Calcium & Alkalinity

Scott Morell

March 14, 2006

Calcium & Alkalinity

- Required by a host of organisms that form calcium carbonate skeletons and shells.
- Can quickly become depleted in a closed system.
- Must ensure that the appropriate levels are maintained.

Calcium & Alkalinity

- Many different ways to supplement calcium and alkalinity.
- All can lead to problems if not used properly.
- Should be checked with reliable test kits

Calcium & Alkalinity – Why do we care?

- Organisms have evolved to use specific amounts of calcium and alkalinity
- Calcifying organisms take a specific ratio of calcium and alkalinity from the water to form calcium carbonate.

Alkalinity

- Total alkalinity is a measure of how much acid it takes to lower the pH of the water sample to the bicarbonate endpoint. (convert all of the bicarbonate (HCO_3^-) to carbonic acid (H_2CO_3).)
- Alkalinity maintenance is a critical aspect of coral reef aquarium husbandry

Alkalinty

- Desired alkalinity levels
  - 7 to 11 dKH (degrees of carbonate hardness)
  - 2.5 to 4 meq/L(milliequivalents per L)
- Helps maintain a stable pH in the system
- The use of alkalinity is a surrogate measure for bicarbonate

Calcium

- Desired Levels
  - 380 to 450 ppm

Calcium & Alkalinity Supplementation (Balanced)

- CA Reactors
- Two part Calcium and Alkalinity additive Systems (such as B-ionic, C-Balance, etc.)
- Kalkwasser/Calcium Hydroxide (Pickling Lime)

CA Reactors

- Pros
  - Balanced Calcium & Alkalinity
  - No Daily Maintenance
- Cons
  - High initial cost (neighborhood of $100 to $1500)
  - Can lower tank pH
- Nifty CA Reactor Setup Calculator
  - http://home.comcast.net/~jdieck1/reactor.html

Two part Calcium and Alkalinity additive Systems

- Pros
  - Provide balanced Calcium & Alkalinity
- Cons
  - Fairly Expensive
  - High maintenance
  - The levels can drift away from perfect balance if not enough or too much is being added

Kalkwasser (Calcium Hydroxide)

- Pros
  - Fairly balanced Calcium & Alkalinity
  - Inexpensive when using pickling lime
  - Ability to reduce the phosphate already in the tank water
  - “Self Purifying” – Metals
- Cons
  - Must be slowly added to prevent pH spikes
  - High maintenance
  - May not be enough to keep up with high demands (Increase evaporation or add vinegar)
  - Very caustic, avoid inhalation and contact of liquid on the skin (ph of ~12.8) See MSDS

Calcium & Alkalinity Supplementation (Not “Balanced”)

- Calcium chloride
- Polygluconate/Gluconate calcium
- Sodium bicarbonate (Baking Soda)
- Sodium carbonate (Washing Soda)

Calcium chloride

- Pros
  - Adds Calcium
  - Can be added with your makeup water
- Cons
  - Can be expensive in the long run
  - High maintenance
- Link
  - http://www.advancedaquarist.com/issues/mar2004/chem.htm

Polygluconate/Gluconate calcium

- Pros
  - Adds Calcium
  - Can be added with your makeup water
- Cons
  - Can be expensive in the long run
  - High maintenance
- Link
  - http://www.seachem.com/products/product_pages/ReefCalcium.html

Sodium bicarbonate/ Sodium Carbonate

- Pros
  - Adds Alkalinity
  - Can be added with your makeup water
  - Can be very inexpensive if using Baking Soda or Washing Soda
- Cons
  - Need to watch for surfactants in washing soda
  - High maintenance

