Adjusting Chemical Levels in a Swimming Pool

When adding chemicals, there are three types of chemical adjustments that can be performed: product label chemical dosage, product label chemical adjustment, or no product label chemical adjustment.

Product Label Chemical Dosage

Some labels will have directions on how much chemical to add for a given quantity of water. They do not give a ppm or mg/l adjustment amount. In those cases calculate the amount of chemical to add as follows:

Total Amount of Chemical to Add = Amount from product label × (Actual Pool Volume in gallons ÷ Gallons from product label)

An example: You have a 95,000 gallon pool and decide to use an algicide. The label states: Use 16 fluid ounces per 10,000 gallons of water. How much chemical do you add?

Total Amount of Chemical to Add = 16 ounces × (95,000 gallons ÷ 10,000 gallons)
Total Amount of Chemical to Add = 152 fluid ounces.
152 fluid ounces ÷ 128 fl.oz/gallon = 1.1875 gallons rounded to 1.2 gallons.

Product Label Chemical Adjustment

Always follow the product label instructions. For example a product label may state that you must add 20 ounces of calcium hypochlorite to raise the chlorine level by 10 ppm in 10,000 gallons of water. Calculate the amount of chemical to add as follows:

Total Amount of Chemical to Add = amount from product label × (Actual pool volume in gallons ÷ Gallons from product label) × (Desired Chemical Change in ppm ÷ ppm change from product label)

To determine the Desired Chemical changes use the following:
Desired Chemical Change = Chemical level you want to achieve – Current chemical level.
(To decrease the chemical levels use the following:
Desired Chemical Change = Current chemical level – Chemical level you want to achieve.)

An example: You have a 60,000 gallon pool that has a free available chlorine level of 1 ppm (mg/l). You want to raise the chlorine level to 10 ppm. The product label states that 20 ounces of calcium hypochlorite will raise the chlorine level by 10 ppm in 10,000 gallons of water. How much calcium hypochlorite do you add?

Determine the amount of desired chemical change:

Desired Chemical Change in ppm = 10 (Chemical level you want to achieve in ppm) – 1 (Current Free Available Chlorine ppm)
Desired Chemical Change = 9 ppm.

Apply the formula:
Total Amount of Chemical to Add = 20 oz. × (60,000 gallons ÷ 10,000 gallons) × (9 ppm ÷ 10 ppm)

Answer 108 oz. or 108÷16 = 6.75 pounds of calcium hypochlorite.

No product label Chemical Adjustment

If the chemical was purchased in bulk, there may not be label with dosing instructions. Two methods can be used to calculate the amount of chemical to add to 10,000 gallons of water to create a 1 ppm change.

1. Commonly accepted chemical parameters can be used from the *Water Chemistry Adjustment Guide* at the end of this document. The product label chemical adjustment formula can then be applied.

An example:
Given: Free Available Chlorine = 1 ppm (mg/l)
Product is Sodium Hypochlorite and label shows 12% available chlorine.
How much sodium hypochlorite must be added to a pool containing 40,000 gallons of water to raise the chlorine level to 3.0 ppm (mg/l)?

Obtain the dosage to treat 10,000 gallons with a desired change of 1 ppm from the Water Chemistry Adjustment Table for Sodium Hypochlorite (12%).

Dosage = 10.7 fl.oz. to bring about 1 ppm change in 10,000 gallons.

Apply the Product Label Chemical adjustment formula:

Desired Chemical Change in ppm = 3 (Chemical level you want to achieve in ppm) – 1 (Current Free Available Chlorine ppm)

Desired Chemical Change = 2 ppm.

Apply the formula:
Total Amount of Chemical to Add = 10.7 oz. × (40,000 gallons ÷ 10,000 gallons) × (2 ppm ÷ 1 ppm)

Answer 85.6 fl. oz. or 86÷128 = 0.67 gallons of calcium hypochlorite.

