Hwy #65, P.O. Box 118
Mora, Minnesota 55051

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

17-07 Formers, Fillers and Sealers of Single Service Containers for Milk and Milk Products

366 Autoprod, Inc. (9/15/82)
(An Alcoa Subsidiary)
5355 115th Avenue N.
Clearwater, Florida 34620

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

382 Combibloc, Inc. (4/15/83)
(Mfg. by Jagenberg, West Germany)
4800 Roberts Rd.
Columbus, Ohio 43228

324 Erca USA, Inc. (11/29/79)
(Mfrd. by Erca, France
72A Grays Bridge Road
Brookfield, Connecticut 06804

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

619 Hassia Verpackungsmaschinen GmbH (2/22/91)
6479 Ranstadt 1/Hessen Germany
(Hassia USA, Inc. 39 Plymouth St.
Fairfield, New York 07007)

473 International Paper Company (6/12/86)
Extended Shelf Life Division
4020 Stirrup Creek Drive, Bldg. B200
Durham, North Carolina 27703

731 LIEDER-Maschinenbau Gmbh & Co. KG (05/18/93)
Postfach 1252/Im Laab 3
3033 Schwarmstedt, GERMANY

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

442 Milliken Packaging (2/21/85)
White Stone, South Carolina 29386

137 Pure-Pak, Inc. (10/17/62)
850 Ladd Road
Walled Lake, Michigan 48088

281 Purity Packaging Corp. (11/8/76)
30000 South Hill Road
New Hudson, Michigan 48165

511 Remy Division (8/14/87)
(Mfg. by E. P. Remy, France)
2096 Gaither Road, Suite 119
Rockville, Maryland 20850

723 James River Corporation (03/26/93)
One Better Way Road
Milford, Ohio 45150

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: Pure-Pak, Inc.
30000 South Hill Road
New Hudson, Michigan 48165

351 Tetra Pak Inc. (1/7/82)
(Mfg. by A. B. Tetra, Italy)
909 Asbury Drive
Buffalo Grove, IL 60089

220 Tetra Rex Packaging Systems (4/24/71)
(formerly TetraPak/EquipUS)
909 Asbury Drive
Buffalo Grove, Illinois 60090

694 Verpaco AG (9/23/92)
Eggenwattt 12
8995 Weissensberg, B R D
Germany

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

141 APV Crepaco, INC. (4/15/63)
100 South CP Ave.
Lake Mills, Wisconsin 53551

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

286 O. G. Hoyer, Inc. (12/8/76)
(Mfg. by O. G. Hoyer A/S, Denmark)
201 Broad Street
Lake Geneva, Wisconsin 53147

465 Leon's Frozen Custard (12/17/85)
3131 S. 27th Street
Milwaukee, Wisconsin 53151

573 Processing Machinery & Supply Company (9/28/89)
(Mfg. by PMS Italiana, Italy)
1108 Frankford Ave.
Philadelphia, Pennsylvania 19125

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

22-06 Silo-type Storage Tanks for Milk and Milk Products

154 APV Crepaco, Inc. (2/10/65)
100 South CP Ave.
Lake Mills, Wisconsin 53551

168 Cherry-Burrell Corp. (6/16/65)
(A Unit of AMCA Int'l, Inc.)
575 E. Mill Street
Little Falls, New York 13365

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

181 Damrow Co. (5/18/66)
(Div. of DEC Int'l., Inc.)
196 Western Ave., P.O. Box 750
Fond du Lac, Wisconsin 54935-0750

312 Feldmeier Equipment, Inc. (9/15/78)
6800 Town Line Road

P.O. Box 474
Syracuse, New York 13211

702 Paul Krohnert Manufacturing, Ltd. (11/6/92)
(Not available in the USA)
P. O. Box 126
811 Steeles Avenue
Milton, Ontario, Canada L9T 2Y3