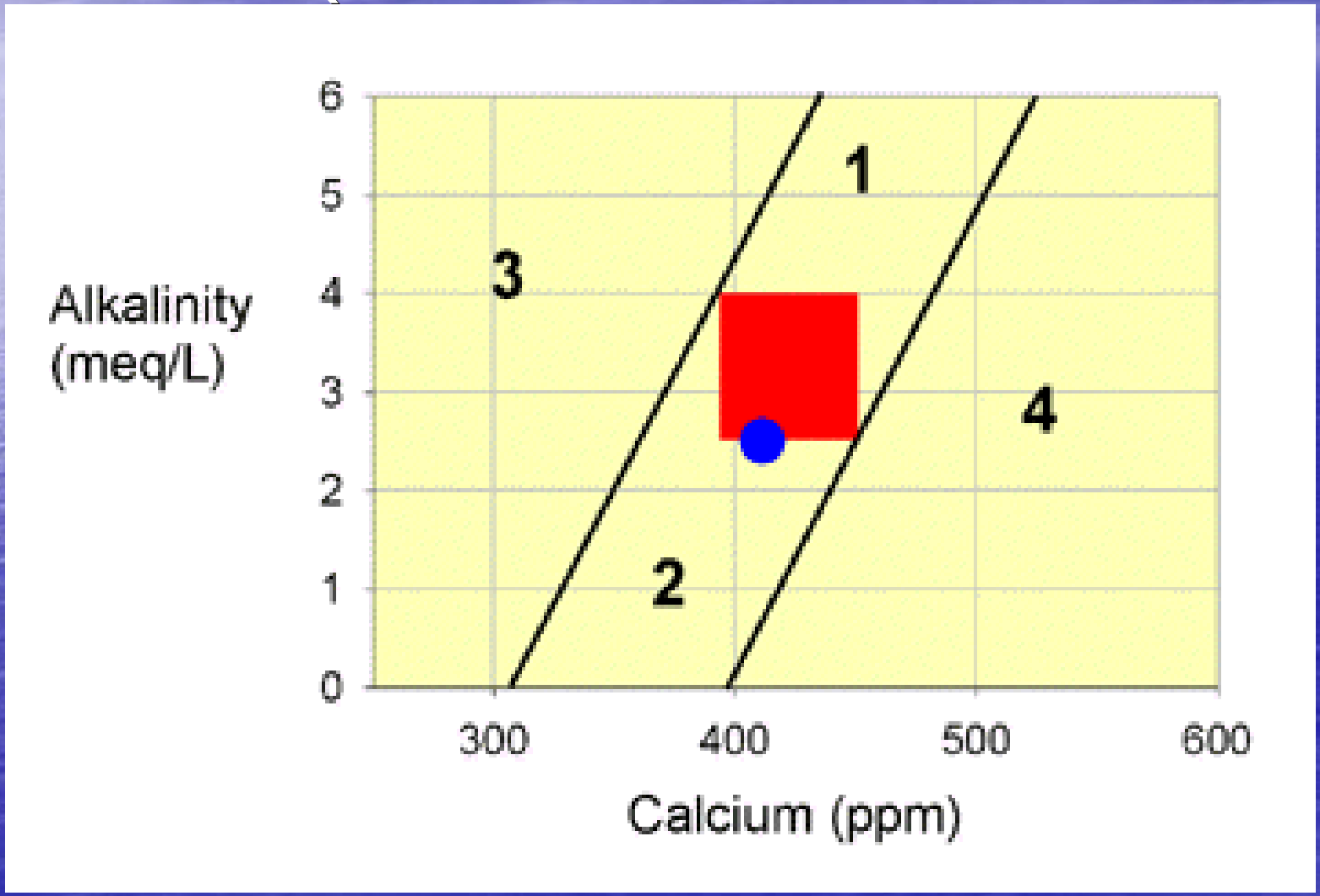
Scott's Method

- Use Seachem Reef Builder and Reef Calcium Advantage in the makeup water. (I alternate every 2 days)
- Measure the Alkalinity and Calcium consumption of the tank.
- Use the Reef Chemistry Calculator to determine the amount of additives to needed.
- Measure daily until Calcium and alkalinity are stable.
- Once stable, add the required amount daily to the make up water.
- Measure weekly to ensure stability. Adjust as needed.
- Measure Monthly