2. Without using the Water Chemistry Adjustment Guide Table, the number of ounces of compound per 10,000 gallons of water that is necessary to raise levels by 1.0 ppm can be calculated using the following:

   1.0 ppm equals about .083 lbs of chemical per 10,000 gallons of water* or 1.3 oz per 10,000 gallons**.

   Obtain the percent of available disinfectant in the compound to be used by reading the label. Change the percent to decimal by moving the decimal two places to left then divide 1.3 for liquids or .083 for solids by the decimal of the percent of available disinfectant from the label. The product label adjustment formula can then be applied.

An example:
Given: Free Available Chlorine = 1 ppm (mg/l)
Product is Sodium Hypochlorite and label shows 12% available chlorine.
How much sodium hypochlorite must be added to a pool containing 40,000 gallons of water to raise the chlorine level to 3.0 ppm (mg/l)?

Obtain the percent of available disinfectant in the compound = 12%.

Change the percent to decimal by moving the decimal two places to left = .12

Divide 1.3 by the decimal of the percent of available disinfectant. 1.3 ÷ .12 = 10.8 oz of sodium hypochlorite to produce 1 ppm of free chlorine for 10,000 Gallons.

Apply the desired chemical change formula:

Desired Chemical Change in ppm = 3 (Chemical level you want to achieve in ppm) – 1 (Current Free Available Chlorine ppm)

Desired Chemical Change = 2 ppm.

Apply the product label adjustment formula:

Total Amount of Chemical to Add = 10.8 oz. × (40,000 gallons ÷ 10,000 gallons) × (2 ppm ÷ 1 ppm)

Answer 86.4 fl. oz. or 86 ÷ 128 = 0.67 gallons of Sodium Hypochlorite.

*.083 Pounds of Chemical = 1 ppm × (10,000 gallons treated ÷ 120,000). 120,000 is always used in the ppm formula when the chemicals used are weighed in pounds and the water measured in gallons since 120,000 gallons weighs 1 million pounds.
**1.3 ounces of chemical = 1 ppm × (10,000 gallons treated ÷ 7,500). (7,500 = 120,000÷16). [There are 16 fluid ounces in 1 pound].

Increasing and Decreasing Chlorine Levels

When it is necessary to increase the level of chlorine in a swimming pool or spa, the following procedure should be used:

1. Determine the free available chlorine (FAC) in the pool water in ppm (mg/l). Using the DPD test kit, following the test kit directions.
2. Determine the amount in ppm (mg/l) you want to increase the chlorine.
3. Determine the ppm (mg/l) change using the following to increase:
   Desired ppm - current ppm (FAC) = ppm (mg/l) change.
   Example: Desired ppm (20.0) - Current ppm or FAC (1.0) = 19 ppm (mg/l) change.
4. Identify the chlorine compound to be used to increase the chlorine level. Use product label chemical dosage, product label chemical adjustment, or no product label chemical adjustment formulas to determine the amount of product to use to produce 1 ppm (mg/l) free chlorine per 10,000 gallons of pool water.
5. Make sure the pH is within the acceptable range of 7.2-7.8. These chlorine compounds will significantly change the pH and affect the effectiveness of the chlorine.
6. Determine the volume of water the pool holds.

An example:
The free available chlorine (FAC) is 1.0. There has been a fecal accident and the operator must raise the chlorine level to 20 ppm and keep the pool closed for 12.75 hours to satisfy the "15,300 rule". The operator will use Calcium Hypochlorite (67%). The volume of the pool is 200,000 gallons. From the *Water Chemistry Adjustment Guide* (at the end of this document), it will take 2 oz. to raise the chlorine level 1 ppm.

20 ppm (chlorine level to be reached) - 1.0 ppm (free available chlorine present in the pool) = 19 ppm (ppm change)

(2 oz) × (19) × (200,000 ÷ 10,000) = 760 oz. or 47.5 pounds of Calcium Hypochlorite (67%) must be added to the pool.