439 JV Northwest Inc. (1/22/85)
28120 SW Boberg Rd.
Wisonville, Oregon 97070

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

503 Ripley Stainless Ltd. (5/1/87)
(Not available in USA)
RR #3, Site 41
Summerland, British Columbia V0H 1Z0

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

675 Stainless Fabrication, Inc. (4/22/92)
620 North Prince Lane
Springfield, Missouri 65802

165 Walker Stainless Equipment Co., Inc. (4/26/65)
Elroy, Wisconsin 53929

23-01 Equipment for Packaging Frozen Desserts, Cottage Cheese, and Similar Milk Products, as Amended

174 APV Rockford, Inc. (9/28/65)
Filling & Wrapping Systems Div.
1303 Samuelson Road
Rockford, Illinois 61109

209 Doboy Packaging Machinery Incorp. (7/23/69)
869 S. Knowles Ave.
New Richmond, Wisconsin 54017

674 Hayssen Manufacturing (4/20/92)
5300 Highway 42 North
P. O. Box 571
Sheboygan, Wisconsin 53082-0571

679 Ice Cream Novelties (6/1/92)
Division of Popsicle Inc., Ltd.
5305 Fairview Street
P. O. Box 610
Burlington, Ontario, Canada L7R 3Y5
U. S. Rep: Sunshine Biscuits
100 Woodbridge Center Drive
Woodbridge, New Jersey 07095-1196

635 Interbake Dairy Ingredients Div. (7/10/91)
2220 Edward Holland Drive
Suite 301
Richmond, Virginia 23230

343 O.G. Hoyer, Inc. (7/6/81)
(Mfg. by Alfa Hoyer, Denmark)
201 Broad St.
Lake Geneva, Wisconsin 53147

626 Klockner Bartelt, Inc. (4/2/91)
5501 N. Washington Blvd.
Sarasota, FL 34243-2283

447 Mateer-Burt Co., Inc. (7/22/85)
(Mfg. by Trustpak, England)
436 Devon Park Drive
Wayne, Pennsylvania 19087

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

666 Rapidpak (3/5/92)
1725 West 8th Street
Appleton, Wisconsin 54911

222 Sweetheart Packaging (11/15/71)
10100 Reistertown Road
Owing Mills, Maryland 21117
(Formerly Fort Howard Pkg. Corp.)

24-02 Non-coil Type Batch Pasteurizers

158 APV Crepaco, INC. (3/24/65)
100 South CP Ave.
Lake Mills, Wisconsin 53551

161 Cherry-Burrell Corp. (4/5/65)
(A Unit of AMCA Int'l., Inc.)
575 E. Mill St.
Little Falls, New York 13365

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

519 Feldmeier Equipment, Inc. (10/22/87)
6800 Town Line Road
P.O. Box 474
Syracuse, New York 13211

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

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

159 APV Crepaco, INC. (3/24/65)
100 South CP Ave.
Lake Mills, Wisconsin 53551

162 Cherry-Burrell Corp. (4/5/65)
(A Unit of AMCA Int'l., Inc.)
575 E. Mill St.
Little Falls, New York 13365

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

725 Inox-Tech, Inc. (04/14/93)
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. (02/10/93)
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)
633 N. Prince Lane
Springfield, Missouri 65802

202 Walker Stainless Equip. Co., Inc. (9/24/68)
618 State St.
New Lisbon, Wisconsin 53950

26-03 Sifters for Dry Milk and Dry Milk Products

634 Great Western Mfg. Co. (7/10/91)
2017 South Fourth Street
P.O. Box 149
Leavenworth, Kansas 66048

363 Kason Corp. (7/28/82)
1301 East Linden Ave.
Linden, New Jersey 07036

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

185 Rotex, Inc. (8/10/66)
1230 Knowlton St.
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, NJ 07036

172 Sweco, Inc. (9/1/65)
7120 Buffington Rd.
Florence, KY 41042

27-02 Equipment for Packaging Dry Milk and Dry Milk Products

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

618 Hayssen Manufacturing Company (2/18/91)
(Manufactured by Yamato Scale Co.
Akasi, 673, Japan)
5300 Highway 42 North
P.O. Box 571
Sheboygan, Wisconsin 53082-0571