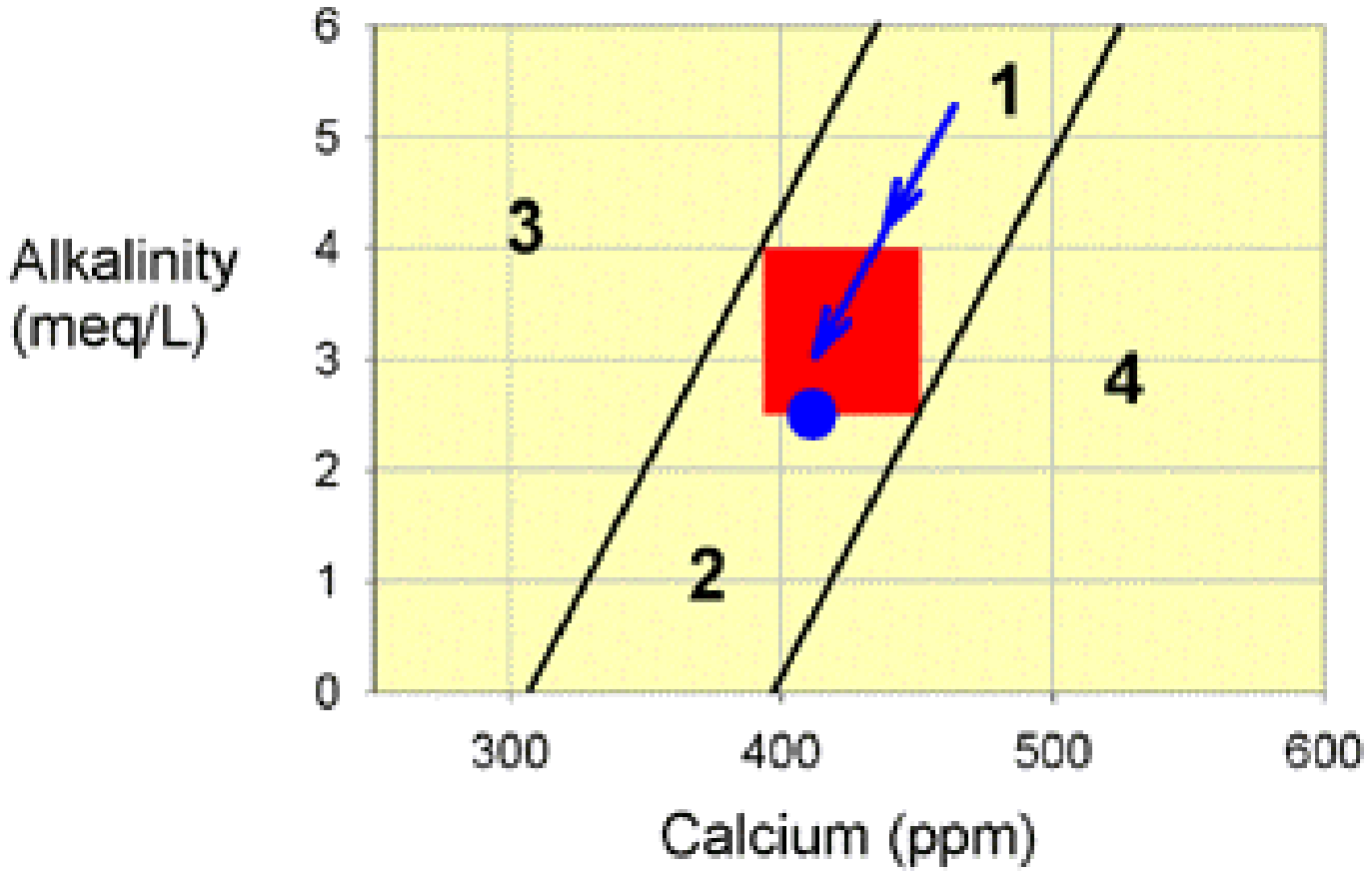
Cost Comparisons

	Yearly Cost for a 100 Gallon Tank ($)			
Method	Start up Costs ($)	Light Load	Medium Load	Heavy Load
Limewater (Bulk Lime)	10 - 400+	0.60	1.70	6.60 (marginally possible)
Limewater (Aquarium Lime)	10 - 400+	20.80	60.50	241.00 (marginally possible)
$CaCO_3/CO_2$ reactor	350 - 650	6.60	19.30	77.00
Two-part systems (original B-ionic)	0	60.00	180.00	700.00
Two-part systems (bicarbonate B-ionic)	0	170.00	490.00	1950.00
Scott's Method	0	20	60	232

Solving Calcium and Alkalinity Problems (Red = Ideal, Blue = NSW)

