"No longer should excellent curling ice be the secrets of the magicians, it should be science, knowledge, and well tested theories."

World Curling Federation *Curling Ice Explained*

Thoughts on Research to Support the Profession of Curling Ice Technicians

Curling Ice Quality Improvement Project (CIQIP)
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Why is research important.

Science based research is an important part of any profession including that of the curling ice technician. It can be used to study problems, identify causes, and explore potential solutions. It can encourage curiosity which can inspire innovation or opportunities for improvement. It can be used to address discrepancies in existing best practice recommendations, or the development of new recommendations. It can support training and professional development of those already working and those who choose to enter the profession in the future.

When developing content for training, all of the resources we used were very good. Those resources included: World Curling Federation *Curling Ice Explained 2011*; the Ontario Curling Association *Ice Technician Reference Manual 2019*; the Scottish Curling Ice Group articles; and the Canada Curling Association (CCA) *Ice Technician Resource* webpage articles. Where we found variation, it was difficult to understand why. Was there new science? The same was true for variation in actual practice. Often it came down to "this is what works best in our club". There was one recommendation that suggested to club ice makers to start here, and then experiment. That is an indication there is a need for more research in that area.

The most recent research closely related to ice making is a paper by Megan Balsdon and Jeffrey Wood, *Comparing Broom Conditions in Curling: Measurements Using Ice Typography*. It is a great example of the type of research document that could benefit the profession. If there is research that speaks to the work ice makers do in clubs it is very difficult to find.

New Technologies

Technology has come long way since 2000. New technologies have been developed and refined in the last ten to fifteen years that could make research easier and more accurate than in the past. Problems or ideas of interest in 2000 that appeared to be impossible to study, might now be quite feasible because of advances in technology. Here are a few examples; there likely are others.

Systems to Monitor and Record Ice Shed Parameters

A number of systems, some simple and others advanced, can record interior and outside parameters. These systems monitor and record ice temperature, air temperature, and relative humidity at frequent intervals at various locations in the ice shed, or where appropriate outdoors. The parameters would be important when conducting certain experiments in the field (ice shed).

Computational Fluid Dynamics
Computational fluid dynamics (CFD) creates computer-based models used to study air flow and develop designs for use in refrigerated warehouses and HVAC systems. For example, one of the on-going challenges for ice makers to address is the loss of ice due to sublimation on curling sheets along the outside walls. CFD could help explore ways to prevent sublimation by changing the air flow along the outside walls within the ice house.

Surface Roughness Measurement
The Gelsight Company makes a mobile device that measures surface roughness. It is primarily used in the automotive and airline industries and measures the texture and geometry of objects it touches, to create high resolution 2d and 3d digital surface maps. These maps may be helpful analyzing changes in curling stone running bands after texturing. It also may be able to measure the shape and size of pebble applied under different conditions. Such as when using different sized pebble heads or different water temperatures, before and after nipping, after brushing, or assessing wear over the course of a game.

Mechanical Curling Rock Throwers
A number of mechanical curling stone throwers are now available. It is likely that their development will continue. These machines could be used to better understand the effects of texturing curling stones, or how different approaches to pebbling affect the travel of the stones.

Types of Research
There are three types of research that could help support curling ice makers that CIQIP identified.

First, ice makers may benefit from research in related areas, such as refrigeration, air flow, and water treatment. This type of research may identify areas where curling related research could be of interest, or that new technologies are identified that can be used in curling related research.

Second, laboratory-based research on topics specific to curling ice making. For example, one theory suggests that in an ice shed with low humidity, pebble water droplets as they move through the air may reduce in size due to evaporation. Running experiments on evaporation rates under varying air temperature and humidity conditions might be best to study in the controlled conditions of a laboratory compared to that of an ice shed.

Third, are club-based field experiments conducted by researchers and ice makers intended to further the knowledge in the profession. For this to be valuable to the

profession requires it follow the scientific method including a written report. Best would be an ice maker working with a person with a background in conducting research affiliated with a university.

In addition to the above, developing a step-by-step guide for ice makers to follow when conducting experiments to determine what works best in their club would be an improvement. There is no written guidance or protocol for ice makers to follow when conducting experiments nor any mention of this in any training that any of us can recall. The following guidance from the CCA articles is a good start. “Remember this is just a starting point. It may not give you your best results so try different variations to see what works best. Only change one thing at a time so you know if that change makes a difference. If you make too many changes at once, you won’t know which one worked or didn’t work.” A guide for icemakers that could be integrated into existing training efforts might be more valuable.

What is research.
Below are some definitions, and the steps in the scientific method. There are many definitions of the same terms on the internet.

Research is “a systematic investigation, including development, testing, and evaluation designed to develop or contribute to generalizable knowledge.”

An **experiment** “is a procedure designed to test a hypothesis as part of the scientific method.”

Scientific method is a six or seven step process that objectively establishes facts.

The below is one example of the steps with simple descriptions taken from a number of sources.

Ask a question
What do you want to learn?
I wonder what would happen if….

Do background research
Find out as much as you can. Look for information in manuals, on the internet, and by talking with colleagues who faced a similar problem.

Construct a hypothesis
It is not an opinion or prediction. They are reasonable expectations based on factual information. A clear testable statement.
If I do X then Y will happen.

Test with an experiment
Design a test or procedure to find out if your hypothesis is correct or not.
It should be detailed enough for others to replicate the experiment.

Analyze data
Record the data and what happened during the experiment.
Did the experiment as designed test the hypothesis?

Draw conclusions

Determine if the data supports or rejects the hypothesis.
Compare your conclusions to other work.

Communicate results

Share your written findings with your community or the world at large.

In conclusion, the purpose of this document is to highlight the need for research into the science of curling ice making. As we looked at how experimentation and research changed and improved sweeping, might there be a similar opportunity for curling ice technicians. We hope ice technicians get interested in the idea of research to support their work. It is not about raising questions on what individual ice technicians are doing. It is focusing on the need for research that supports and advances the profession into the future.

We have a couple of ideas on ways to continue a conversation with ice makers on this topic. If you have any thoughts or ideas email us at rockpic1@gmail.com