Broader Scope for Bioengineering Recommended

Engineering research could improve design of glass wool filters for aerobic fermentations

TERRE HAUTE, IND. A broader definition of the realm of bioengineering was made by A. J. Schmitz of Chas. Pfizer at the Rose Polytechnic Institute Bioengineering Symposium held here on May 23. Dr. Schmitz opined that bioengineering should concern itself "with the economical biosynthesis, processing, or refining of products of plant or animal origin."

In contrast to the most restricted attitude, which would limit the scope of bicengineering to matters dealing directly with the fermentation process, Dr. Schmitz' definition would include food processing, utilization of forest products, and waste disposal, as well as microbiological processes.

Dr. Schmitz feels that when more educational institutions offer bioengineering programs, a more uniform approach will result, advancing the industry appreciably. At present, workers in the bioengineering field have varying backgrounds—microbiologists, biochemists, and chemical engineers predominate. This situation could be compared to the early days of chemical engineering, Dr. Schmitz said. About the time of World War I, the chemical industry was run by men who were either chemists or engineers; it wasn't until later that chemical engineering really came into its own.

Originally planned as a small local affair, the symposium drew over 165 people from many of the country's major fermentation and other biochemical industries. This was perhaps the first time that a meeting of this size has been devoted exclusively to bioengineering.

Filters for Aerobic Fermentations. Filters packed with glass wool are widely used for sterilizing air for aerobic fermentations, but their design has seldom been based on really scientific considerations. Work aimed at developing theoretical relationships which could be applied to the design of an efficient air filter was described by R. K. Finn, University of Illinois.

It is generally accepted that once a bacterial particle comes in contact with a fiber of glass wool it is rather difficult to detach. The problem then becomes one of ensuring that each microorganism will touch a fiber before it has had time to complete its passage through the filter. When it is realized that the fraction of void space in most glass wool-packed columns is upwards of 86%, it is seen that the probability of trapping an organism is not as great as might be thought.

At ordinary air velocities interception is the most frequent mechanism by which bacteria are stopped. The bacterium merely encounters the arresting fiber in its path. Another important, although little understood method, is electrical attraction. Inertia of the particles in the rapidly changing course of the air stream also plays a part. As a result of his investigations at Columbia University, Elmer L. Gaden, Jr., was of the opinion that the air velocity determined which mechanism predominated. At low velocities, electrical attraction accounts for most of the organisms trapped, while at high velocities inertia becomes the most important factor. At intermediate velocities interception occurs. Diffusion has some effect, especially in the case of phage particles.

The effectiveness of a filter is dependent upon the thickness of the bed, the density of the packing, and the fiber diameter. These variables, along with the probable loading of the airstream with viable organisms, the air flow rate, the linear velocity, and the allowable penetration must be utilized in the design of a filter. Although the entrance of one single bacterium into the fermentor will possibly give rise to a whole host of progeny, it is impossible to perfect a filter to remove every single bacterial particle. Setting up some permissible tolerance, such as a one in 100 probability of one contaminating organism per 100 hours of operation (i.e., one organism in 10,000 hours) places the calculation on a realistic basis.

A. J. Schmitz, Chas. Pfizer & Co., R. K. Finn, University of Illinois, and Ralph Bennet, University of Pennsylvania, (left to right), speakers at the bioengineering symposium at Terre Haute, examine air sterilization data

Many nutrient substances are decomposed and toxic products formed when media are heated for prolonged periods. Shorter heating periods, such as those obtainable by continuous sterilizers, were recommended by Dr. Finn.

Media Sterilization. Sterility, as the term is used today, is a misleading expression. When one says that a sample is sterile, one means that no contaminating microorganisms can be detected with the means available. For example, there are types of iron bacteria which have been reported to have withstood autoclaving for several hours. Since the organism is thermophillic and does not grow on ordinary media, its presence would not be detected by the usual test methods. The sample size must also be taken into account. Even if we had a perfect sterility test method, the checking of a small sample from a large fermentor would only indicate that the

degree of contamination in the tank is below a certain level.