625 Ishida Scales Mfg. Co., Inc. (4/2/91)
44, Sanno-Cho, Shogoin
Sakyo-Ku, Kyoto, Japan
US Rep: Heat & Control
225 Shaw Rd.
S. San Francisco, CA 94080

409 Mateer-Burt Co. (10/31/83)
436 Devon Park Dr.
Wayne, Pennsylvania 19087

476 Stone Container Corporation (7/17/86)
1881 West North Temple
Salt Lake City, Utah 84116-2097

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

28-02 Flow Meters for Milk and Milk Products

270 ABB Kent-Taylor, Inc. (2/9/76)
(Formerly Taylor Instruments)
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

359 Brooks Instruments (6/11/82)
407 West Vine St.
Hatfield, PA 19440

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

469 Endress & Hauser, Inc. (3/3/86)
2350 Endress Place
Greenwood, Indiana 46142

692 Endress & Hauser Flowtec AG (9/14/92)
Kagenstrasse 7
Ch - 4153 Reinach, Switzerland

599 Euromatic Machine & Oil Co., Ltd (4/26/90)
P.O. Box 297
St. Helier
Jersey C.I. UK

226 Fischer & Porter Co. (12/9/71)
County Line Rd.
Warminster, Pennsylvania 18974

477 Flowdata Inc. (7/31/86)
1784 Firman Drive
Richardson, TX 75081

506 Flow Technology, Inc. (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. (03/04/93)
3800 Camp Creek Parkway
Ste. 102, Bldg. 2400
Atlanta, Georgia 30331

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

661 G/H Products Corp. (11/21/91)
7600-57th Avenue
P.O. Box 1199
Kenosha, Wisconsin 53142

562 Great Lakes Instruments, Inc. (2/6/89)
8855 North 55th Street
Milwaukee, Wisconsin 53223

630 Halliburton Services (5/28/91)
Drawer 1431
Duncan, Oklahoma 73536-0602

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

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

733 Honeywell, Inc. (05/18/93)
14841 Black Canyon Highway
Phoenix, Arizonaa 85023

474 Hydril Production (6/30/86)
Technology Division
330 North Belt East
Houston, Texas 77032-3411

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

535 Invalco, Inc.
P.O. Box 556

Tulsa, Oklahoma 74101

529 Krohne America, Inc. (5/18/88)
(Mfg. by Altometer, Holland)
One Intercontinental Way
Peabody, Massachusetts 01960

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

729 Peek Measurement, Ltd. (04/14/93)
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 Dr.
Eden Prairie, Minnesota

585 Schlumberger Industries Ltd. (12/7/89)
(Mfg. by Schlumberger, England)
11321 Richmond Ave.
Houston, Texas 77082-2615

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

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

715 Thermal Instrument Co. (02/25/93)
217 Sterner Mill Road
Trevose, Pennsylvania 19053

386 Turbo Instruments, Inc. (5/11/83)
(Mfg. by Turowerk, West Germany)
4 Vashell Way
Orinda, California 94563

664 XO Technologies, Inc. (12/16/91)
28020 Avenue Stanford
Valencia, California 91355

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)
7600-57th Avenue
P.O. Box 1199
Kenosha, Wisconsin 53142

