The following is an excerpt from
Ice Making and Painting Technologies, Ontario Recreation Facilities Association 2001.

IMPORTANCE OF WATER QUALITY IN ICE MAKING

The 3 Important Ingredients in Making Ice
An icemaker that does not have specific knowledge and application of their water make-up, ice paint ingredients and professional application skills of both identified items is vulnerable to criticism. There is an expectation for a quality ice product from users and therefore an icemaker must obtain as much information as possible on both the water and paint being used and follow closely the proven application techniques.

Water
When a sheet of water is frozen, it should be hard, allowing water applications to freeze quickly, leaving little snow development during the harshest use. Both ground sourced and municipally treated waters can contain dissolved minerals, organic matter or the ultimate enemy of ice, "air." Ice quality will differ in all parts of North America, depending on the water source. Applying "hard" water or "soft" water will create two completely different styles of ice, which will perform differently under all conditions. By understanding the properties of water, the icemaker will be adequately prepared to clarify user concerns on ice consistency.

For good ice making, there are three general types of water contamination that must be considered:

- Organic matter
- Dissolved minerals
- Air

Rainwater will provide a hard durable sheet of ice whereas surface or well waters produce entirely different sheets of ice, due to mineral content. The actual kind of mineral content is vital to ice performance. Water is one of the few liquids that are lighter as a solid than as a liquid. This is due to a slight reduction in the degree of hydrogen bonding which holds its molecules together. Any further reduction in this bonding will degrade the ice. Highly mineralized water or some free alkalinity will contribute to this and coupled with a "salting out" effect will create a lower density or "slower" ice.

When raw water is freshly applied during the resurfacing process, the heat flow travels from the top down. The opposite transpires during an "outdoor" freezing which allows the mineral content to always stay in the liquid phase. During the ice resurfacing process, the film on the surface is the last to freeze, thus trapping the entire mineral content directly at the top of the air/ice surface. The effect is a lack of hydrogen bonding and in extreme instances, the dispersion of mineral salts is so concentrated that sometimes a white powder forms. As the season progresses the skating surface becomes more alkaline and its freezing point will continue to drop. High pH levels cause a freezing rate to slow, which in turn creates a poor ice surface. "Alkaline results in poor ice"…the higher the sodium content the more evident this becomes.

Water Treatment Systems
A pH level below 7.0 is strongly recommended for a quality ice surface. Water treatment methods are well standardized and each has its own advantages if it is properly used for the intended application in question. It is highly recommended that competent experienced suppliers be sought prior to any purchases being made. Decisions of purchase should be based on proven industry related testimonials with consideration to chemical costs, annual maintenance fees and return on investment through energy conservation calculations. Being an informed consumer is the best approach to any capital investment.

The following can be found in the *2002 ASHRAE Refrigeration Handbook* (Chapter 34: Ice Rinks)

Water Quality
The quality of the water affects energy consumption and ice quality. Water contaminants, such as minerals, organic matter, and dissolved air, can affect both the freezing temperature and the ice thickness necessary to provide satisfactory ice conditions. Proprietary treatment systems for arena flood water are available. When these treatments are properly applied, they reduce or eliminate the effects of contaminants and improve ice conditions.