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BRINE MAINTENANCE FOR RINKS

A RE-CAP OF HOW TO INTERPRET A BRINE ANALYSIS REPORT

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In the Summer 1995 edition of Facility Focus, we discussed "Summer Maintenance for Arenas" which included on overview of a proper brine analysis. Levels of iron, sediment , and rust inhibitors, as well as the pH, are all important items to monitor and can only be determined through a laboratory analysis. Therefore, you should have the brine analyzed at least once per year. Knowing how to interpret the report is important, so as a follow-up we will take a closer look at a Brine Analysis Results sheet (Figure 1) and review the various test results and recommended actions.

Taking the Sample

The sample should be taken from the mixing valve near the brine pump. For an accurate analyses, it is best to let the brine circulate through the system for a while before taking the sample and then drain some brine off in a bucket first. Once the color is consistent, approximately 600 ml to one litre of brine should be put in a clean bottle. Remember to label the sample as BRINE, and include the name of your facility and the sample was taken.

Iron

High levels of iron are usually attributed to rust in the system from corrosion of carbon steel components such as the headers, chiller tubes, or brine pump. With proper maintenance of rust inhibitor, these levels can usually be kept below 10 parts per million (ppm). Once they exceed this level, a brine filtration system can be added to filter out excess amounts. In this example, the levels of iron are still too high, indicating, that the filter cartridge should be cleaned or replaced.

Suspended Solids

Suspended Solids can be made up of a number of things, from chemicals that have fallen out of solution, to contaminants in your system. These solids eventually begin to accumulate on the walls of the return bends as the flow of the brine makes the 4" radius turn at the end of the rink floor. The pipe itself is 1" diameter, but the return bends are closer to 3/4" diameter. If this goes undetected, it can eventually block the brine loop. A brine filtration system will also filter out unnecessarily high levels of suspended solids.

Having no suspended solid would be ideal but a certain level of these is inevitable. The amount of sediment determines the corrective action to take. Brine samples often have up to 700 parts per million (ppm) of suspended solids. Once you start to get up around 1000 ppm then you should consider addressing the situation in the future. Over 1400 ppm indicates a problem that should be addressed right away. This also depends on the trend of solids over the years. If you usually had approximately 400 ppm, and you suddenly jump to 1200 ppm, you may want to find out what has happened to cause the increase. If left to accumulate at this rate for another year, it could cause serious problems.

Specific Gravity

The specific gravity of your brine should be checked regularly by the rink staff on a regular basis. This is done by using a hydrometer, a glass tube which is weighted at the bottom and has a graduated scale inside. For an accurate reading, it is important to let the brine sample warm up before testing. The hydrometer is to be used in brine at 60°F, but there are correction factors available for other temperatures.

Specific gravity is measured relative to water which as a specific gravity of 1, and is adjusted by adding calcium chloride flake. This affects the concentration of calcium chloride in the solution, as well as the freezing point. As the concentration increases, more energy is required to pump the brine through the system, but the freezing point of the brine decreases. (Note: at a specific gravity of 1.29, the freezing point reverses and begins to increase).

The recommended specific gravity for brine is 1.21 which has a concentration of 22.4% actual calcium chloride and a freezing point of -94°F (-23°C). Most brine pumps are selected based on a specific gravity of 1.21, so for proper system performance, it is important to maintain this level. If levels of calcium chloride are too high, they can be adjusted by diluting the solution with water. If they are too low, then calcium chloride flake can be mixed in a barrel and added to the system through the mixing valve. While some rinks use the expansion tank for adding the brine, this is not the proper procedure.

Analysisb	Test Resultsb	Recommended Rangeb
Total Iron (PPM)	41	< 10 PPM
Suspended Solids (PPM)	956	0.01=LBS./1000 Gal
Specific Gravity	1.206	1.2 To 1.22
Freezing Point (°F)	-7.8°F	-5.8°F to -13°F
Calcium Chloride	22.0%	21.5% to 23.3%
pH Level	8.7	9.0 To 10 Brinehib 7.5 To 9.0 Chromate
Color/Clarity	Turbid	Clear
Ammonia (PPM)	67	Nil
Brinehib (PPM)	34	40 to 50 PPM Phosphonate
Chromate (PPM)	774	1500 PPM N/A When Using Brinehib

