7 page in-depth review

Worth their salt?

Correct salinity is essential for all ocean life. **Levi Major** tests six leading brands to help you decide what salt is right for you and your marine tanks

Seawater in the world's oceans has, on average, a salinity of about 3.5% — meaning that every litre has some 35 grams of dissolved salts. This is equivalent to 35 parts per thousand, or ppt.

The geochemical explanation of how each salt came into existence and how they have remained at near constant levels within the changing oceans is beyond the scope of this article. Let's just agree that the salinity of our oceans has remained reasonably stable for billions of years.

Eleven major ions comprise the majority of salts dissolved within our oceans. Those with the largest concentrations in marine waters are chloride, sodium, sulphate, magnesium, calcium, potassium and carbonate. In the oceans, chloride and sodium are the most abundant, having concentrations of 19.25g/l and 10.7g/l, respectively. Also important are sulphate (2.7g/l) and magnesium (1.3g/l), as well as calcium and potassium (both roughly 0.4g/l).

The first six ions account for some 99% of all salts in seawater.

Next in abundance, with concentrations between 1 and 100 parts per million (ppm), are minor constituents. Those substances, present at very low concentrations (less than 1ppm), are known as trace elements. Virtually every one of some 100 known elements is found in seawater, but, with only a dozen or so present as major and minor ions, most are trace elements.

What are we looking for?

Consider first at what salinity to run your system. The obvious answer would be to look to nature. The salinity of the oceans should provide the answer — but, with all things marine, it's not that simple

Given the volume of the oceans it is not surprising that global salinity remains at a near constant 35ppt. However, salinity on reefs is known to vary largely due to climatic effects. It's the addition or removal of freshwater, not addition or removal of salts, that accounts for salinity changes.

The processes of evaporation and precipitation (rain or snow) remove and add freshwater to seawater and thereby change the amount of salt in it.

Furthermore, some seas, such as the Red Sea, are more 'land-locked' than others, so there will be variance.

In a fish-only system, provided livestock are properly acclimatised, a little change is tolerated. Most fish will live at salinities from approximately 26 to 36ppt. In such a system some believe there is little point in having a higher salinity, so many are run at about 29ppt.

There's evidence that certain parasites don't do well at these lower salinities and running at lower salinity will mean less salt required for routine water changes, reducing running costs. I would not go too low as it may affect fish long term and there are advantages in running closer to full salinity.

Corals will often salinity requirements, even if running a mixed reef system. They are much less tolerant of a lower salinities and 32ppt is considered minimum. The range for corals is usually 32-35ppt.

JACQUES PORTAL

NEIL HEPWORTH

Now we know about the importance of salinity how does this knowledge dictate our salt choices?

Whatever salinity you choose, it must remain stable. As our laboratory results show, parameters such as pH, alkalinity, calcium and magnesium are affected by salinity but, more importantly, can also be affected by brand choice.

There are many salt brands, ranging from artificial mixes concocted in laboratories to replicate seawater, to the real thing

NEIL HEPWORTH

Corals are adapted to a reef environment that has remained unchanged for millenia.

derived from the oceans by evaporative processing.

This article cannot totally answer the question about 'which salt is best' as we have only looked at the major ions and other important parameters, and can't see if there are any deleterious impurities such as elevated heavy metals. While we also cannot draw conclusions on whether artificial is better than evaporative salt, we can clearly see interesting results from the six brands analysed.

What brands were tested — and how have we done so?

Six major brands were submitted for testing: D-D H_2Ocean Pro, Reef Crystals, Tetra Marine Sea Salt, Tropic Marin Pro Reef, Tunze Reef Excel and Red Sea Coral Pro.

Initially it was considered appropriate to look at the parameters of most concern to us as aquarists: nitrite, nitrate, pH, alkalinity, calcium, magnesium and phosphate.

Due in part to prohibitive costs associated with a full analysis of all the ions present, these parameters were chosen to give us a good understanding of what is in the salt we use, love and swear by.

All labware that came into contact with the prepared water and salts, including mixing and measuring containers, sample containers, stirring rods and sampling spoons were acid washed polypropylene or glass.

Each salt was assigned separate sets of labware to minimise any possibility of cross contamination.

Each one was also decanted from transit packaging into buckets to permit the use of a polypropylene stirring rod attached to a drill. They were then individually subjected to ten minutes of stirring prior to sub-sampling.

Five 100g sub-samples were obtained for each salt, taken at varying depths within their containers before further mixing to minimise any effects of settling.

The salts were then mixed with RO/DI water with a TDS reading of 0 to a concentration of 35ppt, as measured with a calibrated refractometer.

Because the D-D salt requires a salinity of 35.5ppt to realise the elevated magnesium levels, a sample to this salinity was additionally produced.

Once the samples were made, each was assigned a random code and decanted into the sample containers provided by the National Laboratory Service, the Environment Agency's commercial analytical laboratory.