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, as Amended

290 APV Crepaco, INC. (6/15/77)
100 South CP Ave.
Lake Mills, Wisconsin 53551

274 Contherm, Inc. (6/25/76)
P.O. Box 352, 111 Parker St.
Newburyport, Massachusetts 01950

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

496 FR Mfg. Corp. (2/23/87)
2807 South Highway 99
Stockton, California 95202

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

32-01 Uninsulated Tanks for Milk and Milk Products

397 APV Crepaco, INC. (6/21/83)
100 South CP Ave.
Lake Mills, Wisconsin 53551

264 Cherry-Burrell Corp. (1/27/75)
(A Unit of AMCA Int'l., Inc.)
575 E. Mill St.
Little Falls, New York 13365

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

354 C.E. Rogers Co. (3/3/82)
S. Hwy #65, P.O. Box 118
Mora, Minnesota 55051

708 Lee Industries, Inc. (01/12/93)
P. O. Box 688
Phillipsburg, PA 16866

683 SANIFAB (7/9/92)
A Division of A&B Process Systems Corp.
528 North Street
Stratford, WI 54484

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

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

33-00 Polished Metal Tubing for Dairy Products

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

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

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

368 Rodger Industries Inc. (10/7/82)
(Not available in USA)
P.O. Box 186, RR1
Blenheim, Ontario
Canada N0P 1A0

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

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

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

34-02 Portable Bins

647 Thomas Conveyor Company (9/18/91)
Tote System Division
P.O. Box 2916
Fort Worth, Texas 76101

35-00 Continuous Blenders

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

526 Bepex Corp./Schugi (3/15/88)
(Mfg. by Lelystad, Netherlands)
333 Taft St. NE
Minneapolis, Minnesota 55413

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

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

464 Dairy Service Mfg., Inc. (12/12/85)
4630 W. Florissant Ave.
St. Louis, Missouri 63115

642 Mondomix Holland b.v. (8/7/91)
Reeweg 13
P.O. Box 98
1394 ZH Nederhorst den Berg
The Netherlands
US Rep: Carrier Assoc.
50 Dunnell Lane
Paawtucket, Rhode Island 02860-5828

680 Quadro Engineering, Inc. (6/3/92)
613 Colby Drive
Waterloo, Ontario
Canada N2V 1A1

724 Silverson Machines, Inc. (04/14/93)
P. O. Box 589
355 Chestnut Street
East Longmeadow, Massachusetts 01028
(Manufactured by Silverson Machines, Chesham, England)

36-00 Colloid Mills

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

608 Kinematica (10/17/90)
170 Linden Street
Wellesley, Massachusetts 02181

37-01 Liquid Pressure and Level Sensing Devices

576 Ametek/Mansfield & Green Division (10/13/89)
8600 Somerset Dr.
Largo, Florida 34643

318 Anderson Instrument Co., Inc. (4/9/79)
R.D. #1
Fultonville, New York 12072

659 Bindicator Company (11/20/91)
1915 Dove Street
Port Huron, Michigan 48060

525 Caldwell Systems Corporation (3/4/88)
1323 Sherman Drive
Longmont, Colorado 80501
(Formerly Zantel Instruments)

672 Computer Instruments Corp. (4/3/92)
1000 Shames Drive
Westbury, New York 11590

706 CTl Celtek Electronics (12/29/92)
136 Merizzi Street
St. Laurent, Quebec, Canada H4T 1S4
U. S. Rep: CTl Celtek Electronics, Inc.
1000 Leonidas Street
New Orleans, Louisiana 70118

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 Rd.
Horsham, Pennsylvania 19044

459 Endress + Hauser, Inc. (10/17/85)
2350 Endress Place
Greenwood, Indiana 46142

524 Flow Technology, Inc. (1/14/88)
4250 E. Broadway Road
Phoenix, Arizona 85040

463 The Foxboro Company (12/6/85)
33 Commercial Street
Foxboro, Massachusetts 02035

668 GP: 50 New York, Ltd. (3/30/92)
2770 Long Road
P. O. Box 805
Grand Island, New York 14072

651 Granzow, Inc. (10/3/91)
2300 CrownPoint Executive Drive
Charlotte, North Carolina 28227
(Mfr: Kubler AG
Baar, Switzerland)

