

Understanding and Using On-board Brine Freezing to Produce Visually Perfect, Premium Quality, Great Tasting Wild Shrimp

UNDERSTANDING HOW BRINE SYSTEMS OPERATE

Proper use ensures best results from brine freezing technology. When used properly, brine freezing technology aboard a shrimp trawler can prevent the invisible defects that may occur when unfrozen shrimp spend too much time in the brine tank. Until they freeze, shrimp lose weight as moisture from muscle tissue is replaced with salt from the brine, and when salt replaces tissue moisture, the salty taste overwhelms the distinctive flavor of wild shrimp that distinguishes them from farm-raised imports. Wild shrimp's sweet taste comes from their very low body salt content, and the rich, savory flavors originate from their diet of plants and animals.

Why is refrigerated salt brine more effective? A brine freezer is the best piece of equipment for preserving your catch at the peak of quality. A refrigerated, 23% salt brine is the quickest, cheapest way to freeze shrimp at sea. With 23% salt, a refrigerated brine will reach

temperatures between 0° and -6° F, which is 32° to 38° F colder than the freezing point of fresh water. Experimentation has shown that brine chilled to 0° F reduces the temperature of a single shrimp tail by 43° F within **2 minutes**, while a colder freezer at -16.6° F takes **75 minutes** to remove the same amount of heat. **This means that a 23% salt brine chilled to 0° F can pull heat out of shrimp 37 times faster than colder air.** The drawback is that the 0° F brine will warm up from each batch of shrimp you freeze. In summer, by the time shrimp are ready to be frozen, they may be in the 60° to 70° F range. Solidly freezing each batch of these shrimp requires removing at least 50 to 60 degrees of heat from them. Once a batch of shrimp are immersed in the brine tank, heat is rapidly removed which, in turn, warms the brine. **Until the warmed brine has re-chilled to about 0° F, the next batch will not solidly freeze within 20 minutes, and possibly not ever!**

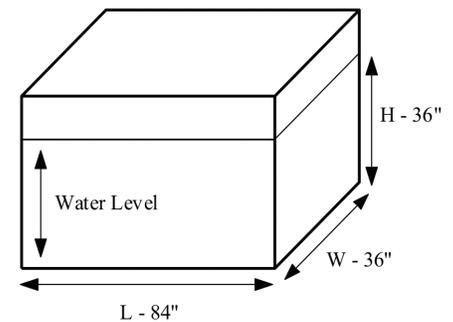
Planning prevents defects during cruises. Correct use of the brine freezer ultimately depends on your planning skills. You need to focus on two main issues. The first is ensuring that the brine solution can reach its lowest possible temperature throughout your cruise. This is accomplished by making sure that the salt brine is (a) initially charged with enough salt to create a 23% solution and (b) periodically recharged during your cruise with buckets of 23% brine. The second element is organizing all of the back-deck work **prior to brine freezing** so (a) the brine tank is not overloaded with deck-temperature shrimp and (b) the salt brine, warmed from the previous batch, can re-chill before the next freezing cycle starts.

In the space remaining, we will explain what needs to be done and how to accomplish those tasks. Initially, there are two preliminary steps required that will characterize the brine system aboard your vessel. The rest of the work centers on steps and routines used to manage brine solutions, prevent overloading, and allow for re-chilling of the brine.

TWO PRELIMINARY, ONE-TIME STEPS THAT CHARACTERIZE YOUR BRINE TANK

First, determine how many gallons (gal.) your brine tank holds. Second, figure the maximum number of pounds (lb.) you can freeze per cycle. These computed values should continue to be used unless the dimensions of the brine tank change.

Determining gallon capacity and initial charging rates. When enough salt is added to a gallon of water, the brine solution remains liquid at 0° to -6° F. For each gallon of water, 2.53 lb. of salt should be added. But, how many gallons of water should be added to your tank? To figure gallons of water, mark the height of the operating brine level in inches, then subtract 4" from this height to allow for added salt and another 4" if you use corn syrup. This will be your fill line for water, and the height used to figure gallons. Next, measure the inside width and length of the tank in inches. As the **example** diagram shows, gallons equal $(H \times L \times W) \div 231$, so $(36" \times 84" \times 36") \div 231 = 471$ gal.



The most important ingredients in a brine freezer are water and salt, but most operators add other ingredients too. Virtually all fishermen who use dip powder add it to their brine units. Although less popular today, some operators add corn syrup or corn syrup solids (CSS), which creates a glaze on the shrimp that ensures a smooth shell. Each of these ingredients is listed in the table, first as the amount to be added per gallon of water, and second as the total amount for the 471-gal. tank used in the example. Developing a similar table, but calculated for the gallon capacity of **your brine tank**, will ensure correct charging of the tank before each cruise. So far you have learned how to figure the gallon capacity of your brine tank and the proportion of each ingredient to add so you begin your cruise with a 23% salt solution.

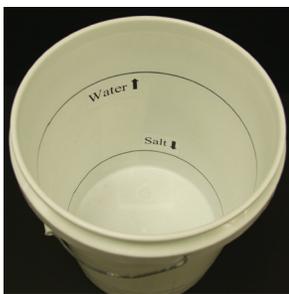
Ingredient	Proportion	Quantity for a 471-gal. tank
Salt	2.53 lb./gal.	1,192 lb. (2.53 x 471 gal.)
Dip Powder (sulfites)	0.074 lb./gal.	34.8 lb. (0.074 x 471 gal.)
Corn syrup or	0.12 gal./gal.	56.5 gal. (0.12 x 471 gal.)
Corn syrup solids (CSS)	1.19 lb./gal.	560 lb. (1.19 x 471 gal.)