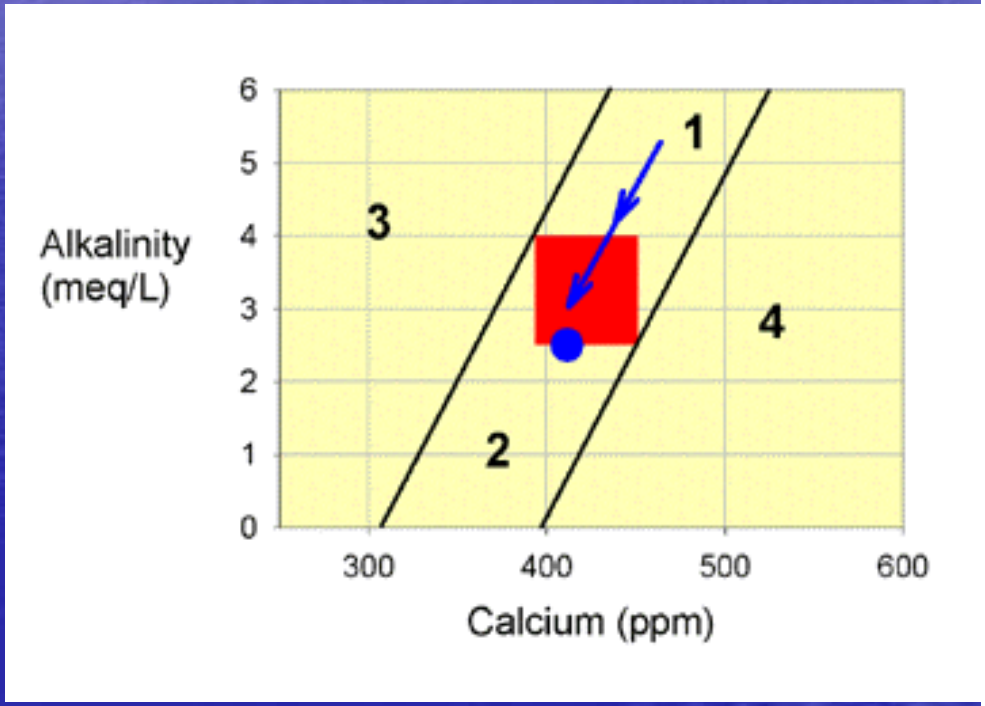


Solving Calcium and Alkalinity Problems (Zone 1)

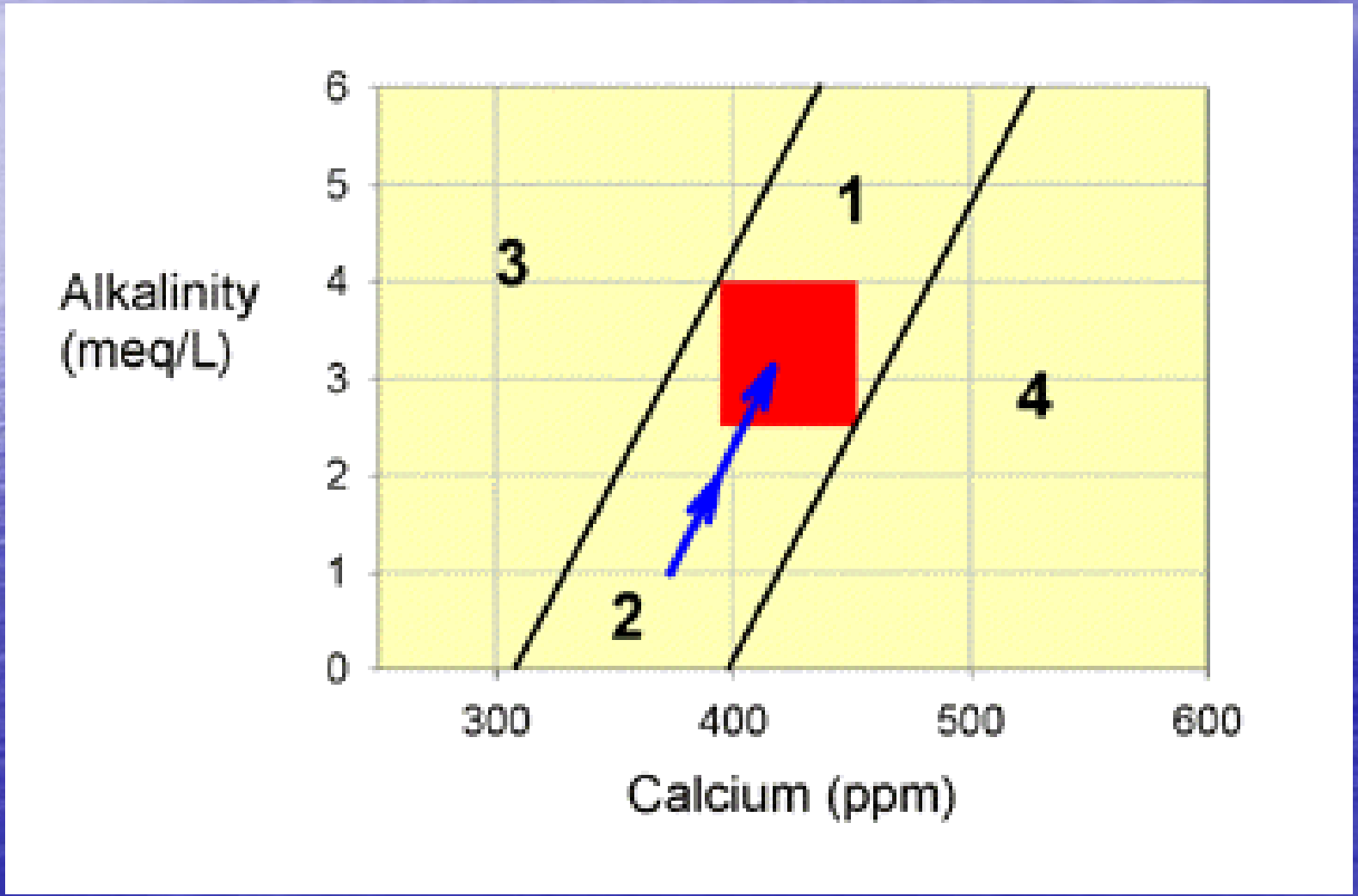


Solving Calcium and Alkalinity Problems (Zone 1)

