Scottish Curling-Ice Group

SWEEPING AND ICE-SURFACE TEMPERATURES

During the Olympic Curling Championships at Pinerolo, Italy, in 2006, commentators on television stated that sweeping warms the ice surface, causing lubrication to allow the stones to travel further and curl less. In the experience of curling-ice technicians this cannot necessarily be true, because stones will normally travel less far and curl more on warm ice, while travelling further and curling less on cold ice. In our report on Why Do Curling Stones Curl, there is solid evidence that the amorphous layer of frost on the surface of the pebbles has a significant effect on the behaviour of stones, and that it is this layer that is melted through the MSMM/F process to provide lubrication and gradually higher bonding between stone and ice for the curl of the stone. Sweeping removes this layer, making it more difficult for the stone to curl, and allowing it to travel further.
It was decided to do a controlled test on the changes in temperature of the ice surface during a game of "normal" play, where 43 stones were played at draw weight down the same line in normal succession, with each stone swept by two players. A probe was placed in the ice surface along the line of play and less than 0.5mm under the surface of the ice pad and tested for reliability over several weeks. The following information is relevant:

T1 A probe under the ice surface 2m away from the line of play and unaffected by play, to use as a control measure of temperature.

T2 A probe under the ice surface along the line of play to record temperatures as the sweepers and stones pass over it, about 2m before the hogline furthest from the hack.
(Neither of these instruments (Microtherma thermometers) were calibrated for absolute accuracy as they were only used to record changes in temperature within 0.1ºC.)

RH Relative humidity at 1.5m, read with an accurate thermo-hygrometer. It was decided to do the tests at an RH higher than 70% to allow for the influence of condensation.

AT Air temperature at 1.5m, read with the same thermo-hygrometer. Although 9ºC was higher than anticipated, this was due to a sudden change in the weather. The outside temperature was 20ºC and the outside RH was 80%.

IST Ice-surface temperature at the point of testing, read with a hand-held Raytek Raynger. This too was not calibrated for absolute accuracy and was only used to observe changes, while the actual IST was around – 4ºC.

Play There were three players delivering and sweeping, while two technicians took the readings and controlled the environment. No-one else was allowed into the rink during the tests to minimise outside influences and the introduction of additional heat. Only two players swept at any given time with the third delivering the stone, and they all used Performance Swivel pads. The players were competent curlers and efficient sweepers.

Plant The refrigeration plant was allowed to run normally through its cycle, with the controller set at – 6.2ºC for On and – 6.5ºC for Off. The controller has its probe in the concrete floor, and at these settings will maintain the IST at around – 4ºC.

Temp The actual reading on the controller display at that time.

The readings below are from the actual log. For T1 and T2 readings were taken before the sweepers arrived at the probe and after the stone had passed, while the IST was taken after the stone had passed. The IST of – 4.4ºC gradually rising to – 3.8ºC is known from experience to be perfectly normal during everyday play, caused entirely by turbulence pulling heat from the air towards the ice. Once the temperature reached –3.8ºC it remained constant, as it usually does. Both the RH and AT remained constant and, as normal, the cycle of the plant did not cause any readable changes in IST.
The T1 control probe shows a gradual rise in temperature of 0.4ºC over the period of 45 minutes, with no changes before and after play. The T2 probe also shows a gradual rise in temperature but slightly more, of – 0.5ºC, over the same period. It shows no consistent change of temperature before and after play and the additional 0.1ºC can certainly be attributed to the fact that the area is affected more by the turbulence of players passing over it.
In conclusion, there is no evidence from this test to prove that sweeping a running stone warms the ice surface. However, when sweeping constantly over the probe, the temperature rose by 0.5ºC within seconds, while the temperature recovered only after several minutes. It is therefore true that sweeping does warm the ice surface when done in one small area, sufficiently to enable a stone to draw more and lose its momentum sooner.

John Minnaar
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	Before		After					Plant	
Time	T1	T2	T1	T2	RH	AT	IST	On/Off	Temp
11.12	-3.5	-2.8	-3.5	-2.9	71.8	9.1	-4.4	On	-6.3
11.14	-3.3	-2.7	-3.4	-2.8			-4.4		
11.16	-3.4	-2.7	-3.3	-2.9			-4.4		
11.18	-3.3	-2.8	-3.3	-2.8			-4.4		
11.19	-3.4	-2.8	-3.4	-2.8			-4.4		
11.19	-3.4	-2.7	-3.4	-2.7			-4.4		
11.20	-3.4	-2.7	-3.4	-2.7			-4.4	Off	-6.5
11.20	-3.2	-2.8	-3.2	-2.7			-4.4		
11.21	-3.4	-2.7	-3.4	-2.7			-4.2		
11.22	-3.4	-2.7	-3.4	-2.7			-4.0		-6.4
11.22	-3.2	-2.7	-3.4	-2.7			-4.4		
11.24	-3.4	-2.6	-3.4	-2.6			-4.2		
11.25	-3.2	-2.6	-3.2	-2.6			-4.2		
11.26	-3.2	-2.6	-3.4	-2.6	72.3	8.7	-4.2		-6.3
11.27	-3.4	-2.6	-3.4	-2.6			-4.0		
11.28	-3.2	-2.7	-3.2	-2.6			-4.0		
11.29	-3.2	-2.7	-3.2	-2.6			-4.0		
11.30	-3.2	-2.6	-3.2	-2.6			-3.8		-6.2
11.31	-3.2	-2.6	-3.3	-2.5			-3.8		
11.32	-3.2	-2.6	-3.3	-2.6	72.7	9.1	-4.0		
11.33	-3.2	-2.6	-3.3	-2.5			-3.8		
11.34	-3.3	-2.5	-3.3	-2.5			-3.8	On	-6.1
11.35	-3.3	-2.6	-3.3	-2.5			-4.0		
11.36	-3.3	-2.5	-3.3	-2.5			-4.0		
11.37	-3.3	-2.5	-3.3	-2.5			-4.0		
11.38	-3.2	-2.5	-3.3	-2.5	73.5	9.1	-4.2		
11.39	-3.2	-2.5	-3.3	-2.5			-4.0		-6.2
11.41	-3.2	-2.5	-3.2	-2.5			-3.8		
11.42	-3.2	-2.5	-3.2	-2.5			-3.8		
11.43	-3.3	-2.5	-3.3	-2.4			-3.8		
11.44	-3.3	-2.5	-3.3	-2.4	71.9	8.8	-3.8		
11.45	-3.3	-2.5	-3.3	-2.4			-3.8		-6.3
11.46	-3.3	-2.4	-3.3	-2.4			-3.6		
11.47	-3.3	-2.4	-3.3	-2.4			-3.6		
11.49	-3.3	-2.4	-3.3	-2.4			-3.6		
11.50	-3.3	-2.4	-3.3	-2.4			-3.6		
11.51	-3.3	-2.4	-3.3	-2.3			-3.8		
11.52	-3.1	-2.4	-3.3	-2.3			-3.8		-6.4
11.52	-3.1	-2.3	-3.1	-2.3			-3.8		
11.53	-3.1	-2.4	-3.1	-2.3			-3.6		
11.54	-3.1	-2.3	-3.1	-2.3			-3.6		
11.55	-3.1	-2.3	-3.1	-2.3			-3.8		
11.56	-3.1	-2.3	-3.1	-2.3	72.5	8.6	-3.8	Off	-6.5