sufficient if the hold is well insulated; on boats with deficient insulation the bottom layer of ice should be considerably thicker. 6. From time to time, especially during the last part of the trip, the first loaded bunkers are turned out and re-iced. This is done with perforated shovels. These cause some breakage of the shrimp even if handled carefully. As soon as the boat docks the shrimp are taken out of the bunkers with the same shovels and placed into straw baskets. Outside the holds they are loaded into wooden boxes and trucked to the freezing plants. In all of these movements, of course, the shrimp are mixed with ice from the bunkers. The wooden boxes are generally steam-washed after use.

Handling Shrimp In the Packing and Freezing Plant

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In order to present a bird's eye view of the general procedure in a shrimp freezing plant, the passage of the shrimp from the boat or truck will be traced through various procedures to the refrigerated truck or railway car in which it leaves the plant in its frozen form.

Briefly, the steps in the freezing process are as follows: 1. unloading, 2. washing, 3. quality grading, 4. heading, 5. size grading, 6. packing, 7. freezing, 8. glazing, 9. mastering, 10. storage.

Care must be exercised in *unloading* the boats or conveyances which bring raw material to the packing plants, to prevent breakage of the shrimp and to keep separate for close inspection, or discard, any material which appears decomposed. Where "pockets" of decomposed shrimp are mixed with good material the sorting job becomes increasingly more difficult.

In *washing*, most plants utilize either tanks from which the shrimp are brailed, or a combination tank and conveyor belt. If insufficient attention is paid to frequent changes of water in the wash tank, the water becomes a soupy mass which adds to the bacterial load of the shrimp. A constant intake and overflow helps alleviate this situation.

Quality grading begins with a careful scrutiny of the raw material received at the plant. If this job is carelessly done it will result in decomposed material getting into the pack.

For practical purposes there are three types of decomposition which occur in shrimp, and this material should be discarded on the inspection belt:

(a) "Heated" shrimp which can usually be detected instantly. In the white and brown varieties such decomposition may be easily distinguished by color changes, but in the pink shrimp it is much more difficult to see.

(b) Blackening or melanosis, often called "ice burn."

(c) "Stinkers," or shrimp which show no visual signs of decomposition, yet which possess a foul and oftentimes putrid odor of decomposition.

Heading must be done manually, and in this operation care should be exercised to prevent breakage of the tail section while removing all of the cephlothorax and the walking legs.

In a number of plants, especially in the United States, *size grading* is

accomplished by mechanical means. To the writer's knowledge there are four makes of mechanical graders on the market. In a large number of U. S. custom-packing plants there is no size grading. In Mexico and in a number of plants in this country, shrimp are graded manually for size. This art reaches a much higher stage of perfection in Mexico than it does in the United States, mainly because of a greater abundance of labor.

In the majority of plants on the West Coast of Mexico the same girls who grade the shrimp for size also *pack* them in layers into metal containers which are subsequently filled with water and then placed in the freezer. In the United States the shrimp are "jumble packed" by hand into paper board cartons, weighed, and (if in small containers) overwrapped. The "put-in weights" must be varied according to the specias of shrimp which is being frozen. Apparently there is a greater freezer loss on pink shrimp than there is on brown and white, and a slightly smaller loss on white than there is on brown. Whether this loss is a true freezer loss, or is a "drip" loss, which occurs after freezing and thawing, is not clear.

Freezing methods are quite variable throughout the industry. Among principle freezing methods are the Contact Plate method and the Blast System (of which there are a number of variants). Varying temperatures are employed, depending on the system in use, from plus 20°F. to minus 45°F.

In the contact plate method the length of freezing time is dependent upon the temperature of the refrigerant and the initial temperature of the product being frozen. This does not necessarily hold true in the blast method, since the freezing time is dependent upon the initial temperature of the product, the amount of the load, the temperature of the refrigerant, the amount and speed of the air circulated, and the amount of coil space.

Care must be exercised to be certain that the individual package has reached a temperature of zero degrees F. at the center before removal for glazing and storage. Samples of slow frozen shrimp have been seen in which the shrimp in the outer portion of the package were hard, but the shrimp in the center had not become frozen and had decomposed.

The majority of the shrimp produced in the United States and on the Gulf Coast of Mexico are frozen in five-pound containers, which are not overwrapped. There is a definite trend towards overwrapping these cartons, since this procedure has been so successful with the consumer-size packages.

In order to prevent dehydration it is necessary that frozen shrimp be glazed before storage. There are several methods of *glazing* employed today. The most popular method of glazing, and the one which I consider the poorest, in the spray method. In this the opened cartons of shrimp are run under a spray of either tap water or chilled water, and the boxes are immediately inverted. Most of the water runs out, a film of ice merely forming over the top of the carton. The boxes, immediately after inversion, are placed in the master cartons, resulting in "wet masters." These quite often freeze together in the storage room or "sweat" when removed from storage and subsequently freeze together in transit. This results in damaged and torn masters, and causes a loss and breakage in the cartons in transit and in the storehouses.

A second method of glazing is the immersion of the cartons of shrimp in a vat, wetting the entire carton and causing them to stick together in the master cartons. A third system involves the flooding of the five-pound

carton with ice water, allowing a complete glaze to form around each individual shrimp, then draining and packing the cartons into masters.

Shrimp should never be glazed nor packed into masters until the center of each package has reached zero degrees fahrenheit. Glazing should only be done with ice water. These points cannot be too greatly emphasized.

The plants on the West Coast of Mexico, which in the main use the pan-freezing system, drop the pans into ice water for removal of the block of shrimp and frozen water, and place the entire block in a cardboard carton for shipment. Breaking out the shrimp in ice water effectively coats any exposed shrimp with a glaze.

One of the main sources of damage to frozen shrimp which occurs during *storage* is the dehydration of the product. In storage plants which use blast systems the product tends to dehydrate with greater rapidity than in plants in which low temperatures are maintained in still air. Further, one of the greatest causes of dehydration is caused by "split," meaning the differential in temperature between the refrigerant and the storage room. Dehydration will be kept to a minimum if a split of no more than seven or eight degrees is maintained.

Finally, a brief word about the important subject of *sanitation* is necessary in any discussion of handling shrimp in the packing and freezing plant.

Care should be exercised to assure an unpolluted supply of water; plants should be adequately screened to protect the product from flies and other insects. Sanitary facilities should be available for all plant personnel. Hand washing facilities with liquid soap and paper towels should be supplied, and a chlorine bath for the hands would be valuable. Plant equipment should be thoroughly washed down before and after each use, and sanitized. Refuse should be properly disposed of, and not allowed to accumulate on the premises.

Lack of plant sanitation can destroy the effectiveness of quality control; sanitation and quality control go hand in hand in the most successful shrimp freezing plants. And finally, a word of caution to producers: freezing cannot enhance the quality of your product. Only by scrupulous attention to quality grading and control, and by control in the various points in processing, as well as in the sanitation of the plant, can a first class product be sent out which, year in and year out, will bring repeat business.

Handling Shrimp in the Breading Plant

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Since its inception just five years ago the breaded shrimp industry has become a multi-million dollar segment of the seafood business. This continuous expansion has been very similar to the amazing growth of frozen citrus concentrates. In both fields, the young but dynamic frozen foods industry has made these products available to the mass consumer market.

At present there must be well over a hundred different brands of breaded shrimp, and even though no accurate statistics are available, it has been