There is no reason not to assume that the absorption of bacteria by a filter is not logarithmic; that is, a layer of glass wool of a certain thickness will absorb a certain fraction of the microorganisms passing into it, and the next layer will absorb the same fraction of the number it receives. The denser the packing the the less thick need be the filter. Wool 3 inches thick with 88 to 90% void space performs as well as a three foot thickness of material having 99% void space. The properties of glass wool to be used in a fermentation plant should be thoroughly studied before purchase.

Apparently one fiber does not interfere with the others in the filter. Dr. Gaden found that values derived from mathematical calculations based on measurements involving a single fiber compared closely with actual experimental data from a filter packed with glass wool. This is possible because of large void spaces and small fiber diameter. There is no turbulent flow around the fibers.

The mechanical condition of the filter bed is of the utmost importance. Uneven distribution of the fibers, giving rise to channeling, reduces filtering action tremendously and renders any computation invalid. The ideal filter medium would be one in which each fiber is rigid and retains its position relative to that of the other fibers. The closest approach to this is a factory preformed filter. Dr. Finn visualized extensive use of thin filters of this type in the future.

The logarithmic rate at which organisms are killed during the sterilization process holds true only for large numbers of organisms. The relationship breaks down when all but the last few viable cells have been destroyed. Chance alone determines the survival or death of the last few organisms. Some of the terms employed in the canning industry, such as "thermal death time," may not be valid said Dr. Finn. He suggested the adoption of the figure obtained by extrapolating the logarithmic death curve to the point where 99.99% of the organisms are killed.

British Find Oiling Good Pretreatment for Storage Eggs

Liquid egg pasteurization on commercial scale by Ulster processor lowers bacterial count, causes only minor changes in functional properties

BELFAST, NORTHERN IRELAND. —Oiling shell eggs before storage reduces the rate of evaporation and exerts a significant protective effect after the eggs are brought from cold storage. This was emphasized in studies by the British Ministry of Food and independent investigators reported before a Symposium on Eggs held here May 19 to 21. The symposium was sponsored by the Northern Ireland section of the Society of Chemical Industry and held on the campus of Queen's University.

In recent years the Ministry of Food has adopted the policy of oiling and cold storing of quantities of home-produced eggs during the peak of production in the spring and of releasing these eggs for sale during the low production periods of the autumn. During the 1952 season almost 400,000 cases of eggs were stored in such a manner. According to N. E. Holmes, Scientific Adviser's Division of the Food Ministry, oiling reduces by about two thirds the amount of water lost by evaporation during 3 to 6 months of cold storage.

Although the quality of oiled and unoiled eggs is not greatly different at the end of the cold storage period, Mr. Holmes pointed out that oiled eggs suffer less deterioration of the internal membrane. After 6 months' cold storage, a 1.23% loss in oiled eggs was reported in contrast to a 3.35% loss in unoiled eggs.

Turning to the influence of washing on storage characteristics, Mr. Holmes declared that certain types of washing seem to accelerate egg deterioration on storing. He reported that an American-designed all-metal egg washing machine, utilizing the principle of air jet agitation, was found unsatisfactory. Washing in warm water (85° to 115° F.) in a machine equipped with rotating bristle brushes and rubber rollers gave only 2.5% rotting during the initial period of use, but in the second month losses jumped to almost 40%. Difficulties were attributed to the inability to clean this type of machine adequately. Holmes said that the Ministry is now developing a new egg-washing machine incorporating the principle of pasteurization. It is hoped that the machine will be produced before the end of this year.

Oiling apparently has only a minor effect on the rate of deterioration of the internal quality during cold storage, according to J. Brooks, of the Department of Scientific and Industrial Research at Cambridge. However, oiling does exert a significant protective effect after the eggs are brought out of cold storage, said Brooks. His studies reveal a similar effect when shell eggs are oiled and kept at normal temperatures.

Mentioning gas storage techniques briefly, Brooks pointed out that carbon dioxide gas can be used as a cover atmosphere. When 2.5% carbon dioxide is used, storage results similar to those obtained from oiling shell eggs result, he said.

Liquid Egg Pasteurization. During the past year a pasteurization unit has been incorporated in the frozen liquid egg processing plant of Gracey Bros.,

A corner session at the egg symposium in Belfast found N. E. Holmes and C. L. Heller of the British Ministry of Food talking things over with R. G. Baskett and K. L. Robinson of Queen's University (left to right)