- Uncommon
- Easiest to correct
- Just stop adding calcium and alkalinity supplements

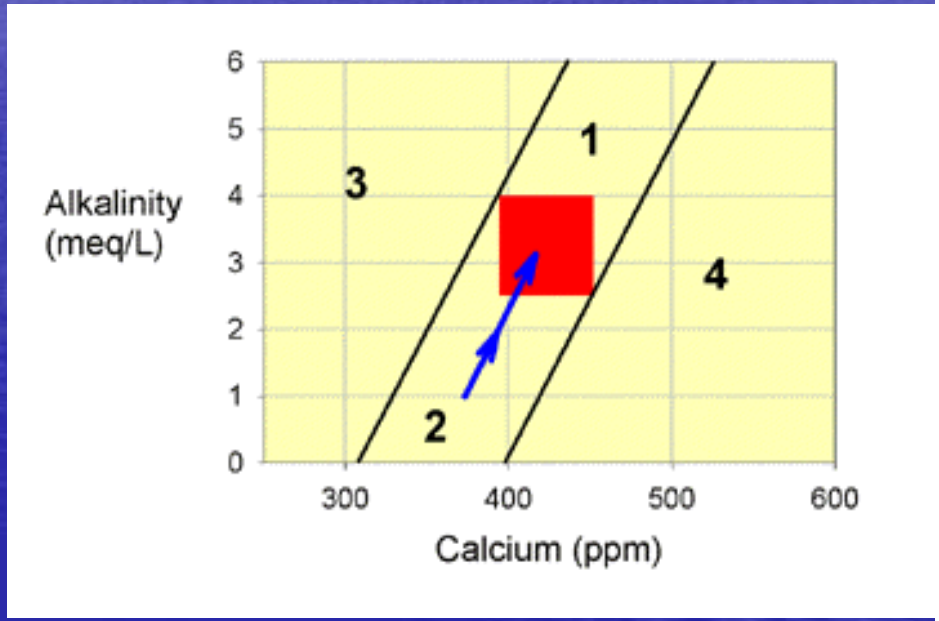


Solving Calcium and Alkalinity Problems (Zone 2)

