Scottish Curling-Ice Group

PEBBLE SALTS

It has been debated many times, but never tested: the amount of salts present in pebble, in the body of pebble and in the tops of pebble, if the ice pad had been installed with raw tap water. To investigate the matter a curling rink (North West Castle, Stranraer, Scotland) was borrowed where nothing other than tap water had been used for several months, both to install the ice and as normal pebble. Samples of snow were collected at several stages and the water was then tested. All the equipment was sterile to prevent contamination, and every aspect was carefully controlled.
We did not know beforehand what we would find or could expect to find, the samples were simply numbered and tested without reference to when they were taken. The results are below.

Sample	Stage	µS/cm	pH	ºC
1	Deionised water used for pebble	67	7.7	15.6
2	Filtered tap water used to install the pad and for normal pebble	493	8.3	15.3
3	Snow from first pass, normal pebble	616	7.9	15.1
4	Snow after four DI pebbles at 10ºC, 2x72 & 2x75 @ 50secs	382	7.9	15.0
5	Snow after two DI pebbles at 30ºC, 2x76 @ 45secs	481	7.5	15.1
6	Snow from Nipper after two DI pebbles at 35ºC, 2x77 @ 45secs	862	7.1	16.0
7	Snow from first pass 12hrs later, after two games with 1x77 between	339	7.2	15.6
8	Snow from Nipper after two DI pebbles at 35ºC, 2x77 @ 40secs	675	6.9	16.0

NWC Curling Rink, Stranraer, concrete floor, March 2007

Referring to the samples above, the following information can be given and/or deduced:

2. The tap water contains a significant amount of salts, unlike the tap water in the second table.
3. The pebble itself contains over 20% more salts, lifted into the top of the pebble.
4. The DI pebble had lifted salts from the pad, even after four cold pebbles one after another. The surface is however significantly cleaner than tap water, and cleaner than sample 9 below.
5. With the warmer pebble, more salts have been lifted from the pad.
6. With an even warmer pebble for game conditions, yet more salts are lifted. However, this sample has been taken with the Nipper, testing only the very tops of the pebbles.
7. Overnight there was a possibility that salts would migrate into the surface from the pad. This has clearly not happened. Compared to sample 4 the surface is becoming cleaner, and compared to sample 6 the pebble itself (without its tops) is also cleaner.
8. Again only the tops were nipped and an improvement is clear compared to sample 6. However, the surface still contains substantial amounts of salts and is not yet as clean as sample 9 below, taken after 12 pebble-cuts.

For some comparison, below are the samples taken during installation of an ice pad.

Sample	Source/Action	µS/cm	pH	ºC
1	Pebble water from dehumidifiers	84	4.9	15.3
2	Flooding water from tap	151	5.9	16.8
3	Snow sample after 5 floods, before 1 pebble/4 cuts	21500	7.3	17.0
4	Snow sample after 3 floods, before 1 pebble/4 cuts	18900	6.9	16.5
5	Snow sample after 1 flood, before 1 pebble/4 cuts	13650	7.1	17.3
6	Snow sample after 1 flood, before 1 pebble/4 cuts	9980	6.7	17.7
7	Snow sample after 1 flood, before 1 pebble/4 cuts	7020	6.6	16.8
8	Snow sample after 1 flood, before 1 HOT pebble/4 cuts	7480	6.7	16.9
9	Snow sample after 12 pebble/cuts	566	5.9	16.5
10	Snow sample after 2 pebbles and 1 pebble/4 cuts	181	5.9	16.5
11	Snow sample after 2 pebbles, frost and 1 pebble/4 cuts	114	5.7	17.0

Forest Hills Curling Rink, concrete floor, mains tap water, August 2003

Observations

Whenever these experiments are done, there is a time constraint and often curling as well. The experiments take many months to plan and prepare, and many more months to understand the results. We accept that this particular experiment is not conclusive and is really only part of the learning curve.
The first objective was to see if several DI pebbles could "bury" the salts and render them insignificant to curling. This did not happen. The second objective was to work on top of these DI pebbles without exposing the pad, so that the samples were of pebble we had applied rather than the pad (except of course samples 1-3). The samples taken were on the same first pass on the same sheet, here sheet three, while the Nipper samples were of all four sheets simply to have sufficient snow for the sample. Sample 7 was taken after the overnight break and we cut almost down to the pad, and probably further down than any of the earlier samples, yet the test showed a good improvement in quality. We suspect that another few pebble-cuts would have cleaned most the salts from the ice and left us with a pad as clean as sample 11 in the second table. In other words, it appears to us that salts ARE lifted into the pebble and gradually removed, rather than being frozen into the pad to stay there for good. It is unlikely that we'll be able to repeat this experiment, but because of the data obtained from other similar experiments we are confident that most of the salts from tap-water installation can be removed through between ten and twenty pebble-cuts.
Another objective of the experiment was to see how quickly we could "finish" the pad to remove highs and lows and inconsistencies in the ice surface. We tested the level with a laser before we started work and found it to be excellent, certainly within 1mm over the width of four sheets. It was clear that the previous pebbles had been applied by different individuals and the surface was rough, but within a few pebble-cuts it looked much better and by the last pebble it was as good as any well maintained ice pad. Fortunately the humidity and all temperatures were very constant and we could discard any other possible influences on our work.
From the curling point of view we had previously observed how the stones behaved on the tap-water pebble, where the only real problem appeared to be a dive at the finish. Play after sample 6 was better, with a very good parabolic curve and no dive, and the pebble did not wear much at all. The speed was very fast though, so the next pebble was speeded up to leave fewer drops. Play after sample 8 was excellent and was tested by a few expert curlers, who immediately proved that the result was consistent and very much to their liking, with a draw of four foot in 27 seconds.

Conclusions

- It is not possible to bury the salts of an ice pad in this way, simply by covering the pad in clean pebble.
- It is possible to remove the salts of a tap-water installation by repeated pebble-cuts.
- A reasonably level ice pad can be finished very quickly by using repeated pebble-cuts and a fine pebble (here 65/0.45 or 77XF).

The local technicians used DI water for their normal pebbles over three weeks, and a further sample was taken to see how many salts remained.

µS/cm	**pH**	**ºC**
178	6.7	16.0

It is clear that the ice surface is now remarkably free of salts.

John Minnaar
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