SoCool®

Low Temperature Thermal Energy Storage Stratification Fluid

The 6 million gallon, 90,000 ton-hour Strata-Therm Thermal Energy Storage (TES) tank at the Dallas/Ft. Worth International Airport was installed in 2002 and was specifically designed to use CB&I SoCool stratification fluid, patented by CB&I. The use of SoCool fluid, at a 3 weight-percent solution, enables this TES system (and the airport distribution piping network) to supply temperatures of 36°F during peak cooling periods, significantly enhancing the system's cooling output.

Unique thermal storage enhancement

CB&I patented SoCool low temperature thermal energy storage stratification fluid is used in place of plain water in a Strata-Therm® TES tank. This unique aqueous solution has the ability to maintain delivery temperatures lower than 39°F, the temperature of maximum density and the lower limit for stratification plain water. SoCool fluid has proven performance at temperatures even colder than ice.

Compared with systems using plain water, incorporating SoCool fluid into the design of a new facility can reduce the size of the storage tank and chiller plant. SoCool fluid can also provide important benefits when retrofit to existing systems. Specifically, increased TES capacity and lower operating temperatures are achieved while the efficiency, simplicity and reliability of the stratified TES tank are maintained.

The value of SoCool fluid can be realized in these applications:

District cooling systems

SoCool fluid can maximize the capacity and/or reduce the size of the TES tank, as well as distribution pumps, piping and air handlers, while providing the proven benefits of stratified TES.

Combustion turbines

Applied as Turbine Inlet Cooling (TIC), SoCool fluid improves the on-peak performance of combustion turbines by lowering hot ambient inlet air to 40-45°F. SoCool fluid can match or exceed the resulting power output increase of other TIC systems, while retaining the simplicity, reliability, efficiency and rapid discharge benefits of stratified water TES at installed costs as low as $300, or less, per kW of net power enhancement.

SoCool fluid advantages

Cost-effective and compact installation

- Reduces the storage tank and chiller plant size and cost
- Decreases the size and cost of downstream piping, pumps and air handlers
- Increases performance, with up to 100 percent more ton-hours than plain water TES, for a given volume

Proven, reliable and economical operation

- Provides a nearly constant discharge temperature throughout its entire cycle
- Minimizes electricity costs by avoiding very low temperature chiller operation (as needed for ice TES)
- Typically eliminates any on-going water treatment for corrosion inhibition and microbiological control
- Optimizes pumping and heat transfer efficiency

District and Turbine Inlet Cooling improved at Princeton University

Since 2005, this 40,000 ton-hour (2.7 million gallon) SoCool fluid TES system has provided both campus cooling and inlet air cooling of the university's on-site gas turbine, reducing operating energy costs, improving the chilled water piping network capacity, and adding flexibility and reliability to facility operations.

Concentration in Water (weight %)	Temp (°F)	Specific Gravity	Viscosity (cP)	Specific Heat (Btu/lb-F)	Freezing Point (°F)	Nominal Minimum Thermal Storage Temp (°F)
0.0	54.0	1.0004	1.23	1.001	32.0	39.4
0.0	40.0	1.0013	1.53	1.004	32.0	39.4
3.0	54.0	1.021	1.32	0.971	28.7	35.0
3.0	35.0	1.023	1.78	0.978	28.7	35.0
7.0	54.0	1.049	1.43	0.931	24.4	30.0
7.0	30.0	1.053	2.05	0.943	24.4	30.0

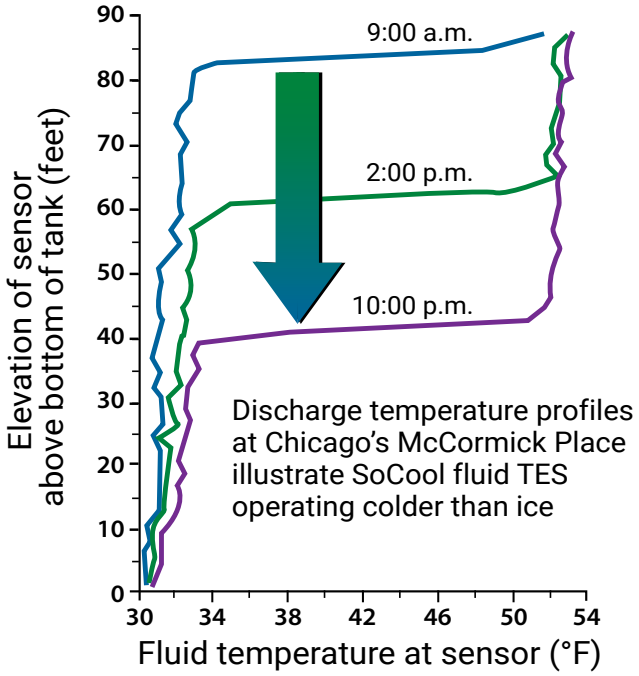
The thermal conductivity for 7 percent SoCool fluid concentration at 68°F is approximately 0.343 Btu/hr-ft-F vs. 0.345 Btu/hr-ft-F for plain water.

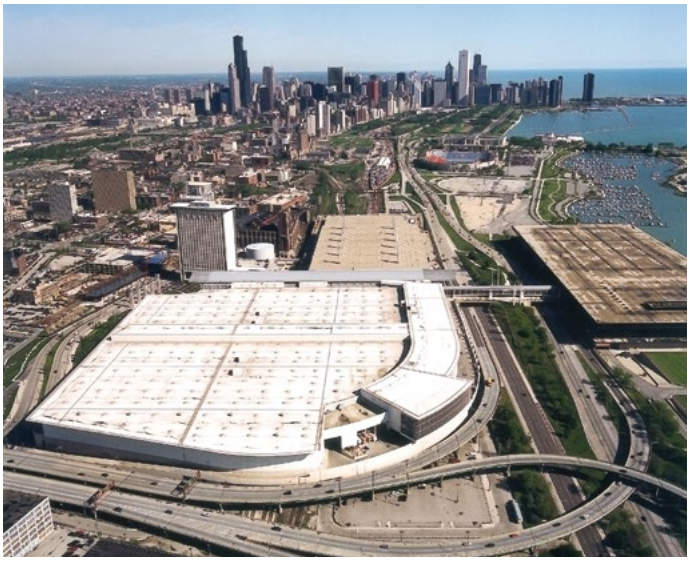
Flexible and expandable application

- Performs effectively at very high discharge rates
- Allows lower storage temperatures, from 20°F to 35°F
- Adapts to incremental phased capacity expansion
- Provides wide applicability for new and retrofit systems
- Enables pre-design for phased conversion from chilled water TES to SoCool fluid for typical capacity increases of 40 to 100 percent

Appealing fluid properties

SoCool fluid has appealing thermophysical properties which are much closer to those of plain water than many other secondary heat transfer fluids. Approximate thermophysical values at 3 and 7 percent SoCool fluid concentrations are compared with those of plain water in the accompanying table.





Long-term, proven service at the McCormick Place Expo Center in Chicago, Illinois

SoCool fluid has been in continuous operation since 1994. The Strata-Therm tank stores 123,000 ton-hours in 8.5 million gallons of SoCool fluid and can deliver 25,000 tons of instantaneous cooling at a 30°F supply temperature. Regular independent testing of SoCool fluid has documented excellent stability of chemical and thermophysical properties, superb corrosion inhibition with passivation of ferrous and non-ferrous metals, and outstanding microbiological control.

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