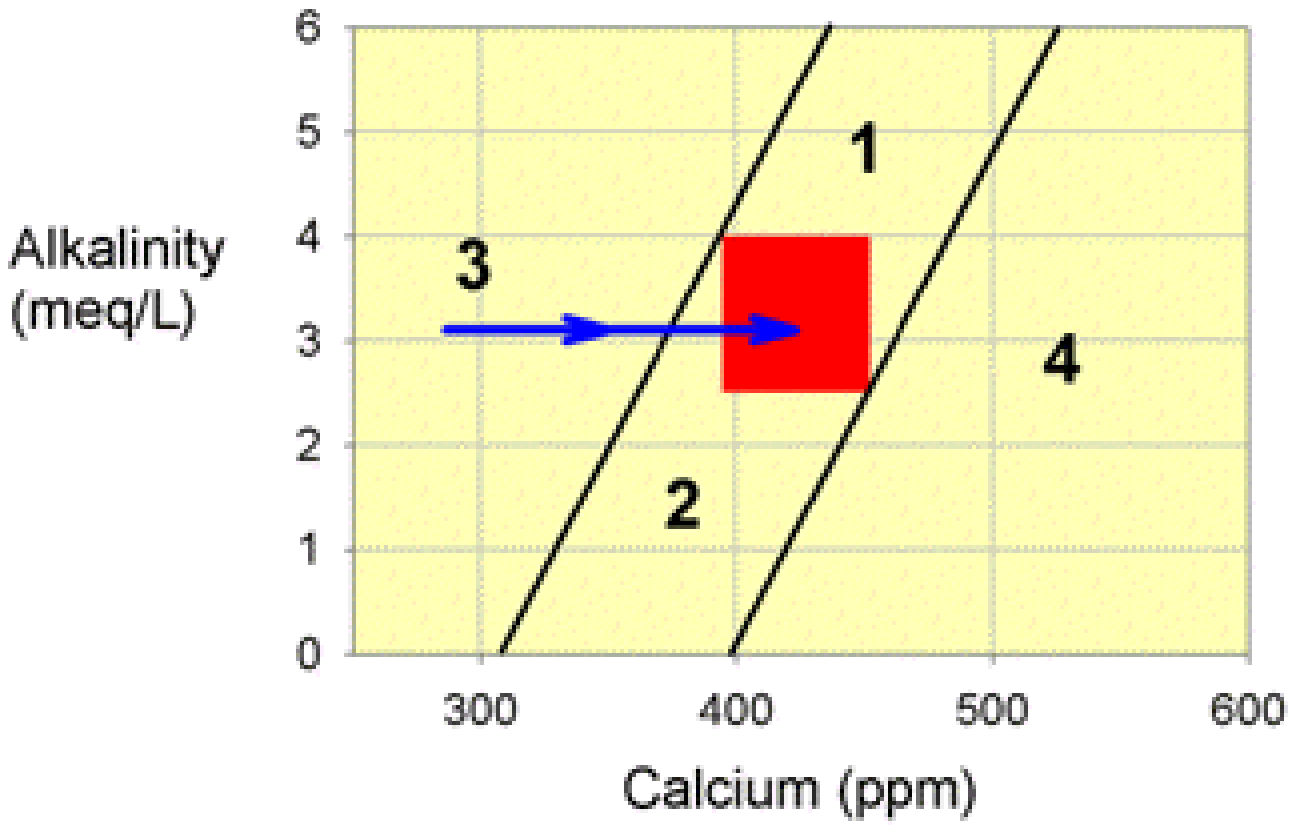


Solving Calcium and Alkalinity Problems (Zone 2)

- Very Common and easy to correct
- Add a balanced additives (Kalkwasser, CA Reactors, or many balanced two-part calcium and alkalinity supplements such as B-ionic, C-Balance, etc.)

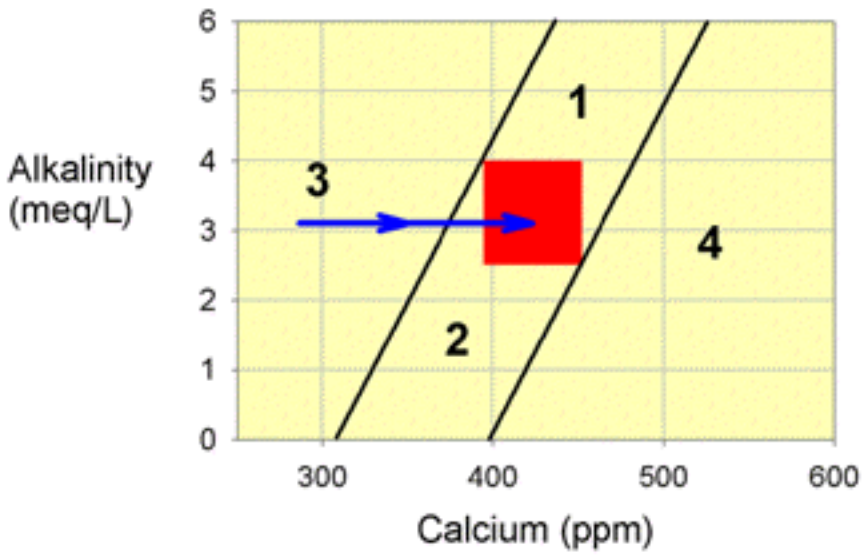


Solving Calcium and Alkalinity Problems (Zone 3)