Recommended Actions To Be Taken:	
Total Iron	High-Change Filter Cartridge
Suspended Solids	Slightly High
Calcium Chloride	Slightly Low-Adjust to recommended range
pH Level	Good
Brinehib	Low-Add 10 LB. per 1000 Gallons
Chromate	N/A

** Note: Ammonia levels have continued to subside since last report*

Figure 1- Brine Analysis Result sheet:
Follow-up analysis for a rink that had a failure of their chiller. The results of the first brine analysis noted high levels of iron and ammonia. The existing brine charge was reused after a titanium plate chiller was installed. Inhibitor and a brine filtration system were also added.

pH
The pH is the alkaline or acid level of the solution, where a value of 7 is neutral, below is acidic, and above 7 is alkaline. pH values are logarithmic, so brine with a pH of 10 is ten times more alkaline than with a pH of 9, and 100 times that of brine with a pH of 8. The pH of untreaterd calcium chloride is very alkaline, which can cause accelerated corrosion of your steel components. The pH can be adjusted as required, by using either caustic soda or carbon dioxide, but using either caustic soda or carbon dioxide, but you are advised to seek further advice and use extreme coution. In this example, th erust inhibitor that is recommended to be added will slightly increase the pH, so no further acton of required.

Ammonia
Sometimes brine samples show traces of ammonia. This is usually due to a chiller tube failure and definetely cause for concern. If the brine results show ammonia, it is recommended theat another test be done for ammonia only at the same laboratory to see if the level has increased or stayed the same. If the levels have increased, the chiller should be repaired or replaced immediately. If the level has stayed the same or decreased, this woiuld indicate residual ammonia in th ebrine charge which will dissipate through the expansion tank over time.

There are other possible causes for ammonia in the brine. If the brine was too acidic, then ammonia may have been added to raise the pH. This is not standard practice and not recommended, but it does happen on occasion. Also, many rinks have already replacced their chiller, so ammonia in the brine could be attributed to a failure of the original chiller. Having past brine analysis reports available for comparison can help lead to a quick diagnosis and provent a lot fo anxiety.

Rust Inhibitor
Although often ignored, maintaining the proper level of rust inhibitor is important to prolong the life of carbon steel components. Sodium dichromate (or chromate) used to be pre-mixed with calcium chloride flake as a rust inhibitor, but after it was discovered to be a carcinogen (cancer-causing), most chemical companies stopped including this with the flake. Products containent chromate are no longer sold or recommended by CIMCO Refrigeration. Because most rinks used chromate in the past, this test iis still done as a check to see if levels have decreased to the point where other additives are required.

One of the alternatives to chromate is Brinehib, an organic rust inhibitor which is available in 50 lb. pails to be mixed with your brine. When circulated through the system, it adheres to stiil surfaces, protecting them from further corrosion. The Brinehib also removes build-up which is then suspended in your brine and removed by a brine filtration system. In the example, the initial charge of Brinehib now requires a supplement of 10 lb. per 1000 gallons of brine to bring it back to full strength. In this cade, approximately one half pail of Brinehib should be added which should be sufficient for the next few seasons.

There are brands of calcium chloride flake on the market that have other types of rust inhibitors included, but based on numerous results from rinks that use these altematives, the levels of inhibitor is not adequate. This could be because depleted levels of inhibitor were not addressed before adding the new flake. Similarly, travelling chemical representatives sometimes resommend corrosion protectoin that may work in water systems, but are not suitable for a rink brine system. This can give arena managers a false sence of security that their system is adequately protected when in fact it is still susceptible to corrosion.

Another note on Chromate
When a shell-and-tube chiller fails, the brine is often contaminated to the point where it cannot be re-used with another carbon steel unit. Because of the chromate, environmental regulations require a proper dinposal wich envolves having the charge trucked to a special facility. The other components of the brine (calcium, chloride, organec inhibitor, and even ammonia) are all natural and do not require the same special disosal procedures. The days of dumping brine down the drain are gone (people get upset oveer schools of dead fish!). You may find someone who is willing to make the brine charge disappear for a small fee, but remember that thriogh due diligence, you are still ultimately responsible.

Hopefully, this overview will make your next brine analysis report more easy to interpret. Remember to keep reports together tor comparison from year to year. Brine maintenance is important, so if you have any questions that have not been addressed, make sure you take the time to find out.

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