When it is necessary to decrease the level of chlorine in a swimming pool or spa, the following procedure should be used:

1. Determine the ppm (mg/l) change (decrease):
   Current ppm - Desired ppm (mg/l) = ppm (mg/l) change.
   Example: Current ppm (20) - Desired ppm (1.0) = ppm change (19)
2. Identify the chlorine reducing compound to be used to neutralize the chlorine level. Use product label chemical dosage, product label chemical adjustment, or no product label chemical adjustment formulas to determine the amount of product to use to produce a drop of 1 ppm free chlorine per 10,000 gallons of pool water.

An example: After a fecal accident the operator has raised the chlorine level to 20 ppm and has kept the pool closed for 12.75 hours. The volume of the pool is 200,000 gallons. Sodium Thiosulfate will be used to neutralize the chlorine level to 1.0 ppm. From the *Water Chemistry Adjustment Guide* (at the end of this document), it will take 2.6 oz. to neutralize the chlorine 1 ppm.

Current ppm (20) - Desired ppm (1.0) = 19 ppm change
(2.6 oz) × (19) × (200,000 ÷ 10,000) = 988 oz. or 23.75 pounds Sodium Thiosulfate

Adjusting Total Alkalinity (TA) Levels

When adjusting the Total Alkalinity make slight adjustments when the TA gets a little high or low rather than wait for the TA to get way off and try to adjust it all back at once. If the TA is way off, make an adjustment and then retest after 24 hours and adjusting again. When the total alkalinity of the water is low, a small amount of acid or soda ash will cause a large variation in pH, and control of pH will be difficult.

It is important to use the Acid or Base Demand Procedure to help determine how much chemical you need to add to the pool water to achieve the desired results.

Low Total Alkalinity

To raise the TA level (and not the pH too), you add Sodium Bicarbonate (Baking Soda). Sodium Bicarbonate will also raise the pH of the pool water slightly. If you need to raise both the pH and TA, then use Sodium Carbonate (Soda Ash) until the

pH comes to the proper level, then use Sodium Bicarbonate to make further adjustments to the TA if needed. NOTE: Sodium Carbonate (Soda Ash) is NOT the same as Sodium Bicarbonate (Baking Soda).

Check the chart to see how much Sodium Bicarbonate is needed to raise the TA level as desired. Do not attempt to raise it more than about 50 ppm at one time. If the TA is at or below 50 ppm, be sure to test for metals in solution before adding Soda Ash or Baking Soda to the pool.

High Total Alkalinity

To lower the TA level, add Acid, either muriatic acid or sodium bisulfate. Check the chart to see how much acid is required to drop the TA to the proper level. Do not add more than one quart of acid per 10,000 gallons at one time. If more acid than this is needed, then make one adjustment, and then retest 12 hours later before making another adjustment. This will help to keep you from over-treating the pool.

To avoid damage to pool walls, dilute acid by adding one quart of muriatic acid (or one pound of sodium bisulfate) slowly to a gallon of water (remember AAA, always add acid to water). It is important that if you want to lower the TA without significantly lowering the pH, you need to pour the acid in the pool directly in one pint shots in the deep end. Standing in one place and pouring the acid in a column will produce an area of low-pH water. This will convert some of the carbonate alkalinity (CO3) into carbon dioxide (CO2), which will "gas off" from the water. By creating pockets of extremely low pH temporarily, you will burn off the alkaline materials in those areas, thus bringing down the Total Alkalinity reading of the pool. Brush the pool afterwards to insure that the acid does not drop down to the bottom and etch the surface since acid is heavier than water.