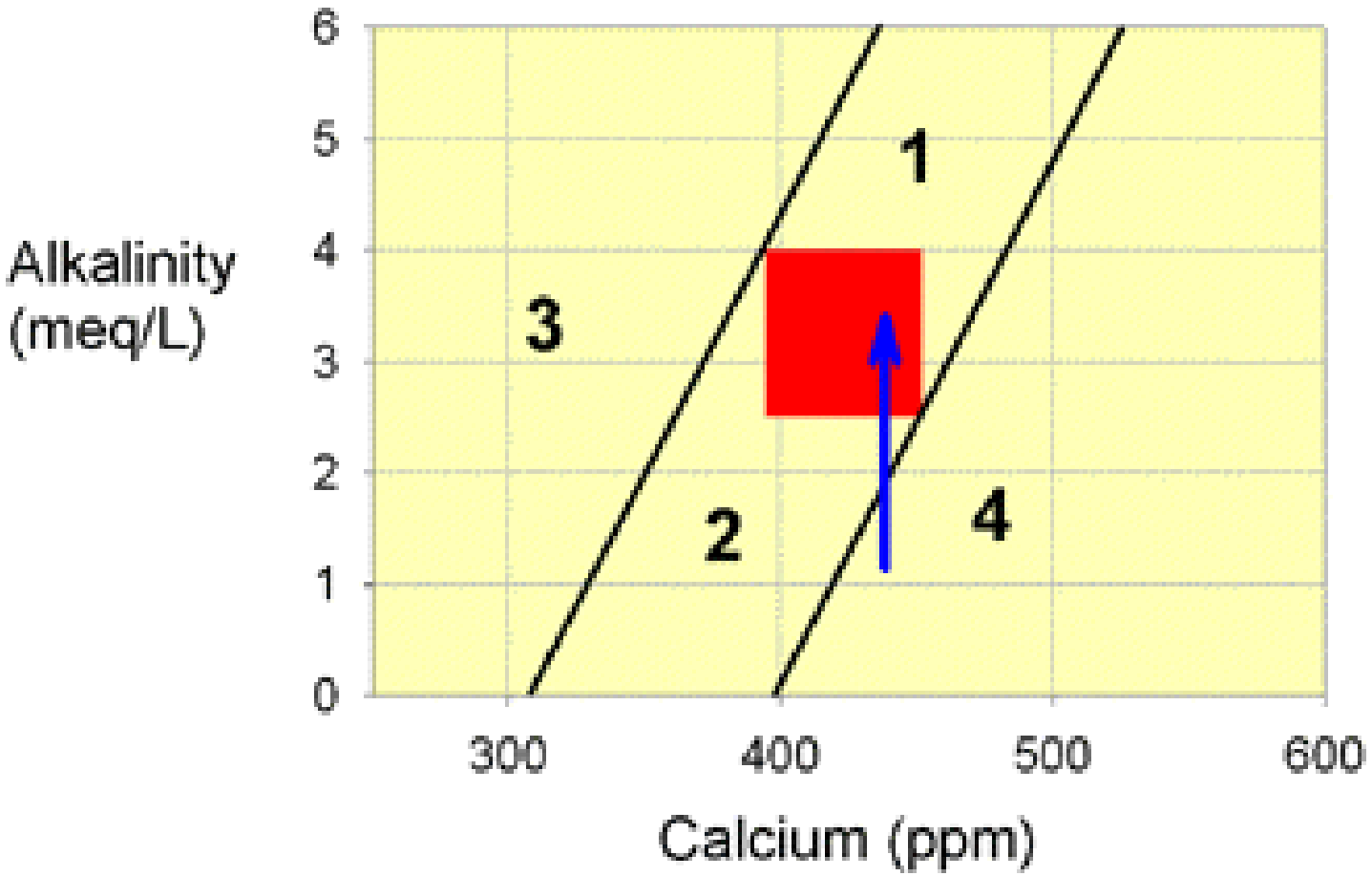


Solving Calcium and Alkalinity Problems (Zone 3)

- Typically caused by overdosing alkalinity RELATIVE to calcium
- Stop dosing Alkalinity and dose with a Calcium supplement i.e. Calcium chloride or the calcium component of the two-part calcium and alkalinity additive systems

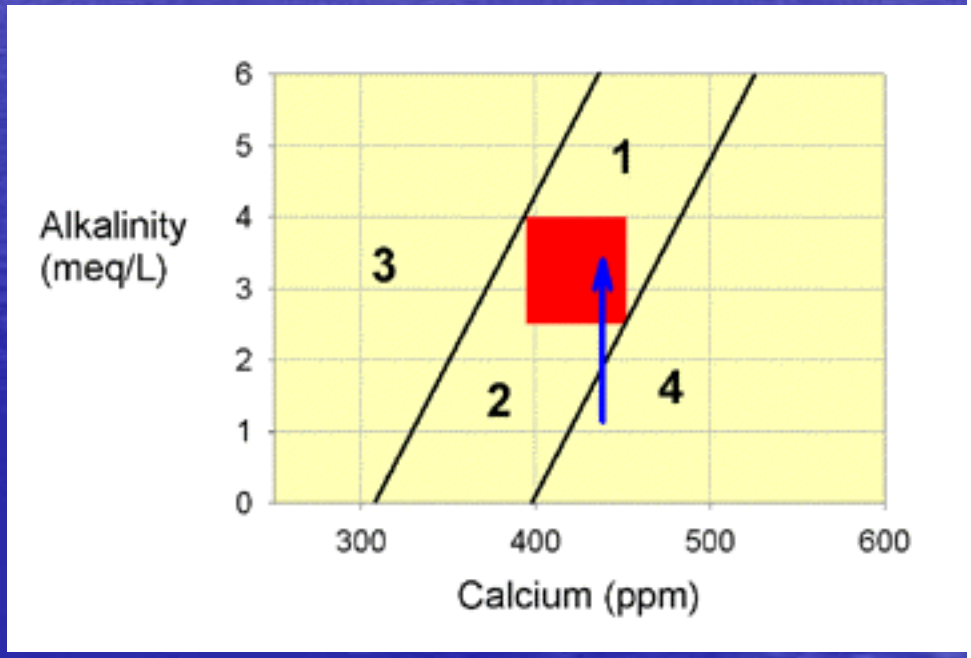


Solving Calcium and Alkalinity Problems (Zone 4)