633 Griffith Industrial Products Company (6/21/91)
P.O. Box 111
Putnam, CT 06260

557 Honeywell, Inc. (12/21/88)
Industrial Controls Div.
1100 Virginia Drive
Fort Washington, Pennsylvania 19034

629 Intrinsic Safety Equipment of Texas (5/20/91)
907 Bay Star
Webster, TX 77598-1531

598 Invalco, Inc. (3/22/90)
P.O. Box 556
Tulsa, Oklahoma 74101

572 ITT Conoflow (9/25/89)
P.O. Box 768
Rt 78
St. George, South Carolina 29477

396 King Engineering Corp. (6/13/83)
P.O. Box 1228
Ann Arbor, Michigan 48106

501 Lumenite Electronic Company (4/27/87)
2331 N. 17th Avenue
Franklin Park, Illinois 60131

596 Magnetrol International (3/20/90)
5300 Belmont Rd.
Downers Grove, Illinois 60515

627 Milltronics Process Measurements (4/12/91)
709 E. Stadium Drive
Arlington, Texas 76011

419 Niro Hudson (4/2/84)
(Formerly Niro Atomizer Food & Dairy)
1600 County Road F
Hudson, Wisconsin 54016

597 NUOVA FIMA S.p.A. (3/20/90)
(not available in USA)
Via C. Battisti 59
28045 - INVORIO (N0) Italy

523 Paper Machine Components, Inc. (1/3/88)
Miry Brook Road
Danbury, Connecticut 06810

554 Par Sonics, Inc. (11/30/88)
P.O. Box 1127
State College, Pennsylvania 16804

563 PI Components Corp. (2/13/89)
10825 Barely Lane, Suite H
Houston, Texas 77070

644 Princo Instruments, Inc. (8/22/91)
1020 Industrial Highway
Southampton, Pennsylvania 18966-4095

328 Rosemount Inc. (5/22/80)
12001 Technology Dr.
Eden Prairie, Minnesota

515 Setra Systems, Inc. (9/14/87)
45 Nagag Park
Acton, Massachusetts 01720

583 S.J. Controls, Inc. (11/11/89)
2248 Obispo Ave. #203
Long Beach, California 90806

638 Span Instruments (7/10/91)
1497 Avenue "K"
Plano, Texas 75074

285 Tank Mate Div/Monitor Mfg. Co. (12/7/76)
P.O. Box AL
Elburn, Illinois 60119

641 Tempress A/S (7/16/91)
Engtoften 6, DK-8260
Viby J, Denmark

410 Viatran Corporation (11/1/83)
300 Industrial Drive
Grand Island, New York 14072

569 WEISS Instruments, Inc. (5/24/89)
(Mfg. by Nuova-Fima, Italy)
85 Bell St.
West Babylon, New York 11704

600 Weksler Instruments Corporation
800 Mill Rd
Freeport, NY 11520-0808

646 WIKA Instrument Corp. (9/10/91)
1000 Wiegand Blvd.
Lawrenceville, Georgia 30243

685 Winter's Thermogauges, Ltd. (8/3/92)
2220-3 Midland Avenue
Scarborough, Ontario
Canada M1P 3E6
U.S. Rep: Winter's Thermogauges, Inc.
100 Sonwil Drive
Buffalo, New York 14225

38-00 Cottage Cheese Vats

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

385 Stoelting, Inc. (5/5/83)
P.O. Box 127
Kiel, Wisconsin 53042-0127

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

504 General Resource Corporation (5/15/87)
201 3rd Street South
Hopkins, Minnesota 55343

381 Marriott Walker Corp. (4/12/83)
925 E. Maple Rd.
Birmingham, Michigan 48011

453 MikroPul Corporation (9/4/85)
10 Chatham Road
Summit, New Jersey 07901

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

41-00 Mechanical Conveyors

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

42-00 In-Line Strainers

606 Cherry-Burrell/Superior Stainless (9/18/90)
Fluid Handling Division
611 Sugar Creek Road
Delavan, Wisconsin 53115

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

44-00 Air Driven Diaphragm Pumps

624 Granzow, Inc. (4/1/91)
Manufactured by KWW-DEPA in Germany
2300 Crown Point
Executive Drive
Charolette, NC 28227

713 Warren Rupp, Inc. (02/05/93)
800 North Main Street
P. O. Box 1568
Mansfield, Ohio 44905

669 Skellerup Engineering, Ltd. (3/30/92)
2 Robert Street
P. O. Box 11-020
Ellerslie, Auckland 5
New Zealand
U. S. Rep: Masport, Inc.
6140 McCormick Drive
Lincoln, Nebraska 68507

