Calculating Legal Amounts Of Sodium Nitrite

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During the mid 1970's, I became interested in a congressional hearing that took place to define safe limits on the amount of nitrates and nitrites introduced into our meat products. It was determined by a panel of doctors that ***the maximum limit of ingoing nitrite in immersed, pumped, or massaged products be set at 200 parts per million.***

To obtain this, it becomes necessary to add precisely 4.2 ounces (120 grams) to one U.S. gallon of water. In the case of comminuted sausages, the maximum allowed limit of sodium nitrite was determined to be 156 parts per million. In non-cooked, dry-cured (air-dried) fermented sausages, the limit was set at 625 parts per million. At the end of the hearings, it was determined that much more study should be done regarding the subject and it was decided that the panel would reconvene to study the issue further and again make recommendations. After 37 years of waiting, I see that there yet remains a wide controversy regarding "safe" and "effective" levels.

Solving For "n" (nitrite in curing mixture) In Comminuted Sausage:

To calculate formulas regarding cures, it is necessary to convert the weight of all components to a common unit such as pounds, ounces, kilograms, grams etc. Let's look at comminuted sausage first and solve the question, "If I grind and prepare 100 lbs. of sausage meat, how much cure #1 do I need to add to the mixture?" The formula solving for "parts per million" equals the curing mixture (unknown), times the percentage of sodium nitrite in the cure, times one million (parts), divided by the weight of the meat. Mathematically written, it looks like this:

Parts per million = Curing mixture X % sodium nitrite in the cure X 1,000,000 (one million) ÷ Weight of meat

Knowns:

Cure #1 contains 6.25% sodium nitrite. It is written as: 0.0625

Maximum allowed parts per million sodium nitrite in comminuted products is 156 ppm.

Solve for:

Amount of Cure #1 (unknown represented by "n" for "nitrite")

The formula is written: 156 = n X 0.0625 X 1,000,000 ÷ 100

Enter these figures into your calculator:

n (nitrite)=156 X 100(lbs) ÷ 0.0625 X 1,000,000

The answer is: n=0.2496 lbs. of Cure #1.

0.2496 lbs. = equals 3.99 ounces or (113 grams)

113 grams of Cure #1 is needed to cure 100 lbs. of meat.

Solving For "n" (nitrite in curing mixture) In Brine-Cured Products

Now let's talk about a brine curing mixture. It's easy to substitute 200 for 156 in the formula for parts per million, but we must remember that in comminuted sausage, the nitrite remains inside the sausage – becoming nitric oxide having been reduced by staphylococcus and micrococcus bacteria. In a brine-cured meat product, a specific amount of nitrite is taken up or "picked up" then the remainder is flushed straight down the drain. There are too many variables in the process, including duration time in proportion to strength, to make precise conclusions or even construct any number of graphs or tables to accurately predict outcome. As Stan Marianski says, “A meat piece can be immersed in brine for a day, a week, or a month, and a different amount of sodium nitrite will penetrate the meat. Brines with different salt concentrations will exhibit different speeds of salt and nitrite penetration.” – (Home Production of Quality Meats and Sausages by Stan Marianski – Bookmagic). So, how do we ensure consistency?

Commercial meat processors employ an injection process that eliminates conjecture insufficient to ensure reliability. Modern processors, using a “gang” of needles, stitch-pump a precisely measured amount of a defined and particular strength wet cure based upon a ten-percent pickup. Here is a link to a commercial chart with the most popular formulas: http://www.wedlinydomowe….peklowania4.htm

So, if Ross has a ten pound ham, he needs to inject it with one pound of brine. To calculate the amount of Cure #1 in this case (placing it into a brine), we need to know the weight of a gallon of water. The formula reads, “Parts per million equal the curing mixture “n” (nitrite in curing mixture), times the % of sodium nitrite in the cure, times the pump percentage, times one million, divided by the brine weight”. Mathematically written, it looks like this:

> Parts per million = Curing mixture, X the % sodium nitrite in the cure,X pumped %, X 1,000,000 (one million) ÷ Weight of Brine
> Knowns:
> Cure #1 contains 6.25% sodium nitrite. It is written as: 0.0625
> Maximum allowed parts per million sodium nitrite in brined products is 200ppm.
> Hams should be pumped at 12% using Cure #1. Several whole muscle meats require only 10% pumped curing brine.
> Solve for:
> Amount of Cure #1 (unknown represented by “n” for “nitrite”)

Note that this time we are factoring in the pumped percentage required by the particular meat (i.e. 12% for hams). We are also dealing with the weight of the brine rather than the weight of the meat. A gallon (U.S.) of water weighs 8.33 lbs. If that water is saturated (100°), it contains 2.64 lbs. of salt. This is the point where no more salt may be dissolved in the water and the total weight of the gallon of water becomes 10.03 lbs. Because we do not use saturated brine (100°), the weight of brines will vary according to how much salt is contained in them. A very popular brine is that of 40°SAL strength. However, reducing the strength (from 100° to 40°) drops the weight of a gallon to 9.5 lbs.

So, the “curing mixture” = parts per million, X brine weight, ÷ % pump, X 0.0625 (sodium nitrate in the cure) X 1,000,000 (one million).

Written, it becomes: “n” = 200 (parts per million) X 950 (brine weight) ÷ 0.12 (percent pump) X 0.0625 X 1,000,000.

Let’s say El DuckO decides to mix up a hundred gallons of brine to “cure a herd of longhorns on the spot” pumping… not hams this time at 12%, rather beef chucks at only 10%! How much Cure #1 will he need to add to the water to make a curing brine? Grab yer’ calculators cowboys. Yee Haw!
Solve for “n” (nitrate) using the formula above.
n = 200 X 9.5 ÷ 0.10 X 0.0625 X 1,000,000

Check your math here. 200 X 9.5 = 1900. That number is divided by the product of .10 X .0625 X 1,000,000 which is 6250

The answer is: n=0.30 lbs. of Cure #1 (based on 9.5 lbs. per gallon)
0.30 lbs = 4.8 ounces or 136 grams

In the United States, the only folks with access to pure sodium nitrite are commercial professionals who cure meat for a living. They basically use the formula above, but substitute pure sodium nitrite in their own formulas in place of the hobbyist's "Cure #1" which is mixed with salt. By equally dispersing nitrate into salt via a roller "drum", Griffith Laboratories developed "Prague Powder Cure #1" containing 6.25% sodium nitrite and 93.75% sodium chloride. Because many nations around the globe (including the United States) yet do not use the metric system, I've found that many people are confused when it comes time to put a specific number of "grams" into a curing mixture. Let's see if we can eliminate some of the confusion by posting a few mathematical equations:

- 1 ounce of Cure #1 = 6 level teaspoons (2 tablespoons). One ounce of cure weighs 28.35 grams.
- 4 ounces of Cure #1 will cure 100 lbs. of sausage. Four ounces of cure weigh 113.4 grams.
- 1 ounce of Cure #1 will cure 25 lbs. of sausage.
- ½ ounce of Cure #1 will cure 12 lbs. of sausage. This means less than ½ ounce will cure ten pounds of sausage.

4.8 ounces of Cure #1 (in the formula above) is equal to 136 grams and will cure 100 lbs. of meat.
I hope this takes some of the mystery out of calculating nitrites in meat. For more information on this subject, refer to "Home Production Of Quality Meats And Sausages"… by Stan and Adam Marianski, and "The Art Of Making Fermented Sausages"… by Stan and Adam Marianski. (See Bookmagic.com)

Best Wishes,
Chuckwagon