Figuring the Maximum Allowable Quantity to freeze per batch: the "15 to 100 rule." The maximum allowable quantity to freeze per batch is found by multiplying 0.15 by the gallon capacity of your tank. If your tank holds 471 gal. of brine, then the maximum allowable quantity to freeze per batch is 70 pounds (0.15 x 471 ≈ 70 lb.).

SKILLS NECESSARY DURING CRUISES

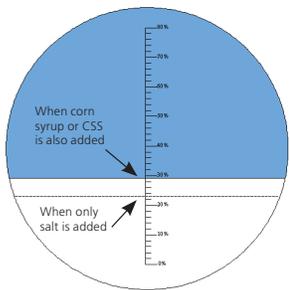
Continually freeze the catch as you and others process the Maximum Allowable Quantity your brine freezer can handle. As shrimp are sorted on the back deck, follow the **"Basket @ A Time Routine"** which says: Once you fill a basket, stand up and rinse that full basket. Then, treat that full basket (if you use Everfresh®). Next, bag or box the contents of that full basket. Finally, put the **Maximum Allowable Quantity** of bagged or boxed shrimp into the brine freezer. Why freeze as you process instead of waiting until all the shrimp are bagged or boxed? The first five steps, from picking to bagging or boxing a **basket**, will take you about 20 minutes. Twenty minutes is also about how long it will take to solidly freeze those deck-temperature shrimp if (a) your brine contains 23% salt, (b) the brine has re-chilled to about 0° F between batches, and (c) you use the rule of freezing no more than **15 lb. of shrimp for every 100 gal. of brine**. Therefore, each time you and others arrive at the brine tank with another batch ready to freeze, the maximum allowable quantity in the brine will have solidly frozen and is ready to be stored below deck. As an added bonus, by then the brine will have recovered to 0° F or below.

Recharge the brine system during each trip. As shrimp are frozen, both salt and sulfite concentrations change (if you use sulfites in the brine freezer). Remember, **only if your brine is a 23% saturated solution** can the liquid be chilled to 0° F or below. Further, periodically restoring sulfite concentration is essential to control black spot.



Recharging the brine tank with the correct amounts of water, salt and sulfite powder (if you use it) should be done after every 1,000 lb.; that is, after 25 40-lb. bags of shrimp are frozen. The idea of recharging seems simple. But do it incorrectly and you will not restore the **concentration** of salt to the brine solution. This is another example of where human skill determines the outcome. The final fundamental rule of proper brine freezing management is this: **"Never add dry salt to cold brine!"** Why? The salt will not dissolve and will not restore the salt concentration to 23%. Here is the correct way to restore both the brine level and salt percentage, one 5-gal. bucket at a time. First, add salt to the 2" "Salt" line

drawn inside the bucket. This equals 7½ lb. Second, add fresh water or clean sea water to the 9½" "Water" line. This equals 3 gal. Third, stir until the salt is **completely** dissolved. Fourth, **once completely dissolved**, pour the mixture into the brine tank. Repeat the first four steps until the "fill" line marked inside of the brine tank is reached. **If sulfites are used**, add water to the 2" line and dissolve 1 cup (8 oz.) of sulfite powder before pouring that solution into the brine tank.



Some operators confirm the concentrations of salt brines with a **refractometer**. As the diagram shows, once you put a few drops of brine solution on the refractometer, look through the eye-piece, and you will see two distinctive colors that make up the circle. The line that divides the circle into two parts shows the percent concentration on the vertical scale. When the correct weight of salt is added, the reading will be 23%. If corn syrup or corn syrup solids are also added, the reading will be between 28 and 30%.

Ignoring the recharge step after every freezing every 1,000 lb. could mean having the product down-graded at the dock for darkening (if you use sulfites to control black spot) or excessive saltiness. Worse yet, **if the salt concentration gets too low in the tank**, the minimum achievable temperature of the brine solution will **increase** no matter how hard the compressor works, and the shrimp will not solidly freeze. Some operators have learned the hard economic lesson that unfrozen or partially frozen shrimp can spoil below deck.

SUMMARY OF ESSENTIAL STEPS

Four steps ensure consistent success with brine freezing technology aboard shrimp trawlers:

- Figure the gallon capacity of your tank so enough salt can be added to create a 23% salt brine. This ensures that once the liquid brine is refrigerated, it can reach the lowest possible temperature of between 0° and -6° F.
- Use the gallon capacity of your tank to figure the **Maximum Allowable Quantity** you can freeze at a time. This will ensure that (a) shrimp solidly freeze within 20 minutes and (b) the brine temperature will re-chill to at least 0° F between batches.
- Follow the **"Basket @ A Time Routine"** so that once the Maximum Allowable Quantity is processed, it is brine frozen.
- Never add dry salt to cold brine. Instead, recharge the tank after every 1,000 lb. are frozen. In a 5 gal. bucket, dissolve 7½ lb. of salt in 3 gal. of water, pour into the tank and repeat until the height of the brine (the fill line) is restored. Then dissolve 1 cup (8 oz.) dip powder in 2" water and pour that mixture into the tank.