46-00 Refractometers and Optical Sensors

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

50-00 Level Sensing Devices

705 CTI Celtek Electronics (12/29/92)
136 Merizzi Street
St. Laurent, Quebec, Canada H4T 1S4
U. S. Rep: CTI Celtek Electronics, Inc.
1000 Leonidas Street
New Orleans, Louisiana 70118

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(800)284-6336 (CAN)
FAX (515)232-4736

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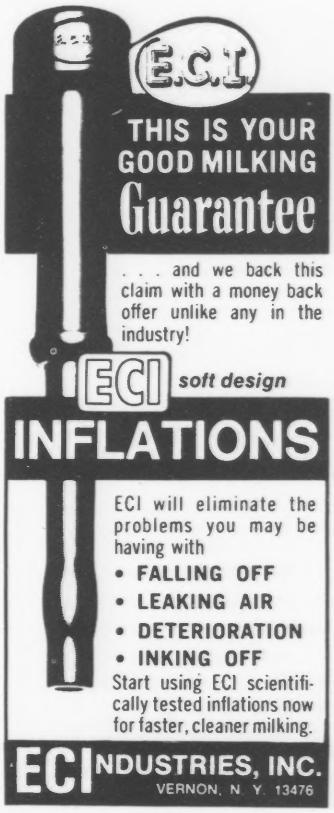

CIRCLE READER SERVICE NO. 318

Coming Events

1993

September

•**9-10, Wisconsin Laboratory Association Annual Meeting** will be held at the Paper Valley Hotel, Appleton, WI. For more information please contact Wisconsin Laboratory Association, P. O. Box 28045, Green Bay, WI 54304.

•**16-17, Minnesota Sanitarians Association, Inc.'s Annual Meeting** will be held at the Earl Brown Center, St. Paul, MN. For more information contact Paul Nierman at (612)785-0484.

•**17, Food Labels: Learning the New Language**, A Workshop on the New FDA and USDA Food Labeling Requirements, will be held in Seattle, WA. This workshop is co-sponsored by The American Dietetic Association Foundation and The Food Processors Institute and developed with a grant from Campbell Soup Company. For more information contact The Food Processors Institute (DLC), 1401 New York Avenue, NW, Suite 400, Washington, DC 20005, (202)393-0890.

•**18, Food Labels: Learning the New Language**, A Workshop on the New FDA and USDA Food Labeling Requirements, will be held in San Francisco, CA. This workshop is co-sponsored by The American Dietetic Association Foundation and The Food Processors Institute and developed with a grant from Campbell Soup Company. For more information contact The Food Processors Institute (DLC), 1401 New York Avenue, NW, Suite 400, Washington, DC 20005, (202)393-0890.

•**20-22, New York State Association of Milk and Food Sanitarians 70th Annual Conference** will be held at the Holiday Inn, Genesee Plaza, Rochester, NY. For more information contact Janene Gargiulo at (607)255-2892.

•**20-24, Special Problems in Milk Protection**, sponsored by the USPHS/FDA State Training Branch and the Nevada Department of Human Resources to be held in Reno, NV. For more information contact Richard Eubanks (301)443-5871 or Joseph Nebe (702)687-4750.

•**22-23, Third Annual Joint Conference of the South Dakota State Dairy Association and Dairy Fieldmen's Association** will be held at the Ramkota Inn, Watertown, SD. For more information contact John Parsons, Dairy Science Department, (605)688-4116.