Solving Calcium and Alkalinity Problems (Zone 4)

- Typically caused by overdosing calcium RELATIVE to alkalinity
- Stop dosing calcium and dose using a alkalinity supplement only i.e. Baking Soda or the alkalinity component of the two-part calcium and alkalinity additive systems



Two part Calcium and Alkalinity additive Systems

Calcium and alkalinity declines in a reef aquarium where balanced additions ***are not meeting*** demand.		
Day	Calcium (ppm)	Alkalinity (meq/L)
1	450	4
2	440	3.5
3	430	3
4	420	2.5
5	410	2.0

Two part Calcium and Alkalinity additive Systems

Calcium and alkalinity increases in a reef aquarium where balanced additions are ***greater than*** demand.		
Day	Calcium (ppm)	Alkalinity (meq/L)
1	410	2.5
2	420	3
3	430	3.5
4	440	4
5	450	4.5
6	460	5
7	470	5.5

Calcium and Alkalinity (Links)

- Solving Calcium and Alkalinity Problems
  http://www.advancedaquarist.com/issues/nov2002/chem.htm
- How to Select a Calcium and Alkalinity Supplementation Scheme
  http://www.advancedaquarist.com/issues/feb2003/chem.htm
- When Do Calcium and Alkalinity Demand Not Exactly Balance?
  http://reefkeeping.com/issues/2004-12/rhf/index.htm
- A Homemade Two-Part Calcium and Alkalinity Additive System
  http://www.advancedaquarist.com/iss...il2004/chem.htm
- Electronic Calcium Monitoring
  http://reefkeeping.com/issues/2005-04/rhf/index.htm
- Purity of Calcium Chloride
  http://www.advancedaquarist.com/issues/mar2004/chem.htm

Calcium and Alkalinity (Links)

- Calcium and Alkalinity Balance Issues
  http://reefkeeping.com/issues/2002-...ature/index.htm
- Calcium Carbonate as a Supplement (Aragamight; Liquid Reactor)
  http://www.advancedaquarist.com/iss...ly2002/chem.htm
- The Relationship Between Alkalinity and pH.
  http://www.advancedaquarist.com/issues/may2002/chem.htm
- The Chemical & Biochemical Mechanisms of Calcification in Corals
  http://www.advancedaquarist.com/issues/apr2002/chem.htm
- Calcium
  http://www.advancedaquarist.com/issues/mar2002/chem.htm
- What is Alkalinity
  http://www.advancedaquarist.com/iss...2/chemistry.htm

Calcium and Alkalinity (Links)

- Limewater (kalkwasser)
  - What Your Grandmother Never Told You About Lime
    http://reefkeeping.com/issues/2005-01/rhf/index.htm
  - The Self Purification of Limewater (Kalkwasser)
    http://www.advancedaquarist.com/issues/may2003/chem.htm
  - The Degradation of Limewater (Kalkwasser) in Air
    http://reefkeeping.com/issues/2003-...ature/index.htm
  - Magnesium and Strontium in Limewater
    http://www.advancedaquarist.com/issues/dec2003/chem.htm
  - How to Select a Calcium and Alkalinity Supplementation Scheme
    http://www.advancedaquarist.com/issues/feb2003/chem.htm
  - Expanding the Limits of Limewater: Adding Organic Carbon Sources (vinegar)
    http://web.archive.org/web/20030418...bio/default.asp
  - Limits To Limewater...Revisited
    http://web.archive.org/web/20030618...bio/default.asp

Solving Calcium and Alkalinity Problems (Links)

- Reef Chemistry Calculators
  - http://www.kademani.com/reefchem.htm
  - http://www.seachem.com/products/reef.html
  - http://home.comcast.net/~jdieck1/chem_calc3.html
  - http://home.comcast.net/~jdieck1/reactor.html
- Volume Calculators
  - http://www.garf.org/calculators/TankVolumeCalculator.asp
  - http://home.comcast.net/~jdieck1/volcalc.html
- Alkalinity Conversion Table
  - http://ozreef.org/content/view/87/2/

Solving Calcium and Alkalinity Problems

- One of the best ways to help fix calcium and alkalinity problems is to simply do a water large change.

Questions???

Scott, don’t forget to go to the next slide after the questions...

IMAS 3rd Annual Reef Tour

- April 8th from 11:00 am to 4:00 pm
- Currently 6 or 7 tanks.