All subsequent handling and testing was performed 'blind' to rule out spurious or biased reporting. Only when the results were finally released from the lab were they then re-assigned their brand name.

Further testing was undertaken using Salifert test kits for the chosen parameters to cross-refer the results a hobbyist is likely to record against that of an analytical laboratory, but we haven't shown these less accurate results here. Each test was triplicated and averaged to rule out user error.

Two of the most important questions I wanted answering were just how much water I could make from my salt — and does it tally with that stated by the manufacturer? To find those answers separate yield testing was conducted while I awaited the lab results for this study.

There's an unexpected glitch in the results obtained in that all salts record a trace of nitrite and, as we did not test for ammonia, the results for nitrate are recorded above the detection limit as this is calculated mathematically.

However, with total nitrogen lying below detection limits in all samples there is negligible ammonia, nitrite and nitrate within any salt tested. This was confirmed in correspondence with the laboratory and further via the Salifert kits.

YIELD TEST

The dry weight of each salt brand required to produce a litre of saltwater with a concentration of 35ppt was undertaken.

The same was done for H_2Ocean Pro to a salinity of 35.5ppt as D-D suggests more salt. After all the solutions were mixed they were aerated for 24 hours to fully dissolve, the salinity then being tested and adjusted.

This table outlines the dry weight of salt used to achieve the given salinity and accordingly the yield that is obtainable from each brand.

Brand	Dry weight (g)	Yield (ml)	ml/g	Product size	Quoted yield	Equivalent yield
D-D (35.5ppt)	36.5	1000	27.4	6.6kg	165-200	180
D-D (35ppt)	35.7	1000	28.0	6.6kg	-	184
Reef Crystals	39.4	1000	25.3	8kg	240	202
Tetra Marine	39.4	1000	25.3	8kg	240	202
Tropic Marin Pro Reef	35	1000	28.6	4kg	120	114
Tunze Reef Excel	35	1000	28.6	8kg	240	228
Red Sea Coral Pro	35	1000	28.6	7kg	210	200

It's clear that many manufacturers do not expect us to run at full salinity in our aquariums when they quote volumes on their packaging, but the table may help you determine the cost benefits of each salt. The figures obtained may further help in deciding which brand should be most suitable for your aquarium.

LABORATORY TEST RESULTS

Brand	Salinity	Total nitrogen	Ammonia	Nitrite	Nitrate	Total inorganic phosphate	pH	$CaCO_3$	Alkalinity	Calcium	Magnesium
D-D H_2Ocean	35.5ppt	<0.2mg/l	0mg/l	0.0062mg/l	<0.194mg/l	<0.020mg/l	8.36	106mg/l	5.9 dKH/2.1meq/l	448mg/l	1360mg/l
D-D H_2Ocean	35ppt	<0.2mg/l	0mg/l	0.0062mg/l	<0.194mg/l	<0.020mg/l	8.30	107mg/l	6.0 dKH/2.1meq/l	418mg/l	1280mg/l
Reef Crystals	35ppt	<0.2mg/l	0mg/l	0.0061mg/l	<0.194mg/l	<0.020mg/l	8.32	107mg/l	6.0 dKH/2.1meq/l	367mg/l	1020mg/l
Tetra Marine	35ppt	<0.2mg/l	0mg/l	0.0057mg/l	<0.194mg/l	<0.020mg/l	8.30	102mg/l	5.7 dKH/2.0meq/l	437mg/l	1190mg/l
Tropic Marin Pro Reef	35ppt	<0.2mg/l	0mg/l	0.0060mg/l	<0.194mg/l	<0.020mg/l	8.53	72.0mg/l	4.0 dKH/1.4meq/l	390mg/l	1220mg/l
Tunze Reef Excel	35ppt	<0.2mg/l	0mg/l	0.0057mg/l	<0.194mg/l	<0.020mg/l	8.37	79.3mg/l	4.4 dKH/1.6meq/l	472mg/l	1370mg/l
Red Sea Coral Pro	35ppt	<0.2mg/l	0mg/l	0.0053mg/l	<0.195mg/l	<0.020mg/l	8.45	111mg/l	6.2 dKH/2.2meq/l	412mg/l	1160mg/l
Natural sea water (Indo-Pacific)	34-36ppt	<0.2mg/l	<0.1mg/l	<0.0001mg/l	<0.1mg/l	0.005mg/l	8.0-8.3	125mg/l	7 dKH/2.5meq/l	420mg/l	1280mg/l

The minimum reportable values for our lab tests were: 0.2mg/l total nitrogen; 0.004mg/l nitrite; 0.005mg/l nitrate; 0.2mg/l total inorganic phosphate; 0.1 pH; 5mg/l $CaCO_3$; 3mg/l magnesium and 10mg/l calcium. Some samples, such as total nitrogen, were at the limits of detection.