•**27-29, Technology of Baking**, a Bilingual Program (English and Spanish) sponsored by the American Institute of Baking, will be held in Las Vegas, NV. For more information please call AIB, 1213 Bakers Way, Manhattan, KS 66502, (913)537-4750.

•**29, Cereal Foods Bakery Engineering Conference**, sponsored by the American Institute of Baking, will be held in Las Vegas, NV. For more information please call AIB, 1213 Bakers Way, Manhattan, KS 66502, (913)537-4750.

•**27-30, Insect Cell Culture and Protein Expression with Baculovirus Vectors,** sponsored by the American Type Culture Collection's Laboratory Workshops Department, will be held in Rockville, MD. For more information, please contact ATCC Workshops Manager, 12301 Parklawn Drive, Rockville, MD 20852, (301)231-5566, FAX (301)770-1805.

•**28-29, California Association of Dairy and Milk Sanitarians** will hold their Annual Meeting at the Ontario Hilton, Ontario, CA. For more information contact John Bruhn, University of California-Davis, at (916)752-2191.

•**28-30, Wyoming Environmental Health Association Annual Education Conference**, in conjunction with the Wyoming Public Health Association, will be held at the Casper Hilton Inn, Casper, WY. For further information contact Kenneth Hoff at (307)235-9340.

October

•**2, Food Labels: Learning the New Language**, A Workshop on the New FDA and USDA Food Labeling Requirements, will be held in Orlando, FL. This workshop is co-sponsored by The American Dietetic Association Foundation and The Food Processors Institute and developed with a grant from Campbell Soup Company. For more information contact The Food Processors Institute (DLC), 1401 New York Avenue, NW, Suite 400, Washington, DC 20005, (202)393-0890.

•**2-7, 36th Annual National Conference and Exposition of the Environmental Management Association** will be held at the Holiday Inn Surfside, Clearwater Beach, FL. For further information on EMA and its national conference, please contact EMA, 4350 DiPaolo Center, Suite C, Dearlove Road, Glenview, IL 60025-5212, (708)699-6362 or (708)699-6EMA, FAX: (708)699-1703.

•**3-8, 1993 National Safety Council Congress and Exposition "World Class Solutions"** will be held at the McCormick Place, Chicago, IL. For more information, please contact Robin L. Ungerleider at (708)775-2303.

•**6-8, Kansas Association of Sanitarians 64th Annual Educational Conference** will be held at the Doubletree Hotel, Overland Park, KS. For more information contact Galen Hulsing at (913)233-8961.

•**6-9, 1993 Dairy Foods Industry Convention**, sponsored by the Milk Industry Foundation, National Cheese Institute, International Ice Cream Association and American Butter Institute, along with their suppliers, will be held at the Palmer House Hilton, Chicago, IL. For more information, please contact Mary Vanderbeck at the International Dairy Foods Association, (202)296-4250.

•**7-8, Fourteenth Annual Joint Educational Conference** sponsored by the Wisconsin Association of Milk and Food Sanitarians, Wisconsin Environmental Health Association and Wisconsin Dairy Plant Fieldmen's Association, will be held at the Chula Vista Resort, Wisconsin Dells, WI. For further information contact, Neil Vassau, Publicity Chairperson, P.O. Box 7883, Madison, WI 53707, (608)267-3504.

•**8, Food Labels: Learning the New Language**, A Workshop on the New FDA and USDA Food Labeling Requirements,

will be held in Atlanta, GA. This workshop is co-sponsored by The American Dietetic Association Foundation and The Food Processors Institute and developed with a grant from Campbell Soup Company. For more information contact The Food Processors Institute (DLC), 1401 New York Avenue, NW, Suite 400, Washington, DC 20005, (202)393-0890.

•**9, Food Labels: Learning the New Language**, A Workshop on the New FDA and USDA Food Labeling Requirements, will be held in Atlanta, GA (suburbs). This workshop is co-sponsored by The American Dietetic Association Foundation and The Food Processors Institute and developed with a grant from Campbell Soup Company. For more information contact The Food Processors Institute (DLC), 1401 New York Avenue, NW, Suite 400, Washington, DC 20005, (202)393-0890.