Chemical Adjustment Guidelines

When it is necessary to adjust the level of chemicals in a swimming pool or spa, keep the following precautions in mind:

- Carefully read and follow the instructions on chemical labels.
- Avoid inhaling the fumes or dust of any chemical.
- When working around chemicals follow the protective measures detailed in the Material Safety Data Sheets (MSDS) for each specific chemical. Eye protection, gloves and boots may be required as a minimum. For frequent or extended chemical handling activities a face shield and liquid impervious apron or coveralls may be needed. If chemical dust or mist may be present use a National Institute for Occupational Health and Safety (NIOSH) approved air purifying respirator.
- Always use a clean scoop or dipper. **Never** use the same scoop for different chemicals.
- Avoid spilling chemicals on your body.
- Never mix any chemicals together.
- Add acids to water, NEVER water to acid. Remember AAA (Always Add Acid).
- Dissolve powders or crystals in water before adding to the pool.
- Add chemicals dissolved in water to the pool when the pool is not in use.
- Add large amounts gradually in thirds over a 2-hour period.
- Do not add chemicals to vacuum filter tanks, skimmers or gutters.
- Chlorine compounds will significantly change the pH and affect the effectiveness of the chlorine. So make sure the pH is within the acceptable range of 7.2-7.8.
- Add chemicals in sequence to adjust for: (1) Free Available Chlorine, (2) total alkalinity, (3) pH, (4) cyanuric acid – outdoor pools, and (5) total hardness.
- Adjust only when swimmers are out of the pool, either direct or through a chemical feeder.
- Use separate designated containers to cleanup spilled chemicals to avoid inadvertently mixing of spilled substances.

Water Chemistry Adjustment Guide

These are commonly accepted chemical parameters. Consult product labels for specific directions for chemical adjustments. The manufacturer's instructions must always be followed.

Dosages to Treat	10,000 Gallons		
Chemical	Desired Change		
Increase Chlorine	1 ppm	5 ppm	10 ppm
Chlorine Gas	1.3 oz	6.7 oz	13 oz
Calcium Hypochlorite (67%)*	2 oz	10 oz	1.3 lb
Sodium Hypochlorite (12%)	10.7 fl.oz.	1.7 qts	3.3 qts
Lithium Hypochlorite	3.8 oz.	1.2 lbs	2.4 lbs
Dichlor (62%)	2.1 oz	10.75 oz	1.3 lbs
Dichlor (56%)	2.4 oz	12 oz	1.4 lbs
Trichlor	1.5 oz	7.5 oz	14 oz
Increase Total Alkalinity	10 ppm	30 ppm	50 ppm
Sodium Bicarbonate	1.4 lbs	4.2 lbs	7.0 lbs
Sodium Carbonate	14 oz	2.6 lbs	4.4 lbs
Sodium Sesquicarbonate	1.25 lbs	3.75 lbs	6.25 lbs
Decrease Total Alkalinity	10 ppm	30 ppm	50 ppm
Muriatic Acid (31.4%)	26 fl.oz.	2.4 qts	1 gal
Sodium Bisulfate	2.1 lbs	6.4 lbs	10.5 lbs
Increase Calcium Hardness**	10 ppm	30 ppm	50 ppm
Calcium Chloride (100%)	0.9 lbs	2.8 lbs	4.6 lbs
Calcium Chloride (77%)	1.2 lbs	3.6 lbs	6.0 lbs
Increase Stabilizer	10 ppm	30 ppm	50 ppm
Cyanuric Acid***	13 oz	2.5 lbs	4.1 lbs
Neutralize Chlorine	1 ppm	5 ppm	10 ppm
Sodium Thiosulfate	2.6 oz	13 oz	26 oz
Sodium Sulfite	2.4 oz	12 oz	1.5 lbs

Chemical amounts have been rounded off. Always follow instructions on the manufacturer's label for exact dosage amounts. This table was adapted from the National Swimming Pool Foundation© Pool & Spa Operator ™ Handbook.

*Other calcium hypochlorite products are available from 47% to 78%. Follow the label directions for dosage amounts or calculate the dosage using example 2 in the no product label chemical adjustment section.

** The only way to reduce calcium hardness is to remove some of the pool water.

** *The only way to reduce the level of cyanuric acid in the water is to drain and refill the pool with fresh water. Studies have shown that cyanuric acid residual remains in the plaster, filter elements and media, and scale in heaters and pipes.