•**12-15, DNA Fingerprinting**, sponsored by the American Type Culture Collection's Laboratory Workshops Department, will be held in Rockville, MD. For more information, please contact ATCC Workshops Manager, 12301 Parklawn Drive, Rockville, MD 20852, (301)231-5566, FAX (301)770-1805.

•**13-14, Annual Conference of the North Central Cheese Industries Association** to be held at the Sheraton Inn Airport Hotel, Minneapolis, MN. For further information contact E.A. Zottola, Executive Secretary, NCCIA, PO Box 8113, St. Paul, MN 55108.

•**13-14, Iowa Association of Milk, Food and Environmental Sanitarians, Inc. Annual Meeting** will be held at the Ramada Inn, Waterloo, IA. For more information, please contact Dale Cooper at (319)927-3212.

•**16, Food Labels: Learning the New Language**, A Workshop on the New FDA and USDA Food Labeling Requirements, will be held in Denver, CO. This workshop is co-sponsored by The American Dietetic Association Foundation and The Food Processors Institute and developed with a grant from Campbell Soup Company. For more information contact The Food Processors Institute (DLC), 1401 New York Avenue, NW, Suite 400, Washington, DC 20005, (202)393-0890.

•**19-21, Food Preservation 2000 - Integrating Processing, Packaging, and Consumer Research** is sponsored by and held at U. S. Army Natick Research, Development and Engineering Center, Natick, MA, USA. For additional information, please contact Lisa McCormick or Sonya Herrin, Science and Technology Corporation, (804)865-7604.

•**21-22, Michigan Food Protection Seminar** to be held at the Bill Oliver Caberfae Motor Inn, Cadillac, MI. For more information call Bob Taylor, IAMFES Delegate and Meeting Liaison, at (517)335-4297.

•**26, Associated Illinois, Milk Food and Environmental Sanitarians Annual Meeting** will be held at the Carlisle in Lombard, IL. For more information call Bob Crombie at (815)726-1683.

•**26-28, Basic Pasteurization Course**, sponsored by the Texas Association of Milk, Food and Environmental Sanitarians, will be held at the Le Baron Hotel, 1055 Regal Row, Dallas, TX. For more information, please contact Ms. Janie F. Park, TAMFES, P. O. Box 2363, Cedar Park, TX 78613-2363, (512)4458-7281.

November

•**14-16, The Food Industry Environmental Conference and Exhibition**, presented by the Environmental Science and Technology Laboratory and Georgia Tech Research Institute, will be held at the Omni Hotel at CNN Center, Atlanta, GA. For more information contact Edd Valentine or Charles Ross at (404)894-3806.

•**15-17, Pennsylvania Association of Dairy Sanitarians and Dairy Laboratory Analysts Fall Meeting** will be held at Penn State University, University Park, PA. For more information, contact Mike John at (717)762-7789.

1994

May

•**7-12, Food Structure Annual Meeting** will be held at the Holiday Inn Downtown City Hall, Toronto, Ontario, Canada. For more information, please contact Dr. Om Johari, SMI, Chicago (AMF O'Hare), IL 60666-0507, USA (or call 708-529-6677, FAX: 708-980-6698).

To insure that your meeting time is published, send announcements at least 90 days in advance to: IAMFES, 200W Merle Hay Centre, 6200 Aurora Avenue, Des Moines, IA 50322.

Advertising Index

IAMFES

International Association of Milk, Food and Environmental Sanitarians, Inc.

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111	124	137	150	163	176	189	202	215	228	241	254	267	280	293	306	319	332	345	358
112	125	138	151	164	177	190	203	216	229	242	255	268	281	294	307	320	333	346	359
113	126	139	152	165	178	191	204	217	230	243	256	269	282	295	308	321	334	347	360

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For more information:

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